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SECTION 10. Astronomy and space research.

THE EFFECT OF THE CLIMATE'S ELEMENTS ON THE SUN RADIATION IN BABYLON FOR 2014

Abstract: *In this study special equations had used for calculation the quantity of the solar radiation which incident perpendicular on the Babylon city, the benefit of this study is exploitation the solar energy by solar cell to get the electricity. The data of the weather from the meteorological station in College of Education for pure sciences contains the information of the Monthly average of the Solar Radiation with absence atmosphere H_0 (MJ/(m^2.day)), the Monthly Average of the theoretical solar radiance (hr) and Relative Air Mass M(z) from 1/ January / 2014 to 31/ December / 2014. The results of this study explains the effects of the climate's elements (degree of temperature and the relative of humidity), on the solar Radiation. In this study it be found that it can transform the solar radiation in the Babylon city to the electricity by using the solar cells because the high relative of the solar radiation falling in Babylon city*

Key words: *climate's elements, Sun Radiation and Babylon city*

Language: *English*

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Introduction

Solar radiation source of thermal energy which is emitted from the sun in the form of electromagnetic waves. And is a source of thermal energy of the universe - (satellites, earth and planets) and reaches of the solar beam us a small part of it. Solar radiation is divided into visible rays and invisible rays. There are several influential factors in connecting solar radiation to the earth's surface are:

1. fall of the solar radiation angle.
2. The length of daylight.
3. The face of the mountain slopes.
4. The purity of the air.

In this study, we will learn about the impact of climatic factors that affect the amount of solar radiation and the possibility of taking advantage of this radiation in electric power generation and utilization by solar cells

The data of the weather from the meteorological station in College of Education for pure sciences from January to December 2014

The data of the Solar Radiation of the Babylon city which was obtained from the meteorological station in Education for pure sciences College in Babylon University. this data was used for the calculations and diagrams that calculate the monthly average of the solar radiation with absence atmosphere H_0 , the monthly average of the theoretical solar radiance and the relative air mass. This calculations and diagrams will show information of Solar Radiation in the Babylon city. Look at the table (1).

Table 1

The data of the Solar Radiation in the Babylon city for 2014

Month	Monthly Average of the Solar Radiation with absence Atmosphere H_0 $(MJ/m^2.day)$	Monthly Average of the theoretical solar radiance (hr)	Relative Air Mass $M(z)$

1	January	19.64364066	10.14784815	0.957876263
2	February	24.82763992	10.8821888	0.857107249
3	March	32.17738958	11.92144922	0.762160161
4	April	37.81203181	12.83273765	0.716604141
5	May	41.729454	13.68210849	0.698956581
6	June	42.82640108	14.10679653	0.696622747
7	July	41.21962654	13.87697116	0.69743467
8	August	37.20677834	13.11247089	0.708612311
9	September	31.4953311	12.13693744	0.748283623
10	October	25.15436905	11.14014487	0.828893124
11	November	19.93017363	10.29706023	0.935043219
12	December	17.72986775	9.892257158	0.999733785

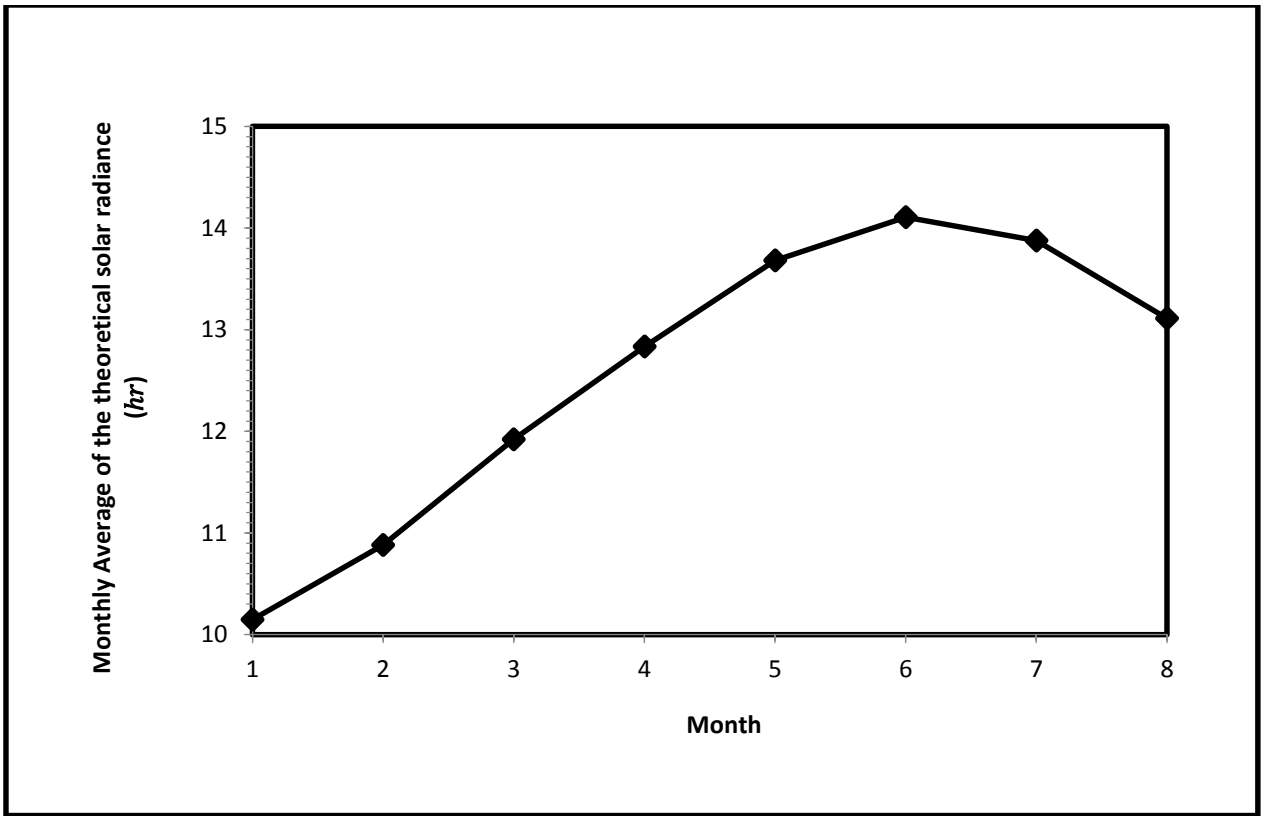

Figure 1 - Diagram of the Monthly Average of the theoretical solar radiance in Babylon city for 2014 .

At the general, the values of the Monthly Average of the theoretical solar radiance in the Babylon city to be distinguished by height in all months especially in May, June and July. But it is slightly low in January and February.The total Average of the theoretical solar radiance in Babylon city is 12.057032 *hr*.

The effect of change in temperature and relativity Humidity on the solar radiation.

The quantity of the solar radiation which arriving to any point in the earth is final resultant for any angle of the solar ray and the period of solar radiance therefore there are many of equations which used to expression The quantity of the solar radiation which arriving to the earth.

The Angstrom equation is very important equation. It used to calculation the quantity of the solar radiation and the period of solar radiance.

$$\frac{H_{cal}}{H_0} = a + \left(b \cdot \frac{S}{S_0}\right) \quad (1)$$

H_{cal} is the quantity of the total solar radiation which incident perpendicular on the earth.

H_0 is the solar radiation outside the atmosphere.

S is the period of the practical solar radiance.

S_0 is the period of the theoretical solar radiance.

a and b is a constants, it is dependent on the place of city.

For the place of Babylon city $a = 0.0379$ and $b = 0.5389$ these constants has a no unit.

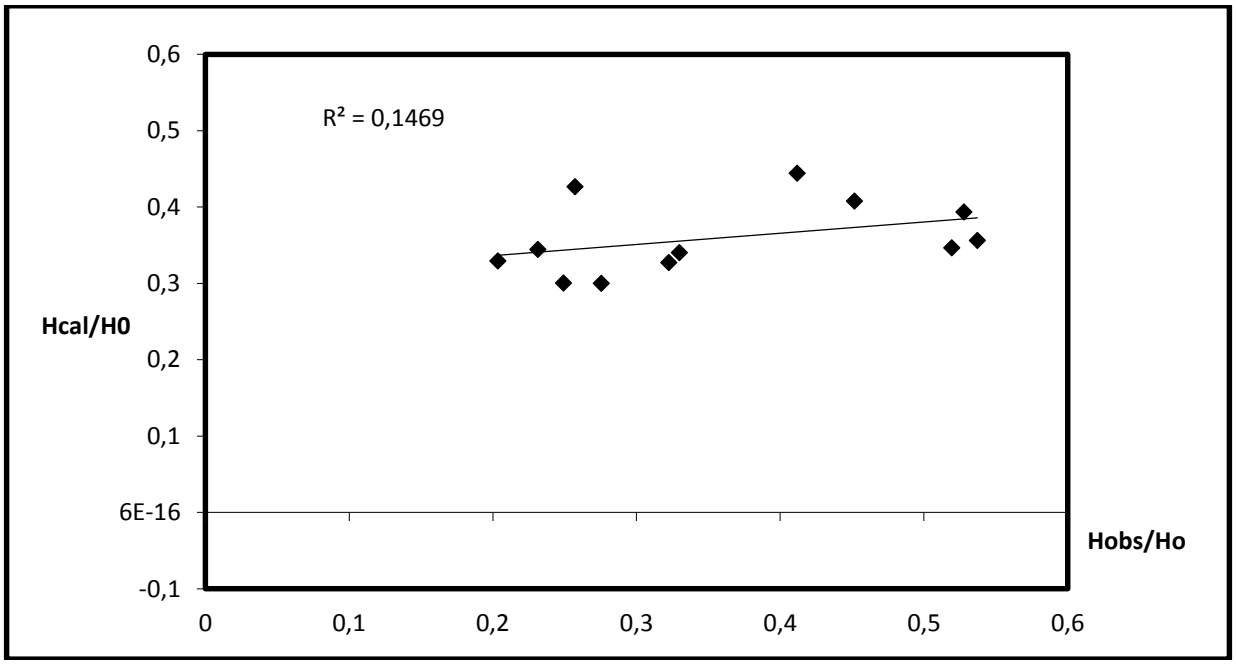

Figure 2 - The slope between the relative of the incidence solar radiation in Equation (1) with the relative of the absorbent solar radiation in the Babylon city in 2014.

When we take the climatic inductions on the incidence solar radiation (degree of temperature and the relative of humidity), we will get the following equation:

$$\frac{H_{cal}}{H_0} = 0.511 + \left(0.664\frac{S}{S_0}\right) - (0.013T_{av}) - (0.005R.H_{av}) \quad (2)$$

$$\frac{H_{cal}}{H_0} = -0.215 + \left(0.516\frac{S}{S_0}\right) + \left(-\frac{3.279}{T_{av}}\right) + (0.015R.H_{av}) \quad (3)$$

$$\frac{H_{cal}}{H_0} = 1.999 + \left(-1.63\frac{S}{S_0}\right) + (0.015T_{av}) + \left(-\frac{30.562}{R.H_{av}}\right) \quad (4)$$

$$\frac{H_{cal}}{H_0} = 0.208 + \left(-0.023\frac{S}{S_0}\right) + \left(\frac{5.651}{T_{av}}\right) + \left(-\frac{3.768}{R.H_{av}}\right) \quad (5)$$

$$\frac{H_{cal}}{H_0} = 1.306 + \left(0.874\frac{S}{S_0}\right) + (-0.021T_{av}) + (-0.006\ R.H_{av}) + (-0.026[T_{max} - T_{min}]) \quad (6)$$

$$\frac{H_{cal}}{H_0} = 0.216 + \left(0.587\frac{S}{S_0}\right) + (-0.011T_{av}) + (0.009R.H_{av}) + (0.004[R.H_{max} - R.H_{min}]) \quad (7)$$

$$\frac{H_{cal}}{H_0} = 11.899 + \left(1.838\frac{S}{S_0}\right) + (-0.165T_{av}) + (-0.161R.H_{av}) + \\ +(-0.11[T_{max} - T_{min}]) + (0.029[R.H_{max} - R.H_{min}]) \quad (8)$$

And when we sketch the figures of these equations with the absorbent solar radiation, we will get following figures:

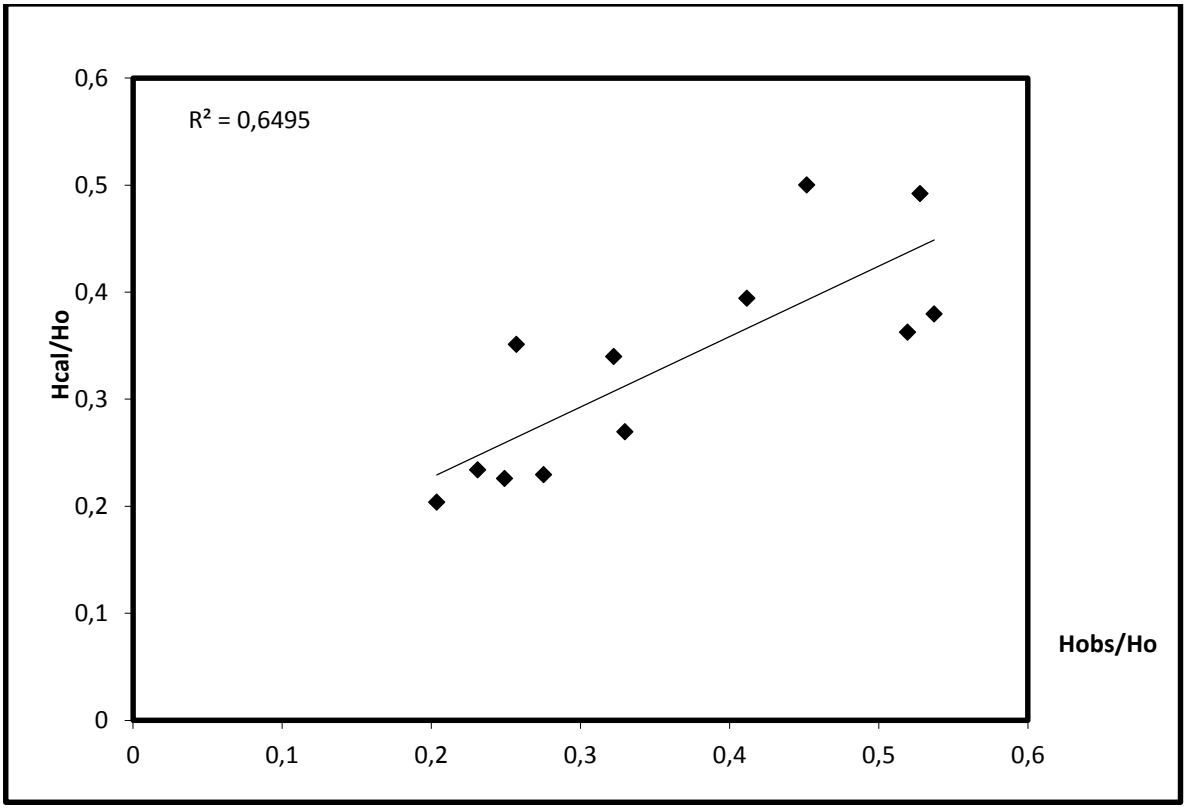

Figure 3 - The slope between the relative of the incidence solar radiation in Equation (2) with the relative of the absorbent solar radiation in Babylon city for 2014.

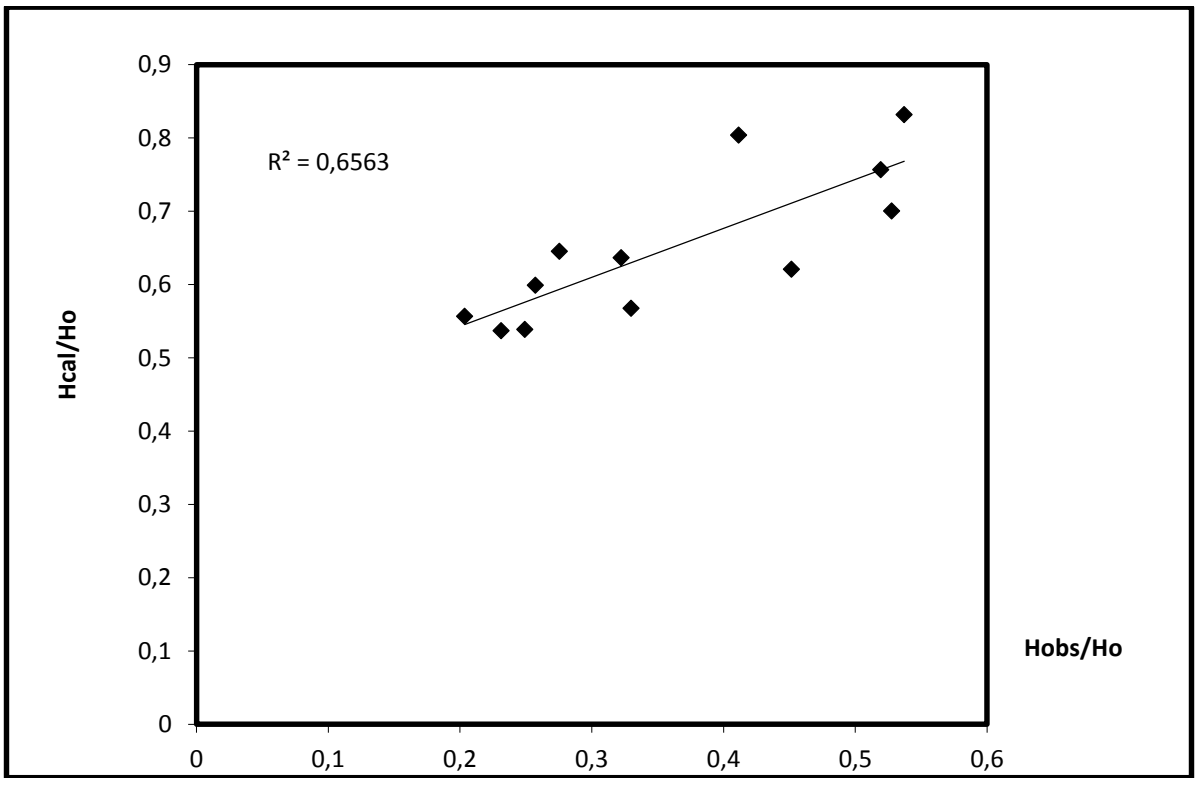

Figure 4 - The slope between the relative of the incidence solar radiation in Equation (3) with the relative of the absorbent solar radiation in Babylon city for 2014.

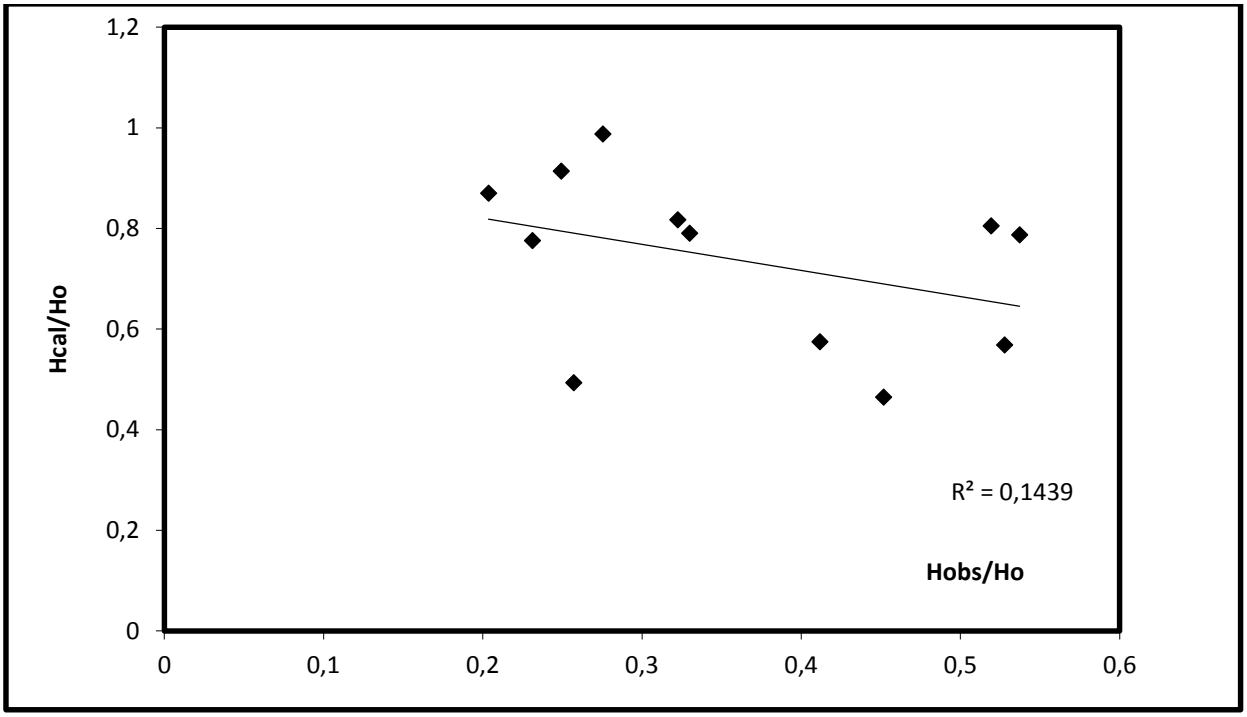

Figure 5 - The slope between the relative of the incidence solar radiation in Equation (4) with the relative of the absorbent solar radiation in Babylon city for 2014.

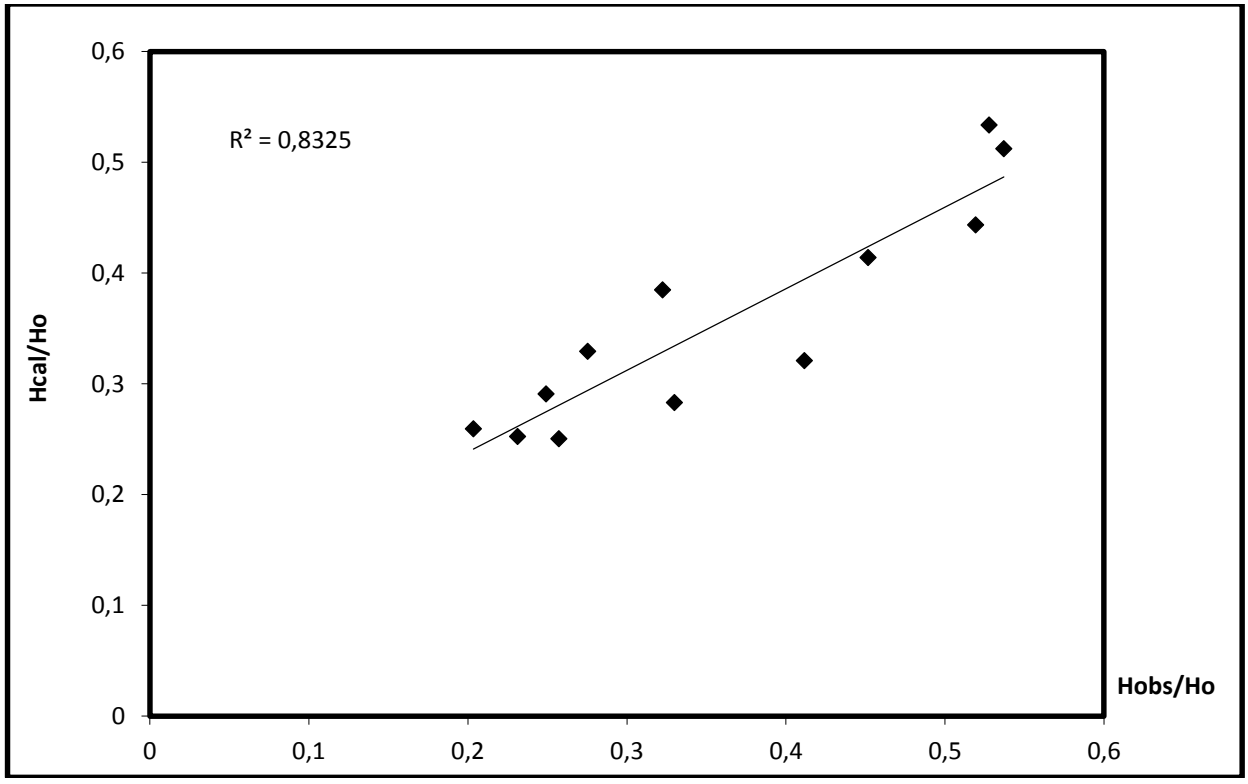

Figure 6 - The slope between the relative of the incidence solar radiation in Equation (5) with the relative of the absorbent solar radiation in Babylon city for 2014.

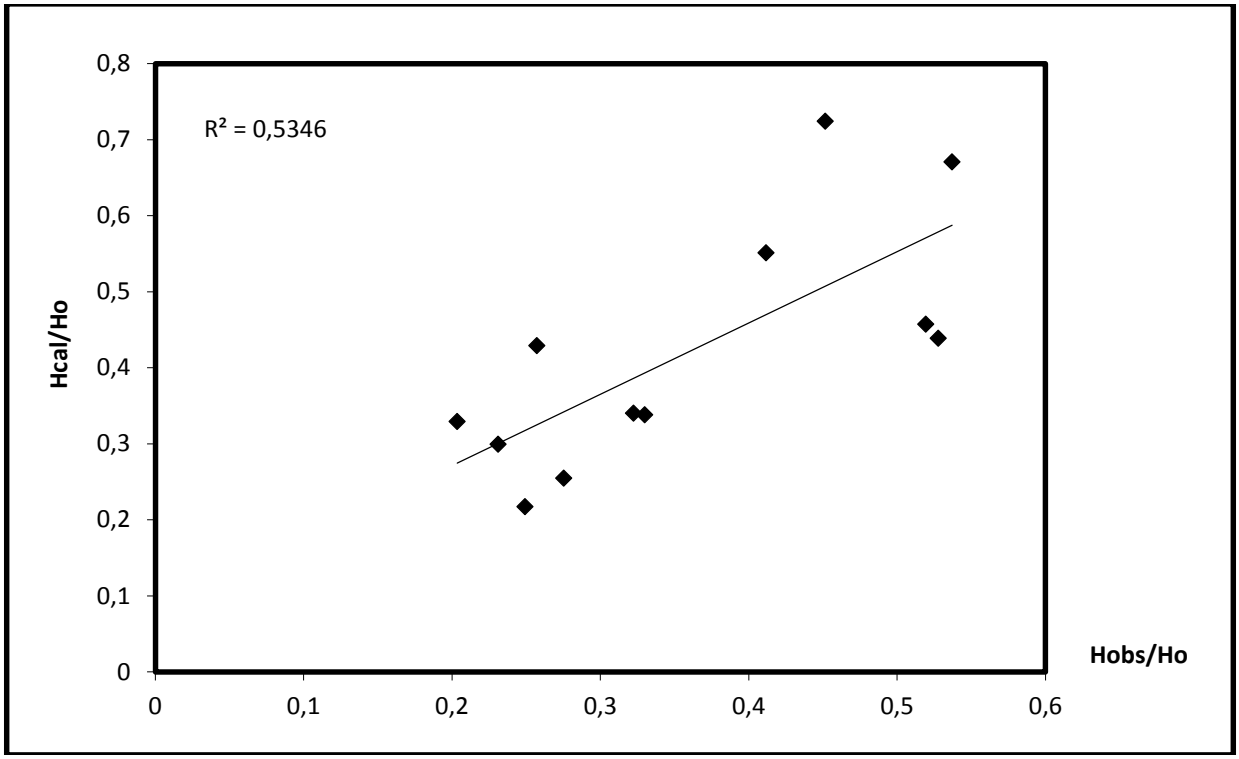

Figure 7 - The slope between the relative of the incidence solar radiation in Equation (6) with the relative of the absorbent solar radiation in Babylon city for 2014.

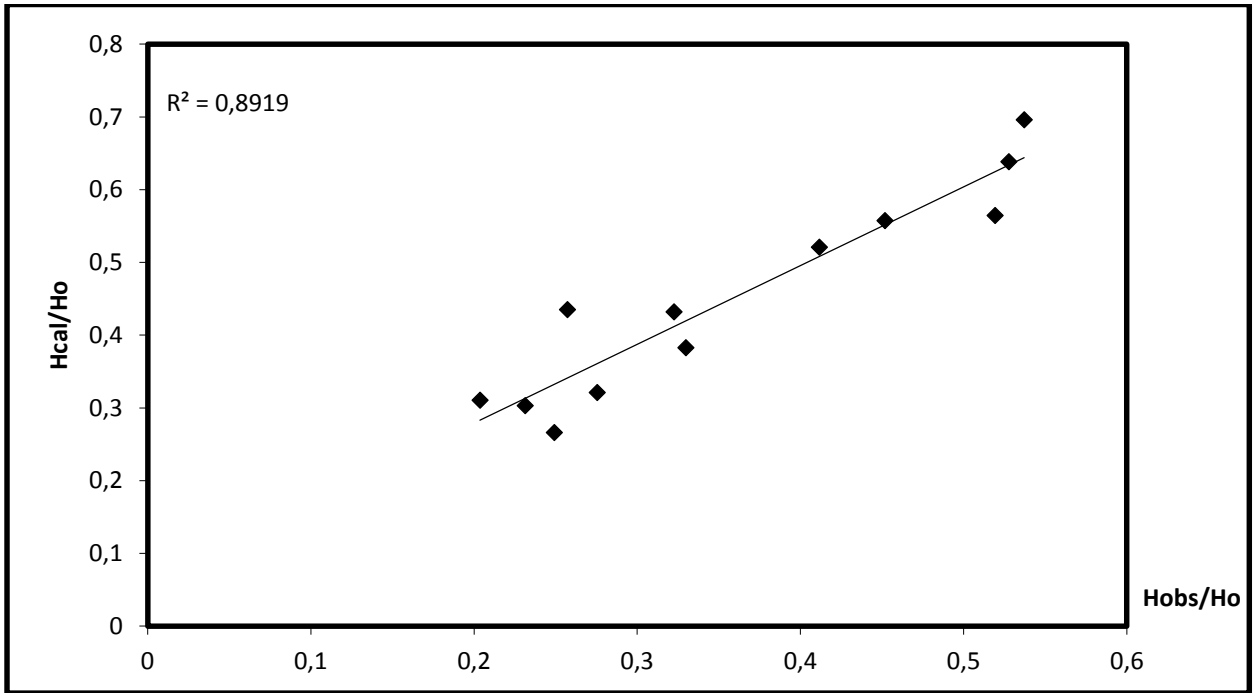

Figure 8 - The slope between the relative of the incidence solar radiation in Equation (7) with the relative of the absorbent solar radiation in Babylon city for 2014.

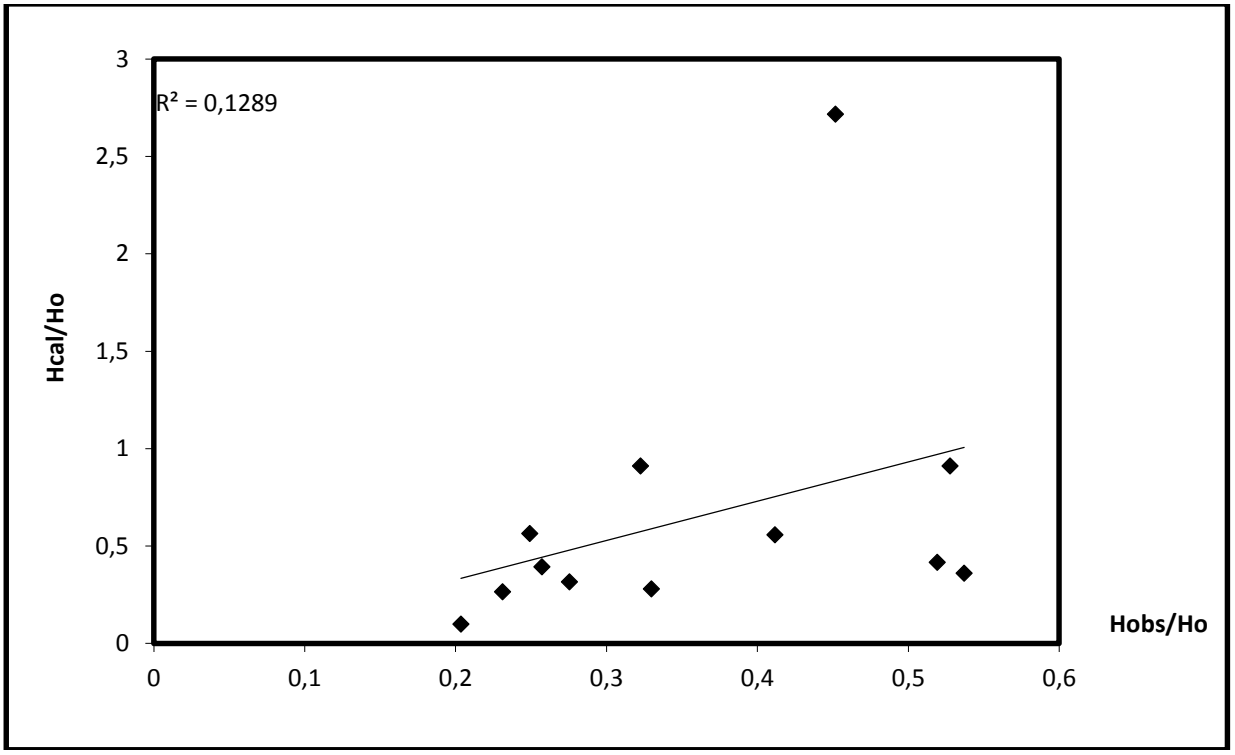

Figure 9 - The slope between the relative of the incidence solar radiation in Equation (8) with the relative of the absorbent solar radiation in Babylon city for 2014.

Discussion

The average value of the solar radiation in the Babylon city in 2014. is relative law in the winter and first of the spring (January, February, March and April) but it is high in the summer and last of the spring (May, June, July and August).

In the winter, the average value of the solar radiation is between$(19-38\ \mathrm{MJ/m^2.day})$, and in the summer it is between $(37-43\ \mathrm{MJ/m^2.day})$, this is because place of Babylon city in the earth and the angle of the incident solar ray, this angle is inclined in the winter beside the sky is full of clouds and rains and the humidity is high.

In the summer, the angle of the incident solar ray is perpendicular, the sky is clean and the humidity is law therefor the average value of the solar radiation is high.

The Monthly average of the solar radiance effects on the solar radiation too, it is between $(10-13\ hr)$ in the winter and it is between $(13-14\ hr)$ in the summer.

Conclusions

1. The average value of the solar radiation in Babylon city for 2014. is equal $(30.979392\ \mathrm{MJ/m^2.day})$, and the monthly average of the solar radiance is equal $(12.05\ hr)$, we can get 358.56 watt for any square meter of Babylon city in about $(12.05\ hr)$ if we get competent solar cell:

$$30.97939\frac{\mathrm{MJ}}{\mathrm{m^2.day}}=\frac{30.97939\times10^6\ \mathrm{J}}{\mathrm{m^2.}(24\times60\times60)\mathrm{sec}}=358.56\frac{\mathrm{J}}{\mathrm{m^2.sec}}=358.56\frac{\mathrm{watt}}{\mathrm{m^2}}$$

2. From the data of the table (1), when the monthly average of the solar radiance is maximum and the relative air mass is minimum the solar radiation become maximum, and when the monthly average of the solar radiance is minimum and the relative air mass is maximum the solar radiation become minimum.
3. The maximum average value of the solar radiation is equal $(42.8264\ \mathrm{MJ/m^2.day})$ in the summer in August and the minimum average value of the solar radiation is equal $(19.6436\ \mathrm{MJ/m^2.day})$ in the winter in January.

References:

1. Akpabio LE, Etuk SE (2003) "Relationship between global solar radiation and sunshine duration for Onne, Nigeria", Turk J. Phys. , Vol.15 , P.865.
2. Duffie JA, Beckman WA (1994) "Solar Engineering of thermal Processes" , 2nd Edn. , John Wiley, New York.
3. Falayi EO, Rabiu AB (2005) "Modeling global solar radiation using sunshine duration data Nig." , J. Physics, Vol.17S, P. 181.
4. Medugu DW, Yakubu D (2011) "Estimation of mean monthly global solar radiation in Yola – Nigeria" , Pelagia Research Library , Vol.2 , P.414.
5. Okundamiya MS, Nzeako AN (2011) "Empirical model for estimating global solar radiation on horizontal surfaces for selected cities in the six geopolitical zones in Nigeria" , J. of Control Sci. and Eng. , Vol.2011 , P.7.
6. Paulescu M, Fara L, Tulcan-Paulescu E (2006) "Model's for obtaining daily global solar irradiation from air temperature data" , Atmospheric Research ,Vol. 79, P. 227.
7. Prescott JA (1940) "Evaporation from a water surface in relation to solar radiation", Trans Roy Soc Aust. ,Vol. 64, P.48.
8. Skeiker K (2006) "Correlation of global solar radiation with common geographical and meteorological parameters for Damascus province" , Syria, Energy conversion and management, Vol.47 , P. 331.
9. Stone RJ (1993) "Improved statistical procedure for the evaluation of solar radiation estimation models", Solar Energy,Vol. 51, P.289.
10. Toğrul IT (2009) "Estimation of Solar Radiation from Angstroms Coefficients by using Geographical and Meteorological data in Bishkek" , Kyrgyzstan , J. Thermal Science and Technology, Vol.29 , P.99.
11. Toğrul IT (1998) "Comparison of statistical performance of seven sunshine-based models for Elazığ, Turkey" , Chimica Acta Turcica ,Vol. 26, P.37.
12. Walpole RE, Myers RH (1989) "Probability and statistics for engineers and scientists", Macmillan ,4th ed, New York.

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SECTION 21. Pedagogy. Psychology. Innovations in the field of education.

PSYCHOLOGY OF RELIGION IN THE SYSTEM OF SCIENTIFIC KNOWLEDGE: DETERMINING THE SUBJECT OF RESEARCH

Abstract: *The article examines the problems of researching the psychology of religion as an independent discipline within the framework of socio-psychological knowledge. Theoretical questions are raised at the junction of social psychology and religious studies, which lead to the development of a new methodology, a new conceptual research apparatus, which is reflected in the definition of the subject of the psychology of religion.*

Key words: *The psychology of religion, the subject of the psychology of religion, religiosity, religious worldview, religious phenomena, social psychology, the philosophy of religion.*

Language: *Russian*

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ПСИХОЛОГИЯ РЕЛИГИИ В СИСТЕМЕ НАУЧНОГО ЗНАНИЯ: ОПРЕДЕЛЕНИЕ ПРЕДМЕТА ИССЛЕДОВАНИЯ

Аннотация: *В статье рассматриваются проблемы исследования психологии религии как самостоятельной дисциплины в рамках социально-психологического знания. Поднимаются теоретические вопросы, находящиеся на стыке социальной психологии и религиоведения, которые ведут к выработке новой методологии, нового понятийного аппарата исследования, что отражается в определении предмета психологи религии.*

Ключевые слова: *Психология религии, предмет психологии религии, религиозность, религиозное мировоззрение, религиозные явления, социальная психология, философия религии.*

Введение

Вопрос установления места психологии религии в системе научного знания тесно связан с определением предмета данной междисциплинарной дисциплины и заключается в том, следует ли относить психологию религии к психологии или к философии религии, либо к религиоведению. Если психология религии – это часть психологии, то какая из областей последней – индивидуальная или социальная – должна быть преимущественно отражена в исследованиях. В последнее время появилась тенденция, согласно которой психология религии – это самостоятельная наука, с чем во многом можно согласиться. Однако сложность определения психологи религии в таком понимании заключается в том, что методология данной дисциплины зависит от философии и богословского мировоззрения, которые и устанавливают метод определения эмпирических показателей религиозного феномена [7].

Методология

Большое влияние на развитие психологии религии оказали европейские теологические, философские и психологические традиции. Поэтому проблема предмета изучения психологии религии достаточно полно рассмотрена в отечественной и зарубежной философской, религиоведческой и социально-психологической литературе, в том числе в работах, посвященных вопросам психологических проблем религии [5].

Среди них – классический британский эмпиризм на рубеже XVIII-XIX вв., классическая немецкая философия, прежде всего философско-

трансцендентальная проблематика опыта. Позже на психологию религии оказывали влияние в той или иной мере практически все движения и течения в европейской философии, в которых проблема религиозного опыта занимала заметное место. Необходимо отметить также и влияние на развитие психологии религии философского знания XX века, такого как философская феноменология и аналитическая философия, которые настолько интегрированы в исследование религиозного опыта, что без них исследование уже невозможно представить, по общему мнению, сложившемуся в классическом религиоведении [5].

При всем этом в случае рассмотрения психологии религии как отдельной дисциплины в рамках психологического знания нерешенными будут являться вопросы, связанные с проблемами методологической базы большинства исследований феномена индивидуальной религиозности. Возникает ряд сложных теоретических вопросов, находящихся на стыке социальной психологии и религиоведения, которые ведут к необходимости выработки новой методологии, нового понятийного аппарата исследования, что выражается в поиске и определении непосредственного предмета исследования, присущего именно психологии религии как оригинальной научной дисциплины.

Целью статьи является анализ вопросов по определению предмета психологии религии, поскольку признание психологии религии самостоятельной дисциплиной обнаруживает, что методика ее исследований зависит от социально-психологической методологической базы, от обстоятельств социологического и исторического порядка, и в том числе – от особенностей человеческой психики.

Вопрос определения предмета психологии религии усложняется еще тем, что до появления научной психологии (формально дату ее возникновения связывают с основанием В. Вундтом в 1879 г. первой экспериментальной психологической лаборатории в Лейпциге) проблемы психологии религии оказывались главным образом в лоне философии или теологии [1, с. 46–48].

Однако уже первые попытки систематического изучения психологических проблем религии двигались в направлении эмпиризма и заключали в себе стремление приблизиться к эталонам, выработанным конкретным естественнонаучным знанием. Методологической базой в системе психологической науки для большинства исследователей был позитивизм или стихийный материализм; уже в ранних работах обнаружилась тенденция разграничения задач психологии религии и религиоведения [5]. Однако институционально психология религии практически не была представлена в психологических исследовательских центрах и на факультетах психологии. Более того, специалист по психологии религии чаще находил себе применение в системе религиоведческих, философских или теологических учреждений.

Отнесение психологии религии к социальной психологии либо к общей психологии, либо к религиоведению осложнено трудностью проведения строгой границы между этими областями исследования. На первый взгляд, очевидно, что, будучи явлением социальным, личная религиозность более естественно вписалась бы в контекст социально-психологического исследования, что и происходило в начале определения психологии религии. Тем не менее, как показало позднейшее развитие, большинство концепций в психологии религии обязано своим происхождением общей либо индивидуальной психологии: психологии бессознательного, психологии поведения и т. д. При этом, как правило, известные общетеоретические положения о природе индивидуальной психики экстраполировались на проблемы религии и религиозных отношений[6].

Уже на ранних этапах развития психологии религии сформировался подход, предполагающий ограничение объекта исследования исключительно внутренней, или субъективной стороной религии. У. Джемс в своей ставшей классической работе «Многообразие религиозного опыта» определял различие между внутренней и внешней сторонами религии следующим образом: «С первого шага мы встречаем пограничную линию, проходящую через всю область религии. По одной стороне ее находится религия как учреждение, по другой – как личное переживание. <…> Внешний культ, жертвоприношения, воздействие на благосклонность божества, теологические системы, обрядность и церковная организация представляют существенные черты первой ветви. Если бы мы сосредоточили свое внимание на ней, то должны были бы дать религии определение как некоему внешнему действию, имеющему целью привлечение к себе милости богов. Наоборот, в религии личного характера центр, на котором должно сосредоточиться внимание, составляют внутренние переживания человека, его совесть, его одиночество, его беспомощность и несовершенство. <...> Действия, к которым побуждает такого рода религиозность, имеют не обрядовый, а чисто личный характер…». У. Джеймс настойчиво подчеркивал, что именно личная, субъективная область религии составляет объект преимущественного внимания науки [3, с.146].

С одной стороны, с этим трудно не согласиться – понимание тех религиозных явлений, которые связаны с внутренним миром человека, возможно прежде всего в рамках психологического исследования. С другой стороны, такое понимание никак нельзя признать универсальным. Представитель, например, бихевиористского направления в психологии занял бы прямо противоположную позицию, заявив, что так называемая внутренняя сторона религиозности не может изучаться вообще, а настоящий предмет исследования может составить только религиозное поведение в его соотношении со средой, в которой оно формируется. Можно согласиться, что такую точку зрения разделили бы последователи И. П. Павлова и В. М. Бехтерева, сторонники теории «инстинктов социального поведения» В. Мак-Дугалла или представители структуралистской школы [4].

Однако, для значительной части исследователей, работавших в области психологии религии, именно подход, сформулированный У. Джемсом, оставался главенствующим на протяжении долгого времени. В поле зрения психологии религии в первую очередь попадали явления субъективного мироощущения человека: переживания, эмоции, восприятия и их переработка, мотивация, намерения, волевые усилия, акты мышления, наконец, память и все ее сознательное и бессознательное содержание [8]. При этом не обязательно речь шла о внутреннем мире индивидов, имеющих религиозную установку, объектом рассмотрения могла стать и психология безрелигиозного индивида, изучаемая под соответствующим углом зрения.

Существует значительный пласт религиозных явлений интерсубъективного характера, к ним относятся, в первую очередь, вероучение и система религиозной социализации (воспитания и обучения). Так, вероучение объективно, поскольку существует вне и независимо от воли и сознания приверженцев той или иной религии, зафиксировано в текстах или устной традиции и сохраняется или развивается усилиями религиозной организации. Однако в то же время оно субъективно, т. е. интериоризировано, известно верующим и воспринято ими как система своих, внутренних ценностей, составляет фундамент их внутренней религиозности [8]. Аналогичным образом система религиозной социализации, включающая все исторические формы трансляции религиозности из поколения в поколение, от первобытных инициаций до духовных академий также объективна – она есть данность общественной жизни, существующая вне и независимо от отдельных людей, в частности, тех, кто оказывается в сфере ее влияния. Кроме того, используя объективированные, социально закрепленные стандарты – методы воспитания и обучения, учебники, эталоны, авторитеты и т. п., она, в конечном итоге, приводит к тому, что вырабатываются стереотипы внутренней религиозности индивидов – каноны религиозного переживания, религиозного мышления, религиозно направленного волевого акта. Их выработка является конечной задачей системы, и потому они выступают как формирующий существенный ее принцип. В религиозной жизни большое значение имеет именно интерсубъективный характер этих составляющих: для верующего, как правило, и очевидно, и важно, что содержания, образующие его внутреннюю религиозность, являются существенным связующим звеном между ним и религиозной организацией, между ним и единоверцами, а это само по себе представляет важный психологический факт [8].

Если в настоящее время попытаться указать фактический предмет психологии религии как части психологической науки, то внутренний мир верующего будет отнесен к нему без колебаний. Однако внешняя сторона религии – религиозные организации, культ и его материальные атрибуты, религиозное поведение, характер жизнедеятельности религиозных индивидов, сообществ, иерархий, лидеров и т. д., – стала объектом внимания исследователей социальной психологии. Психология религии, в свою очередь, находит тесную связь с социальной психологией, поскольку во внешнем пласте религиозных явлений присутствуют аспекты, которые находят существенное и преимущественное объяснение не столько в обстоятельствах социологического или исторического порядка, сколько в особенностях человеческой психики.

Таким образом, при выделении психологии религии в качестве отдельной научной дисциплины очень трудно дать единое определение предмета психологии религии, которое не вызвало бы возражений. Если сформулировать дефиницию, которая максимально точно отражала бы реальную картину исследований в данной области и была по возможности более нейтральной по отношению к уже известным школам и парадигмам, то можно согласиться с определением предмета психологии религии как изучения психологических аспектов и закономерностей религиозных явлений [8].

Однако психология религии может строиться на базе не только естественно-научного рационализма, но и религиозного мировоззрения. В этом случае говорят о конфессиональной, или конфессионально

ориентированной психологии религии. Она иногда существует в институциональных рамках некоторой религиозной организации, а иногда развивается вне и независимо от таковой: так, христианскую конфессиональную психологию религии можно подразделить на церковную и внецерковную [2].

Кроме этого, заметное место занимает психология религии в теоретических исследованиях, ведущихся под эгидой католической церкви и протестантских церквей на Западе. Такое воплощение психологии религии связано, главным образом, с внутренними задачами церковной жизни и интерпретацией вероучения. Это связано с широким внедрением психологии и психотерапии в практическую повседневную жизнь католического или протестантского прихода, почву для чего подготовила прежде всего давняя и богатая традиция душепопечительской деятельности христианской церкви. Душепопечение предполагает индивидуальную работу священника с прихожанином. Священник идет к верующему как человек к человеку и ведет разговор, предполагающий внимание к личностным особенностям своего подопечного, включая, в первую очередь, проблемы его душевной и духовной жизни. Польза определенных психологических знаний и психотерапевтических навыков в такого рода деятельности очевидна, и эти знания и навыки активно используются церковью, начиная с 20-30-х г.г. XX в [9, с. 123–126].

Другая причина проникновения психологии в христианство связана с необходимостью теологической рефлексии над теми антропологическими выводами, к которым приходит современная психология. Особенно глубоко и заинтересованно работает в этом направлении экзегетика. В этой связи прослеживается единство: психология исследует религию, чтобы дополнить свои знания о человеческой психике изучением феноменов религиозности, христианство использует психологию, чтобы внедрять ее в практику повседневной деятельности священников и укреплять позиции теологии [9, с. 123–126].

Интересно то, что внецерковная конфессионально ориентированная психология религии не связана, как правило, со специфически церковными задачами, но предполагает в качестве методологической базы религиозную антропологию. Например, психолог, организационно независимый от церкви, может переосмыслить с позиций вероучения то, что известно ему из психологической теории и практики. Если в церковной психологии обнаруживается стремление пересмотреть те или иные разделы теологии с позиций психологии, привлечь ее для объяснения и интерпретации тех элементов вероучения и культа, которые в силу своей иррациональности плохо воспринимаются современными верующими, то во внецерковной психологии наблюдается тенденция уйти от жесткого рационализма, пересмотреть основные разделы науки с позиций представления о человеке как о homo religiosus [2].

Для психологов большую проблему создает генезис религии и религиозности. Основываясь на эмпирических методах, современная психология только описывает религиозные факты так, как их воспринимает человек, или группа людей и дает их объяснение с помощью различных теоретических положений. Психология религии разрешает признать трансцендентные опыт и убеждения, не присоединяясь к исследованиям реальности или вероятности трансцендентного предмета. Психология религии не занимается вопросами объективного существования Бога, Его благодати – это вопросы философии и богословия, но она исследует как конкретный человек или группа людей понимает существование Всевышнего и Его действия в жизни этих людей [10].

Подобная практика ставит ряд сложных теоретических вопросов, дает импульс к разработке проблем, находящихся на стыке социальной психологии, психологии личности и религиоведения, а также требует исторических и социологических исследований. Все это ведет к выработке нового инструментария, нового понятийного аппарата, который был бы адекватен для всех сфер психологии религии как отдельной дисциплины. Задание не сводится к выработке некоторого сверх-языка, поскольку в данном случае возникает проблема не столько переименования, так как категориальный аппарат – не совокупность обозначений: категории определяют угол зрения, задают подход к исследованию, в итоге моделируют его объект. Описанная работа ведет к становлению такой модели психологического знания, которое одновременно отражала бы запросы и религии, и психологии. В свете этого необходимо обратить внимание на то, что почти все современные вероучения имеют свою значительную традицию анализирования реальности духовной жизни. Следовательно, сопоставление религиозного и психологического отображений действительности неминуемо поставит вопрос о корреляциях науки и религии – в этом и будет заключаться оригинальность и новация предмета психологии религии в его новейшем выражении.

Выводы

Для того, чтобы рассмотреть развитие личной религиозности средствами психологии религии, необходимо прежде всего, определить основания изучения этого развития. Понимание психологии религии как самостоятельной дисциплины в системе социально-психологической науки является приоритетным, поскольку в изучении религиозных явлений присутствуют аспекты, которые находят объяснение как в человеческой психике, так и в обстоятельствах социологического и исторического порядка.

Учитывая это, перспективы дальнейших разработок в данном направлении связаны с изучением феномена религии и религиозности методами и средствами не только социальной и индивидуальной психологии и религиоведения. Наиболее плодотворно религия и религиозность могут быть изучены в рамках психологии религии как отдельной научной дисциплины, обладающей оригинальным предметом, системным объектом исследования, сформированным категориальным аппаратом в целом.

References:

1. Vundt V (2002) Problemy psihologii narodov / V. Vundt. – M.: EHksmo, 2002. – p. 46–48.
2. Grasseri R (1901) Psihologiya religii. – SPb., 1901. – 283 p.
3. Dzhejms U (1993) Mnogoobrazie religioznogo opyta. Per. s angl. / U. Dzhejms. – M.: Nauka, 1993. – p.146.
4. Zen'ko YM (2002) Psihologiya i religiya. / YU.M. Zen'ko. – SPb., 2002 – 383 p.
5. (1996) Klassiki mirovogo religiovedeniya: Antologiya, 1996, V. 2-h t.: Per. s angl., nem., fr. T. 1. – M.: Kanon+, 1996. – 496 p.
6. Krasnikov AN, Gavrilina LM, EHlbyakan ES (2003) Problemy filosofii religii i religiovedeniya: Uchebnoe posobie / A. N. Krasnikov, L. M. Gavrilina, E. S. EHlbyakan. – Kaliningrad: Izd-vo KGU, 2003. – 153 p.
7. (1998) Mesto psihologii religii v sisteme nauk / Available: www.pstbionline.orthodoxy.ru/.../Psihologiya+religii+4+kurs.doc (Accessed: 25.03.2017).
8. (2005) Osnovy religiovedeniya. Retrieved from Available: https://books.google.ru/books?isbn=5276010234 (Accessed: 25.03.2017).
9. Popova MA (1973) Kritika psihologicheskoj apologii religii (Sovremennaya amerikanskaya psihologiya religii). / M.A. Popova – M.: Mysl', 1973.– p. 123–126.
10. Ugrinovich DM (1986) Psihologiya religii. / D.M. Ugrinovich – M., Politizdat, 1986. – p. 152–160.

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SECTION 21. Pedagogy. Psychology. Innovation in Education.

IMPROVEMENT OF THE DATABASE OF PEDAGOMETRIC MODELS OF THE CONTROL ERGGAMMAL ANALYSIS OF EDUCATIONAL OBJECTS

Abstract: *The basic directions of Improving the database of pedagogometric models controllin ertsgamming analysis of educational facilities in the formation of mathematical vogueley learning activities about the nature of achieving the criteria of life, cyclicness, consistency and phasing, which form the basic cell education space, as well as the use of the twelve pointed star Ertsgammy for the submission ertsgamming principle which determines the foundations pedagogometric through substantive shaping metods hyperspace professional life, psychological and educational activity theory, psycho-pedagogical system analysis and the theory of the formation of mental dei Business Plan.*

Key words: *database, control ertsgamming analysis, educational facility, pedagogometric, lifeactivity, recurrence, systemic, stages, star Ertsgammy.*

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СОВЕРШЕНСТВОВАНИЕ БАЗЫ ДАННЫХ ПЕДАГОГОМЕТРИЧЕСКИХ МОДЕЛЕЙ КОНТРОЛЬНОГО ЭРЦГАММНОГО АНАЛИЗА ОБРАЗОВАТЕЛЬНЫХ ОБЪЕКТОВ

Аннотация: *Рассмотрены основные направления совершенствования базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов при формировании математических моделей учебной деятельности относительно характера достижения критериев жизнедеятельности, цикличности, системности и этапности, которые образуют базисную ячейку образовательного пространства, а также применение двенадцати конечной звезды Эрцгаммы относительно представления принципа эрцгаммности, который определит основы педагогометрики через формообразование предметными методами гиперпространства профессиональной жизнедеятельности, психолого-педагогической теории деятельности, психолого-педагогического системного анализа и теории формирования умственных действий.*

Ключевые слова: *база данных, контрольный эрцгаммный анализ, образовательный объект, педагогометрика, жизнедеятельность, цикличность, системность, этапность, звезда Эрцгаммы.*

Introduction

Совершенствования базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов при формировании математических моделей учебной деятельности относительно характера достижения критериев жизнедеятельности, цикличности, системности и этапности, которые образуют базисную ячейку образовательного пространства. Это проявляется в совершенствовании базы данных математических моделей относительно уровня представвления в учебном процессе: базисной звезды Эрцгаммы гиперпространства жизнедеятельности (E1); базисного целостно-системного цикла жизнедеятельности (E2); базисной звезды

Эрцгаммы системного анализа (E3); базисного проявления двенадцати этапов и форм познавательного гиперпространства жизнедеятельности относительно образовательного процесса (E4).

Совершенствование заданой базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов с признаком базисно-нормативной эрцгаммности, независимо от целевого назначения, выполняет собственную функцию психолого-математического представления, имеющего соответствующий показатель базисно-нормативного целостного развития относительно характеристик собственной значимости. Каждый базисно-нормативный глобальный объект (E1N, E2N, E3N, E4N) образовательного пространства выполняет синфазно двенадцать сравнительных функций: смыслообразующей ориентировки, смыслообразующего исполнения, смыслообразующего контроля, ориентировки в принятии решения, исполнении в принятии решения, контроля в принятии решения, абсолютной ориентировки, абсолютного исполнения, абсолютного контроля, ориентировки в прогнозе развития, исполнения в прогнозе развития и контроля в прогнозе развития собственной фазы совершенствования образовательного процесса относительно нормативной учебно-профессиональной деятельности эрцгаммного типа. Тогда можно провести совершенствование заданной базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов при эрцгаммном контроле педагогометрического исследования познавательной активности, выражающей степень многофазного развития всех составляющих процессов обучения студентов. При этом можно представить двенадцати-этапную модель базисного действия, состоящего из смыслообразование действия; принятие действия; ориентировочной части действия; исполнительной части действия; контрольная части действия и прогноза развития действия относительно собственной ориентировки, исполнения и контроля – представляющего инвариантную основу образовательной активности [1]. При этом решаются сорок восемь задач формирования целостно-системной личности плюс двенадцать задач инвариантного эрцгамно-педагогометрического действия. Процесс решения каждой задачи разворачивается относительно реализации базисной звезды Эрцгаммы гиперпространства жизнедеятельности (E1); базисного целостно-системного цикла жизнедеятельности (E2); базисной звезды Эрцгаммы системного анализа (E3); базисного проявления двенадцати этапов и форм познавательного гиперпространства жизнедеятельности относительно образовательного процесса (E4) и установлении инвариантного уровня эрцгамно-педагогометрического действия (E0).

Materials and Methods

Совершенствование базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов при формировании математических моделей учебной деятельности относительно способа достижения критериев эрцгаммности на различных целостно-системных представлениях о профессиональной практической деятельности связывается с различными информационными представлениями об ориентировочных, исполнительных и контрольных качествах образовательно-технологических процессов [10].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта связывается с отражением существующей структуры этапов формирования интеллекта относительно различных методов представления образовательного процесса. Анализ контрольного педагогометрического математического моделирования процесса формирования интеллекта уподобляется с представлением системы управления и диагностики учебной деятельности в вербальных проблемных средах.

При этом применялись положения теории вероятности, комбинаторики, системного анализа, методов компьютерного моделирования, кибернетики, теории конечных автоматов. При программной реализации полученных концепций использовались методы: теории алгоритмов и языков программирования; объектно-ориентированного программирования; математического моделирования и визуализации, опирающиеся на методы вычислительной математики. Это позволило: разработать математическую модель информационного взаимодействия управляющего центра и объекта управления в виде системы петель обратной связи, заданных рекурсивными уравнениями, описывающих изменение ресурса, величины рассогласования между целевым и текущим состоянием; прогнозируемым и реаль-ным значением функции ценности с учётом синтаксических и семантических свойства действий; создать систему автоматического управления учебной деятельностью по решению задач в вербальных проблемных средах, на основе модели, позволяющей получать полезный результат независимо от индивидуальных качеств и свойств объекта управления с ограничением ресурса объема работ и времени, позволяющим

определять оптимальное время деятельности объекта управления [2].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта также определяется проблемой разработки модели и алгоритмы контроля знаний по гуманитарным дисциплинам, которая решается с помощью семантического анализа информации, использования аппарата нейронных сетей и методов педагогической квалиметрии. Для реализации программного обеспечения используется: система программирования Borland C++ Builder 6, система управления базами данных MySQL, драйвер программного интерфейса доступа к базам данных MySQL Connector ODBC и C++, кросс-платформенный инструментарий разработки программного обеспечения Qt. При этом формируется алгоритм анализа ответов NeuroLD, основанный на расчете взвешенного расстояния Левенштейна и нейронных сетей Кохонена, который позволяет классифицировать текст или предложения по смысловому значению; отрабатывается модель тестирования, основанная на методе уточнения результата ответа, которая позволяет оценить знания тестируемых за счет учета частичных ответов; представляется модель тестирования знаний, основанная на методе коррекции ошибок, кото-рая объединяет закрытые и открытые типы заданий и позволяет испытуемому выбрать ответ или дать его в свободной форме при структурном анализе [3].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта позволяет представить метод и алгоритмы измерения латентных переменных при управлении в образовательных системах. При этом используются методы системного анализа, теории управления сложными информационными системами, теории алгоритмов, имитационного моделирования, математического планирования эксперимента, прикладной математической статистики, которые приводят метод и алгоритм генерирования значений индикаторных переменных в соответствие с моделью Раша, отличающийся тем, что на основе имитационного моделирования формируется полный класс экспериментальных ситуаций и позволяющий исследовать точность измерения латентных переменных методами имитационного моделирования; формируют средства оценки точности измерений латентных переменных в зависимости от числа дихотомических индикаторных переменных, отличающиеся тем, что точность измерений оценивается на линейной шкале, что позволяет расширить область применения разработанных средств в различных ситуациях; устанавливают структурно-функциональную организацию системы управления качеством тестовых заданий, отличающихся введением блока поиска заданий не соответствующих модели Раша и блока анализа качества дистракторов, позволяющих создавать тесты для кон-троля уровня подготовленности студентов на линейной шкале [4].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта связывается с управлением образовательным процессом по вектору знаний через методологию системного подхода, принципы системно-структурного анализа, причинно-следственный, информационный характер взаимосвязей в интегрированной системе управления образовательным процессом. При этом формируется совокупность математических моделей, представляющих механизм обучения системой дифференциальных уравнений с использованием интеллектуальных операторов в соответствии с векторами управляющих воздействий и управляемых координат, позволяющая повысить эффективность проведения исследований механизма управления образовательным процессом с использованием инновационных технологий обучения; создаются условия проектирования программной платформы, комплекса про-грамм, методик и алгоритмов, обеспечивающий проведение математического и физического моделирования технических объектов и систем управления в условиях интегрированного комплекса сетевых автоматизированных лабораторий, определяющих этапы развития интеллекта [5].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта также определяется созданием адаптивного управления качеством предметной подготовки на основе компетентностного подхода при использовании методов системного анализа, теории адаптивного управления, теории управления социальными и организационными системами, дискретного оптимального управления и сетевого моделирования. При этом построена модель адаптивного управления предметной подготовкой студентов на основе компетентностного и процессного подходов; разработана компетентностная модель предметной подготовки как иерархической структуры результатов обучения; выделена методика построения индивидуальных образовательных траекторий студента на основе модульной технологии организации учебного процесса и сетевого моделирования предметной

подготовки с использованием классов эквивалентности; выделена методика оценки качества освоения предметных компетенций путем формирования системы специальных критериев и индикаторов, которая реализована в форме человеко-машинной системы контроля достигаемых результатов образования; построен алгоритм адаптивного управления образовательными траектория-ми на множестве классов эквивалентности, предполагающий возможность учета индивидуальной предыстории обучения студента и его мотивации в повышении уровня образования в рамках предметной подготовки при реализации индивидуальных образовательных траекторий [6].

Совершенствование контрольного педагогометрического математического моделирования процесса формирования интеллекта позволяет представить математическое и программное обеспечение поддержки принятия управленческих решений для организации дополнительного профессионального образования. На основе метода статистических испытаний, математической статистики, регрессионного анализа, эконометрики, онтологического моделирования, теории принятия решений, программирования, разработки баз данных и информационных систем представлены: метод обработки временных рядов на основе трехмерного представления данных с последующим анализом сезонной волны, тренда и гармоники для решения задач управления социальной системой учреждения дополни-тельного профессионального образования; метод Монте-Карло случайной выборки количества слушателей усеченного нормального и экспоненциального распределения вероятностей для принятия решений в социальных системах в условиях риска; формализация и постановка задачи принятия управленческого решения о выборе оптимального режима работы учреждения дополнительного профессионального образования [7].

Анализ контрольного педагогометрического математического моделирования процесса формирования интеллекта связывается с повышением эффективности управления обучением на основе системы автоматизированного создания электронных учебных ресурсов. На основе методов системного анализа, теории управления, теории информационных систем и обработки данных, методов исследования и построения систем хранения и обработки информации с удаленным доступом, операций математической логики разработаны: способы повышения эффективности управления обучением за счет ускорения создания электронных учебных ресурсов с применением наборов правил изменения текстовых данных, которые в отличие от общеиспользуемых языков программирования максимально приближены к естественному человеческому языку и предназначены для выполнения узкоспециализированной задачи создания электронных учебных ресурсов; усовершенствована технология обработки документов, при которой информация сегментируется по принципу визуального отображения, которое обрабатывается с помощью макрокоманд и проводит коррекцию контента на основе контроля усвоения учебного материала независимо от типа содержания и формата исходных данных [8].

Развитие контрольного педагогометрического математического моделирования процесса формирования интеллекта также определяется моделями и алгоритмами поддержки принятия решения в задачах адаптивного управления качеством педагогической системы. При этом, с помощью системного анализа, теории управления, экспертных систем, корреляционного анализа, теории информации, проектирования информационных и педагогических систем, теории графов, структурных матриц Шатихина, выбора и принятия решения, теории нечетких множеств, математического моделирования и программирования разработаны: структурная модель поведения педагогической системы, основанная на теоретико-множественном описании функционирования систем, в которой используются системные категории время, состояние, функция, процесс, позволяющая определить условия, при которых педагогическая система развивается, стагнирует; предложены сорок алгоритмических правил, образующих основу для нечетких алгоритмов планирования в каждой конкретной ситу-ации управляющих воздействий и уровней регулятивности преподавателей и проводимости обучаемых [9].

Структуирование контрольного педагогометрического математического моделирования процесса формирования интеллекта позволяет представить поддержку управления учебным процессом на основе информационных технологий многомерного анализа данных. На основе концепции непрерывной информационной поддержки процессов жизненных циклов (CALS), методов теории организационного управления, системного анализа и общей теории систем, математической теории множеств, системного моделирования, а также теории баз данных можно представить решение проблем: разработка способа иерархического структурирования информационного пространства для построения многоуровневых моделей учебного процесса;

формирование структурно-логической модели единого информационного пространства учебного процесса для организации оперативного получения, обработки, хранения информации; представление метода получения и многомерной обработки информации для обеспечения оперативной информационной поддержки управления учебным процессом на всех этапах его жизненного цикла; формирование структуры информационной системы для реализации предложенных моделей и метода; анализ эффективности применения предложенных моделей и метода для поддержки управления учебным процессом [10].

Анализ контрольного педагогометрического математического моделирования процесса формирования интеллекта связывается с мониторингом качества вузовского дополнительного образования на основе интегрированных показателей. При этом, на основе теории управления организационными системами, теории принятия решений, системном анализе, а также использовании методов управления качеством, математической статистики, обратных вычислений, экспертных оценок, методов структурного программирования, теории баз данных решались задачи: разработка системы показателей качества вузовского дополнительного образования, отличающаяся использованием агрегативных групп показателей, что позволяло оценить направления деятельности подразделения вуза, осуществляющего подготовку по дополнительным образовательным программам; формирование теоретико-множественной модели, отличающейся описанием слабоформализованных объектов мониторинга с использованием теории нечетких множеств, позволяющая определить интегрированные показатели качества вузовского дополнительного образования; представлена методика проведения мониторинга качества вузовского дополнительного образования, отличающаяся использованием механизма обратных вычислений, что позволяет формировать управленческие решения на основе анализа интегрированных показателей качества образования [11].

Совершенствование контрольного педагогометрического математического моделирование учебного процесса отражает общее направление автоматизаци образовательных технологий, направленных на совершенствование циклической, базисной, фундаментальной и широкопрофильной подготовки специалистов, которые должны ориентироваться в общей структуре производства, совокупности методов его самоорганизации и этапах формирования профессионального мастерства.

Совершенствование базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов при формировании математических моделей учебной деятельности относительно способа достижения критериев эрцгаммности максимально достигается при анализ базисных педагогометрических математических моделей учебной деятельности на основе психолого-педагогического системного анализа, психологической теории деятельности, теории формирования интеллекта, гиперпространства целостно-системных циклов жизнедеятельности эрцгамного формообразования. Целостно-системное учебное действие (ЦСУД) составляет базисную структурную основу целостно-системного цикла жизнедеятельности (ЦСЦЖ), состоящего из двенадцати компонентов звезды Эрцгаммы. Каждый элемент ЦСЦЖ представляется методами системного анализа через двенадцать психолого-педагогических действий, которые в процессе интериоризации принимают двенадцать основных форм от ориентационной до внутренней и также имеют деятельностную основу. С учётом процессов коммуникативной деятельности дополнительно выделяются четыре целостно-системные учебные действия. Существует сорок восемь базисных ЦСУД, которые имеют предметно-деятельностную основу относительно ЦСЦЖ, психолого-педагогического системного анализа и процесса формирования интеллекта. Математическое моделирование целостно-системного учебного действия определяет базисную задачу педагогометрики [1].

Всякое целостно-системное учебное действие имеет три базисные компонента: ориентировочный, исполнительный и контрольный, которые определяют основные направления математического моделирования ЦСУД. Множество элементов учебного действия можно записать в виде набора последовательных элементов системных операций. Каждый элемент ЦСУД характеризуется конкретными свойствами, которые однозначно определяют его в данной системе. Совокупность всех свойств элемента учебного действия устанавливает его состояние. Между базисными компонентами ЦСУД констатируют связь - множество счётных зависимостей свойств между элементами системы учебного действия, составляющих ведущие компетенции. Это определяет собственную структуру развития каждой из сорока восьми задач формирования целостно-системной личности современного специалиста

через решение базисной задачи о структуре эрцгамно-педагогометрического действия (E0).

Conclusion

Поиск и анализ основных направлений развития и совершенствования базы данных педагогометрических моделей контрольного эрцгаммного анализа образовательных объектов относительно педагогометрического математического моделирования учебного процесса связывается с процессами совершенствования программируемых математических моделей учебной деятельности относительно характера представления критериев жизнедеятельности, цикличности, системности и этапности, которые образуют базисную ячейку образовательного пространства, определяют условия развития абсолютного образовательного цикла, отражающего специфическую структуру подготовки широкопрофильных специалистов при реализации международных образовательных стандартов. При этом важно установить направление развитие и способы формирования уровня состояния основных базисных параметров всех основных четырёх структур целостно-системных звёзд Эрцгаммы, степень их взаимосвязи в направлении исследования двенадцати-элементной структуры базисного целостно-системного действия. Каждая контрольная задача формирования целостно-системной личности задаётся критериями достижения уровней мультипликативного пространства широкопрофильной деятельности через реализацию многофазных предметно-деятельностых отношений скоростных формирующих схем. При этом контролируются уровни смыслообразующей ориентировки, смыслообразующего исполнения, смыслообразующего контроля, ориентировки в принятии решения, исполнении в принятии решения, контроля в принятии решения, абсолютной ориентировки, абсолютного исполнения, абсолютного контроля, ориентировки в прогнозе развития, исполнения в прогнозе развития и контроля в прогнозе развития собственной фазы совершенствования образовательного процесса. Формируемая система линейных уравнений с шестьюдесятями переменными и шестьюдесятями уравнениями позволяет сформировать соотношения, проектирующие представление субъектности учебного процесса, составляющие математических функций процесса математического моделирования, ограничивающие предметные условия контролируемых параметров, определяющие результаты моделируемых результатов образовательной деятельности, через установлении рефлексивной формы последующего предметного преобразования опредмеченного субъективизма, через последующие компаунд-субъектные отношения к профессионалу нового типа – алигурометрического содержания эревнометрической формы.

References:

1. Mishchik SA (2014) Mathematical modeling integrity - system performance subject – fourth task pedagogometriki. Materialy Mezhdunarodnoy nauchnoy konferenctsii “Eurapean Science and Technology” – 30.11.2014. ISJ Theoretical &Applied Science 11(19): 51-54 Southampton, UK. doi: http://dx.doi.org/10.15863/TAS.2014.11.19.10
2. Nikolaeva ÛS (2012) Sistemy upravleniâ i diagnostiki učebnoj deâtel'nosti v verbal'nyh problemnyh sredah [Tekst]: dis. ... kand. teh. nauk: 05.13.10 / Û. S. Nikolaeva. – Krasnoârsk, 2012. – 195 s.
3. Poguda AA (2016) Modeli i algoritmy kontrolâ znanij po gumanitarnym disciplinam [Tekst]: dis. ... kand. teh. nauk: 05.13.10 / A.A.Poguda. – Tomsk, 2016. – 174 p.
4. Pozdnâkov SA (2009) Metod i algoritmy izmereniâ latentnyh peremennyh pri upravlenii v obrazovatel'nyh sistemah [Tekst]: avto-ref.dis. ... kand. teh. nauk: 05.13.10 / S.A.Pozdnâkov.– Kursk, 2009. – 18 p.
5. Prošin DI (2011) Upravlenie obrazovatel'nym processom po vektoru znanij (na primere napravleniâ podgotovki "Avtomatizaciâ tehnologičeskih processov i proizvodstv") [Tekst]: dis. ... doktr. teh. nauk: 05.13.10 / D. I. Prošin. – Moskva, 2011. – 404 p.
6. Stolbova ID (2012) Adaptivnoe upravlenie kačestvom predmetnoj podgotovki v tehničeskom vuze na osnove kompetentnostnogo podhoda (na primere grafičeskoj podgotovki studentov) [Tekst]: dis.

... doktr. teh. nauk: 05.13.10 / I.D. Stolbova. – Perm', 2012. – 399 p.
7. Temnikova EA (2015) Matematičeskoe i programmnoe obespečenie podderžki prinâtiâ upravlenčeskih rešenij dlâ organizacii dopolnitel'nogo professional'nogo obrazovaniâ [Tekst]: avto-ref.dis. ... kand. teh. nauk: 05.13.10 / E.A.Temnikova. – Novosibirsk, 2015. – 23 p.
8. Timčenko MS (2012) Povyšenie èffektivnosti upravleniâ obučeniem na osnove sistemy avtomatizirovannogo sozdaniâ èlektronnyh učebnyh resursov [Tekst]: dis. ... kand. teh. nauk: 05.13.10 / M.S.Timčenko. – Samara, 2012. – 145 p.
9. Fedûnin ML (2012) Modeli i algoritmy podderžki prinâtiâ rešeniâ v zadače adaptivnogo upravleniâ kačestvom pedagogičeskoj sistemy [Tekst]: dis. ... kand. teh. nauk: 05.13.10 / M.L.Fedûnin. – Voronež, 2012. – 180 p.
10. Šilina MA (2012) Podderžka upravleniâ učebnym processom na osnove informacionnyh tehnologij mnogomernogo analiza dannyh [Tekst]: dis. ... kand. teh. nauk: 05.13.10 / M.A.Šilina. – Ufa, 2012. – 154 p.
11. Štyrova IA (2014) Monitoring kačestva vuzovskogo dopolnitel'nogo obrazovaniâ na osnove integrirovannyh pokazatelej [Tekst]: avtoref.dis. ... kand. teh. nauk: 05.13.10 / I.A.Štyrova. – Astrahan', 2014. – 16 p.

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SECTION 4. Computer science, computer engineering and automation.

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AUTOMATION OF MAKING REPORTS IN THE AREA OF MANAGEMENT SYSTEMS' CERTIFICATION VIA ORACLE BUSINESS INTELLIGENCE

Abstract: *There is a great variety of companies, including certification centers, whose activity requires carrying out business analysis and creating different significant reports. In connection with information technologies' development and influence of a human factor a lot of Business Intelligence systems have appeared. These systems enable to make correct business decisions on the basis of obtained structured information, which shows crucial trends of enterprise's activity. Oracle Business Intelligence is one of Business Intelligence systems. The system is a package of analyzing instruments, which are aimed at transforming data into structured information, which can be used for both business analysis and reporting. Hence, this article focuses on Business Intelligence systems, Oracle BI, its possibilities, components, processes of creating reports and dashboards, using a database as a data source, reports' delivery in terms of certification and expert organizations' activity.*

Key words: *Business Intelligence, Oracle Business Intelligence, Oracle BI Publisher, reports, dashboards, Oracle, databases.*

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1. Introduction

There is a great variety of different enterprises, whose activity is inseparably linked with making various reports, graphic means of business analysis, representing the results of their activity at seminars and meetings. Certification and expert organizations are related to the above mentioned enterprises. The reports of certification centers frequently represent the outcome of certification process, auditors' workload and other significant data, which are indispensable for carrying out profound business analysis.

In spite of information technologies' development a lot of employees do not cope with methods of working with different software. In connection with this feature and the influence of human factors, a great variety of unacceptable mistakes and design defects appear in finished reports or these reports fail to be done in time. It is obvious that these mistakes might be critical in matters of stable and successful financial future of the company.

Hence, automation of making reports makes it possible to reduce the influence of human factors, thereby to decrease expenses, report creation time and increase correctness and timeliness. Furthermore, the automation enables to find out bottle necks, significant tendencies of organization's activity, which are represented in a visual form, and reflect the reality in different frames of reference.

This article is devoted to automation of making reports in the area of management systems' certification via Business Intelligence system namely Oracle Business Intelligence. Thus, the paper tells about Business Intelligence systems, Oracle BI, its possibilities, components, processes of creating reports and dashboards using a database as a data source, reports' delivery in terms of certification and expert organizations' activity.

2. The features of Business Intelligence

Business Intelligence systems combine data gathering, data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision makers [1, p. 32]. In other words, Business Intelligence systems are analytical systems, which unite data obtained from various data sources, process these data in a particular way, which makes it possible to estimate received information, carry out business analysis and make decisions which contribute to a favorable outcome. Moreover, Business Intelligence systems are capable of making reports, which can be used for both business decision making and keeping important documents. It is supposed that 97% of organizations whose revenue exceeds $100 million use Business Intelligence systems to some extent [2, p. 5368].

Owing to the development of information technologies and growth of competition on the market, a lot of Business Intelligence systems have appeared. The list of the most widely-known examples includes Oracle Business Intelligence, SAP Business Intelligence, Microsoft Business Intelligence, QlickView, IBM Cognos BI, SAS BI and Prognoz Platform. All the above mentioned systems vary in price, simplicity of installation and security of serviceable condition, supported data sources and OLAP's modes, possibility of using different expansions, profusion of graphical aids and so on. On the basis of systems' characteristics companies choose the system which is the most suitable for their business processes, which have to be taken into account.

Nowadays Business Intelligence technologies are becoming more and more popular. Various BI solutions can be found in different branches, whose activity refers to the great amount of data. For instance, BI technology is used in telecommunications for identifying reasons for customer churn, in utilities for power usage analysis, and health care for outcomes analysis [3, p. 89]. Furthermore, spread of BI approves another fact. Business Intelligence and Business Analytics software has been included in many information systems curricula [4, p. 23].

3. Oracle Business Intelligence and its possibilities

Oracle Business Intelligence is a BI system, which is provided by the American transnational company Oracle. Thus, Oracle Business Intelligence is the package of analyzing instruments, which is oriented to transformation data into structured information, which can be used for both business analysis and reporting. An important aspect in which Oracle has a different approach from the other providers is the use of the ELT architecture for data integration, rather than ETL [5, p. 66]. The work with Oracle BI is implemented by Web interface, which is notable for clearness, the hierarchical structure of provided possibilities and the support of various languages. It should be noted that the tools of the software are available for both users who are IT specialists and those whose activity is not connected to having technical skills.

Oracle BI consists of different components ensuring its functionality, with basic components being Oracle BI Server, Oracle BI Publisher, Presentation Services, Repository, Oracle BI Delivers, Oracle Enterprise Manager and Office Plug – in. The first component represents a core super high-speed component, which is a connecting part between the repository and data sources. The second component is responsible for scheduled creating reports in widespread formats and their delivery to different destinations such as mailboxes, printers and faxes. Presentation Services include Oracle BI Analysis Editor and Oracle BI Dashboards, which are used to create data panels, or dashboards, and interact with Presentation Server connected to Oracle BI Server. The repository stores metadata which will be used by Oracle BI Server subsequently. Oracle BI Delivers are the means of reports' delivery and notification of users. Oracle Enterprise Manager is used for the administration of Oracle BI instance. The last one represents a set of tools for integration with Microsoft Office.

The above mentioned components characterize Oracle Business Intelligence as a powerful tool enabling to create common and interactive reports, which contribute to monitor company's trends and carry out the analysis of used corrective measures. Furthermore, due to the components, the following functional abilities can be specified:

- support of different data sources, which include relational databases, OLAPs, which operate in relational, hybrid and multidimensional modes, XML files and Excel files;
- implementation of multidimensional business analysis and decision making;
- creation of dashboards and reports in common formats (RTF, PDF, HTML);
- repository development for metadata unity;
- support of high extent of personalization;
- notifications and report's delivery and bursting;
- integration with Microsoft Office;
- assignment of roles to different users to provide established security police.

To sum up, it should be noticed that this analytical package has various positive features, which can be marked as significant benefits. Thus, Oracle BI is characterized by high performance, scalability, correctness, integration simplicity and availability for the employees who have different levels of skills of working with software products.

4. Making reports via Oracle BI Publisher

As it has been mentioned before, creating common reports and their delivery is implemented via BI Publisher, which has an ability to operate separately from the full Oracle BI package. It should be noted that Oracle Publisher is based on separation of data and templates of the documents' formatting. This feature contributes to flexibility of reports' development and simplicity of the development process.

The procedure of creating reports based on information of a particular database is linked with the following algorithm: the connection to data source is implemented by means of JDBC driver, a data model is created, a template and a style template, if it is necessary, are formed.

The connection to data source is implemented on Administration page. It is necessary to state the name of data source, driver type, driver class, connection string and the name of the user, whose schema includes required information. The connection string includes the database's host, port and SID.

The second step consists in creating a data model via Data Model Editor on the basis of joint data source. Data model represents a collection of data sets, which, in turn, represent natural queries to a chosen data source. Data models are stored in the repository for fixed availability support. It may also contain parameters with a list of values, bursting definitions and other structures or properties that determine how data are provided to a report [6, p. 95].

The next step is creation of a template by means of Template Builder or Layout Editor. Layout Editor is an online tool, which is accessible via BI interface. Template Builder is an extension of Microsoft Word. Thus, Template Builder seems to be more familiar for the vast majority of users. The process of templates' development via Template Builder refers to the following actions: selecting the data model, choosing containers such as tables, lists, graphs and so on for the data set of the data model and personalization of the report. Personalization can be implemented by means of Microsoft Word abilities and XML and XSL languages.

In connection with the paradigm which uses BI Publisher it is possible to implement scheduled delivery of reports and their bursting. Bursting is a process of generating multiple documents from the same report, and delivering each document to a different destination [7, p. 108]. To deliver reports it is necessary to join the installed mail server to BI by means of specifying a master domain and a server network address. BI Publisher interface enables to create report jobs which are used for reports' delivery. These jobs contain a report, used template, output name and format, locale and time zone, addresses and schedule which determine the data of the report creation and its delivery.

Functionality of report jobs includes not only the delivery of created documents by a developer, but also automatic creation of the reports on the basis of specified schedule. This feature makes it possible to automate entirely the report's making and workflow of an organization. Thereby it provides timely creation of reports and reduction of labor expenditures.

Thus, Oracle BI Publisher enables to create different reports, which show basic trends of a company's activity or are suitable for business analysis and decision making. Furthermore, the process of creation is simple and fast, which is very important in case of large organizations interested in their competitive power.

5. Layers of Oracle BI Repository

Various dashboards are frequently preferred as the way of reflecting significant data which are used for carrying out business analysis. However availability of the dashboards depends on Oracle BI component called the repository. Oracle BI repository represents one of the most important components of Oracle Business Intelligence. The repository makes it possible for users to work with finished dashboards or create them by means of working with Oracle BI Analysis Editor and Oracle BI Dashboards. As it has been already mentioned, users vary in their technical skills, purposes and specificity of their work. In connection with the feature three layers of the repository have appeared. Hence, the repository is divided into physical, business model and mapping and presentation layers, which are adapted by Oracle Administration Tool. Furthermore, Oracle Business Intelligence does not limit the company in what concerns the number of data sources and their heterogeneity due to presence of the repository.

Physical layer is a fundamental layer, because dashboards will not be available, if the layer is not adapted. It includes basic information about one data source or several data sources whose data have to be retrieved. If the data source is relational database, the layer reflects information about the database, connection pool, user's schema, tables, columns, keys depending on the configuration created by a developer. The connection pool is a connection string to the data source. When the physical layer is adapted, creation of dashboards is possible by means of direct queries to the data source.

Business model and mapping layer defines business, or logical models, of the data and specifies the mapping between the business models and the physical layer schemas [8, p. 111]. The first stage of the layer's configuration is creation of the business model, which includes logical dimensions. Logical dimensions, in turn, are divided into various logical tables making up a special common hierarchical

structure. Business models might be connected to different physical sources and logical tables – different physical tables.

Presentation layer is developed for the work of end users. Thus, dimensions which have been created on the previous stage are grouped into subject areas depending on the category of dimension's data and their orientation. Correspondingly, only required objects with correct and appropriate aliases will be added to a particular subject area. In other words, this layer serves the purpose of presenting data in a customized view.

6. Making dashboards via Oracle BI

Making dashboards via Oracle BI is implemented by means of using two components: Oracle BI Analysis Editor and Oracle BI Dashboards. It should be noted that a dashboard is a page in business Intelligence application that displays content [9, p. 52]. When the repository is adapted, the developer should create BI analyses, which consist of data source queries, for instance, SQL queries. The creation of analysis is carried out by means of the first above mentioned component and indication the name of connection pool to get access to data of used data source.

Furthermore, it is important to choose a container for BI analyses, which can be a table, bar graph, bubble graph and so on, and select properties for the container. However, the properties of containers and their data depend on the profoundness of the previous setup of the repository. For instance, filters, groups and objects' hierarchy and other advanced properties are available after the full setup of the repository. The process of working with a container is simple: a developer has to drag a particular column in the container model.

When all necessary analyses are created, the dashboard's layout can be made by dragging a particular analysis to a particular section of a column. Users have an ability to add not only created analyses, but also images, links, text, alert sections and action links. All sections and columns have their features, which can be specified in a determined way.

7. The characteristics of certification process

Certification is a checking of a particular object against requirements, which are fixed in different standards. The list of these objects includes management systems, goods, stuff, educational centers and other objects, whose presence depends on the accreditation of a certification center. However, the most popular and widespread object is a management system such as quality management system, food safety management system and environmental management system.

Different contractors and auditors participate in the certification process. Contractors are organizations that are being certified, and auditors are employees, who carry out an audit in compliance with the management scheme and standard. It should be noted that the necessary standard and management scheme are chosen by the contractor in compliance with the contactor's needs and are reflected in the concluded pact which, in turn, represents other pact's conditions. The simplified diagram of the certification process is shown on the Figure 1.

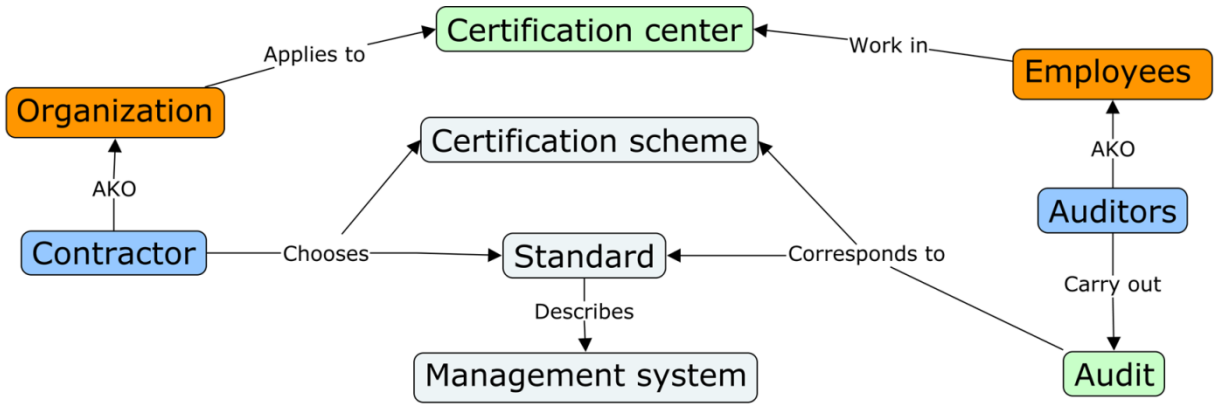

Figure 1 - The simplified scheme of the certification process.

8. The implementation of automation of making reports via Oracle BI

As it has already been mentioned, the first step of making reports via Oracle BI Publisher is the connection to a data source by means of JDBC driver. In this implementation Oracle 11g database serves as a data source. Thus, the driver type is "Oracle 11g" and the driver class – "oracle.jdbc.OracleDriver". The connection string appears in the following way: "jdbc:oracle:thin: @localhost:1521:orcl", where "localhost", "1521" and "orcl" are host, port and SID of a chosen database, correspondingly.

Reports which are created in the implementation refer to the results of the certification department's activity and the workflow of the organization during the current month. For instance, one report includes a list of contractors, who have made a contract during that month, a list of contractors that have been certified, summary table of certification results, summary table of auditors' activity and other required information. Another report shows created documents during the current months and the process of their agreement. Every of the above mentioned parts of the reports represents SQL query or PL/SQL function and, thereby, represents a data set, which is included in Data Model which refers to the joint data source.

Every data set is placed in a suitable container such as a table, list or diagram via Template Builder. Properties such as page layout, headlines' styles, font, size, color of text and so on can be adapted by means of Microsoft Word. Furthermore, XML and XSL are frequently used in report's personalization. For instance, if it is required to mark out auditors whose activity has been insufficient and unite the cells of a total row, XML and XSL might be used, correspondingly. The examples of the made report's parts are shown on the Figure 2 and Figure 3. All data of the examples are fictitious and has no relation to the reality. The first example shows color indicting of auditors depending on the results of their month work. XML code appears in the following way:

<?if@row:number(DIFFERENCE)<0?>
<?attribute@incontext:backgroundcolor;
'#F9E1B5'?>
<?attribute@incontext:color;'Red'?><?attribute @ Incontext: font–weight; 'bold'?>
<?end if?>.

The second example demonstrates documents which have been created during the current month. The total row is united by means of following XSL code: <?if: LOCATION =' '?>

<xsl:attribute xdofo:ctx= "block"
name="number–columns–spanned">3</xsl:attribute>
<?end if?>.

Auditor	Contractor	Current salary	Wage	Difference
Smirnov A. S.	Gubernskie Apteki	10000		
Smirnov A. S.	Gazprom Neft	10000		
Smirnov A. S.	Hlebny Dom	15000		
Smirnov A. S. Totals:		35000	30000	5000
Petrova A. B.	EXTERRAN	10000		
Petrova A. B.	Gubernskie Apteki	10000		
Petrova A. B. Totals:		**20000**	**30000**	**-10000**
Sergeev S. N.	VeroPharm	20000		
Sergeev S. N.	Gazprom Neft	10000		
Sergeev S. N. Totals:		**30000**	**30000**	**0**

Figure 2 - Financial efficiency of auditors (example of XML)

Document	Location	Creation date
Writ	C:\Users\Documents\writ1	05.05.2016
	C:\Users\Documents\writ2	06.05.2016
Order	C:\Users\Documents\order1	10.05.2016
	C:\Users\Documents\order2	11.05.2016
Explanatory memorandum	C:\Users\Documents\EM1	12.05.2016
	C:\Users\Documents\EM2	12.05.2016
Report	C:\Users\Documents\report	13.05.2016
Record	C:\Users\Documents\record	14.05.2016
Totals: 8		

Figure 3 - Created documents (example of XSL)

The process of created reports' delivery has previously been described. In matters of this implementation, CommiGate Pro in conjunction with Microsoft Outlook and MAPI Connector have been used in the capacity of a mail server. Report jobs include schedule, which launches the process of report's creating and delivery on the last day of a month. In that case scheduled report's creation is possible owing to using SYSDATE in SQL queries.

Creating dashboards is similar to creating reports. However, availability of dashboards depends on the setup of physical layer of the repository. Hence, if the source is Oracle database with defined features, which can be found in file called tnsnames.ora, the connection pool appears in the following way:

"(DESCRIPTION = (ADDRESS = (PROTOCOL = TCP) (HOST = 127.0.0.1) (PORT= 1521)) (CONNECT_DATA = (SERVER = DEDICATED) (SERVICE_NAME = orcl.5.5.3) (SID = orcl)))".

Turning back to the certification centers, it might be possible to reflect the number of contractors who have made a pact depending on the quarter and year, the percentage ratio of old and new contactors, years when contractors make a pacts and other basic information about contractors. Each piece of data represents a retrieved data via direct queries to the database or Oracle BI Analysis. Retrieved information refers to the last three years and is placed in a particular container. Properties of the container can be adapted in matters of their style, size, fixed size, the availability of prompts, which filter the results of embedded analyses to show only the results that match the prompt criteria [10, p.139], scaling and scrolling and so on. All the created containers are located on a dashboard in a special way. For instance, the size of tables is fixed so as not to damage the layout of the dashboard. The example of a created dashboard is shown in the Figure 4. The image is a link to another page of the dashboard. The conversion is shown in the Figure 5. All the data shown on the dashboard are fictitious and has no relation to the reality.

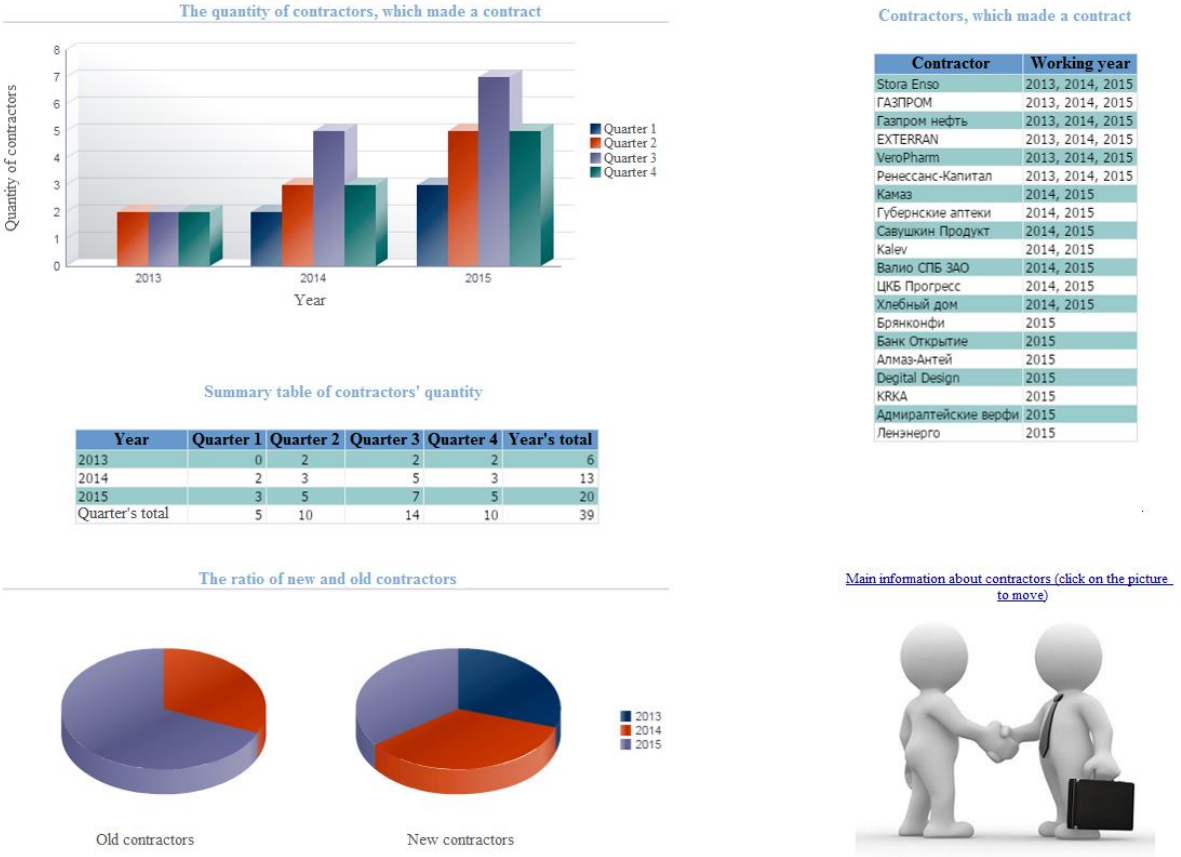

Figure 4 - The company's activity dashboard

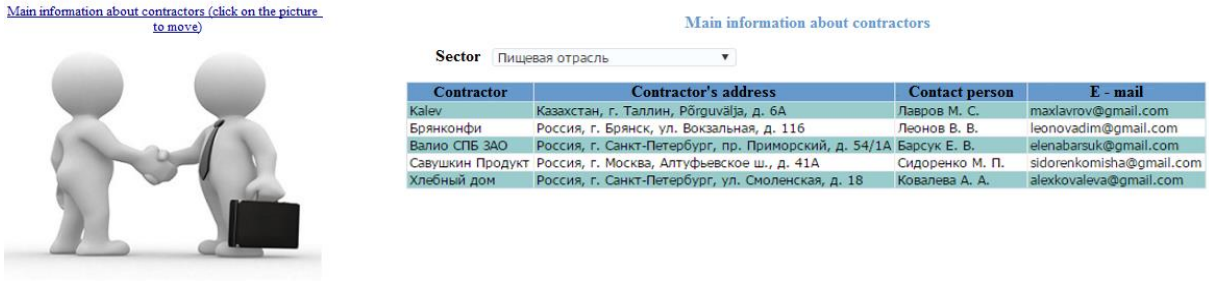

Figure 5 - Linked page of the company's activity dashboard

9. Conclusion

To sum up, Oracle Business Intelligence is a powerful high-technology tool for carrying out business analysis and making reports. This package makes it possible to create correct reports and deliver them in time, create colorful and informative dashboards which are characterized by high personalization and suitability for decision making. All the above mentioned features are demonstrated on the reports and dashboards in terms of certification center's activity. Furthermore, Oracle BI like other BI technologies contributes to expenditure's reduction and increasing the efficiency of control ways. It should be noted that the materials of this paper were presented at a conference held by Leibniz University, Hannover, Germany.

References:

1. Rostami NA (2014) Integration of Business Intelligence and Knowledge Management – A literature review. Journal of Intelligence Studies in Business, p. 30-40.
2. Junyi Yang, Alain Pinsonneault, J.J. Po-An Hsieh (2017) Understanding Intention to Explore Business Intelligence Systems: The Roleof Fit and Engagement. Hawaii International Conference on System Sciences, p. 5368-5377.
3. Surajit Chaudhuri, Umeshwar Dayal,Vivek Narasayya (2011) An overview of Business Intelligence Technology. Communications of the Acm, p. 88-98.
4. Gary Alan Davis, Charles R. Woratschek (2015) Evaluating Business Intelligence / Business Analytics Software for Use in the Information Systems Curriculum. Information Systems Education Journal, p. 23-29.
5. Bogdan-Andrei Ionescu, Sorina Podaru (2014) Business Intelligence. A Presentation of the Current Lead Solutions and a Comparative Analysis of the Main Providers. Database Systems Journal, p. 60-69.
6. Lea Shaw, Sindhu Rao (2011) Oracle BI Publisher 11g R1: Fundamentals, Volume 1. Redwood: Oracle.
7. Lea Shaw SR (2011) Oracle BI Publisher 11g R1: Fundamentals, Volume 2. Redwood: Oracle.
8. Sarokin J (2011) Oracle BI 11g R1: Build Repositories, Volume 1. Redwood: Oracle.
9. Dan Hilldale, Lea Shaw (2012) Oracle BI 11g R1: Create Analyses and Dashboards, Volume 1. Redwood: Oracle.
10. Dan Hilldale, Lea Shaw (2012) Oracle BI 11g R1: Create Analyses and Dashboards, Volume 2. Redwood: Oracle.

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	JIF = 1.500	SJIF (Morocco) = 2.031	

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OPTIMIZATION TREATMENT OF MATERIAL SELECTION IN MACHINE DESIGN - CONSIDERING TECHNICAL, ECONOMIC AND SUPPLY ASPECT

Abstract: *Optimal design of gear or any other machine requires the consideration of the two type parameters known as material and geometrical parameters. The choice of stronger material parameters may allow the choice of better geometrical parameters and vice versa. Very important difference among these two parameters is that the geometrical parameters are often varied independently. On the other hand, material parameters can be inherently correlated to each other and may not be varied independently. An example of which being the variation of the bending fatigue limit (Sbf) with the core hardness (HB) for some steel materials. If these parameters would be varied independently in an optimization case, it may result in infeasible solutions. Therefore, the final choice of material may not be possible within available data base.*

Key words: *Selection parameters, decision making, Cost, Lead Time*

Language: *English*

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INTRODUCTION

If in gear, the material and geometrical parameters are optimized simultaneously then it is common to assume empirical formulas approximating a relation between material parameters for example the bending fatigue limit (Sbf) and ultimate tensile strength (UTS) as a function of hardness. If the choice of material is limited to a list of pre-defined candidates, then two difficulties can be appeared. First, a discrete optimization process should be followed against material parameters. Second, properties of different alternatives materials may not indicate any obvious correlation in the given list. The main goal is to choose material with best characteristic among alternatives.

OVERVIEW OF GEAR MATERIAL*:*

Gears are commonly made of cast iron, steel, bronze, phenolic resins, acetal, nylon or other plastics. The selection of material depends on the type of loading and speed of operation, wear life, reliability and application. Cast iron is the least expensive. ASTM / AGMA grade 20 is widely used. Grades 30, 40, 50, 60 are progressively stronger and more expensive. CI gears have greater surface fatigue strength than bending fatigue strength. Better damping properties enable them to run quietly than steel.

Nodular cast iron gears have higher bending strength together with good surface durability. These gears are now a day used in automobile cam shafts. A good combination is often a steel pinion mated against cast iron gear. Steel finds many applications since it combines both high strength and low cost. Plain carbon and alloy steel usage is quite common.

Through hardened plain carbon steel with 0.35 - 0.6% C are used when gears need hardness more

than 250 to 350 Bhn. These gears need grinding to overcome heat treatment distortion. When compactness, high impact strength and durability are needed as in automotive and mobile applications, alloy steels are used. These gears are surface or case-hardened by flame hardening, induction hardening, nitriding or case carburizing processes. Steels such as En 353, En36, En24, 17CrNiMo6 widely used for gears.

Bronzes are used when corrosion resistance, low friction and wear under high sliding velocity is needed as in worm-gear applications. AGMA recommends Tin bronzes containing small % of Ni, Pb or Zn. The hardness may range from 70 to 85Bhn.Non metallic gears made of phenolic resin, acetal, nylon and other plastics are used for light load lubrication free quiet operation at reasonable cost. Mating gear in many such applications is made with steel. In order to accommodate high thermal expansion, plastic gears must have higher backlash and undergo stringent prototype testing.

MATERIAL PERFORMANCE INDICES

The main characteristics considered in the design of

gears are:

- ✓ surface fatigue limit (Ssf),
- ✓ root bending fatigue limit (Sbf),
- ✓ wear resistance of tooth's flank
- ✓ High tensile strength to prevent failure against static loads
- ✓ High endurance strength to withstand dynamic loads
- ✓ Low coefficient of friction
- ✓ Good manufacturability

Generally cast iron, steel, brass and bronze are preferred for manufacturing metallic gears with cut teeth. Where smooth action is not important, cast iron gears with cut teeth may be employed. Commercially cut gears have a pitch line velocity of about 5 metre/second. For velocities larger than this, gear sets with non-metallic pinions as one member are used to eliminate vibration and noise. Non-metallic materials are made of various materials such as treated cotton pressed and moulded at high-pressure, synthetic resins of the phenol type and rawhide. Moisture affects rawhide pinions. Gears made of phenolic resins are self-supporting on the other hand other two types are supported by metal side plates at both ends of the plate. Large wheels are made with fretting rings to save alloy steels. Wheel centre is commonly cast from cast iron. The ring is forged or roll expanded from steel of the respective grade specified by the tooth design.

DESIGN CONSIDERATIONS

The accuracy of the output of a gear depends on the accuracy of its design and manufacturing. The correct manufacturing of a gear requires a number of prerequisite calculations and design considerations. The design considerations taken into account before manufacturing of gears are:

- Strength of the gear in order to avoid failure at staring torques or under dynamic loading during running conditions.
- Gear teeth must have good wear characteristics.
- Selection of material combination.
- Proper alignment and compactness of drive
- Provision of adequate and proper lubrication arrangement.

Problem Definition

An organization has got 9 different materials with different specifications for gear. The decision maker considered 7 selection criteria. The materials are as follows:

Table 1

SL. NO.	**Material**	GRADE
Material 1	Cast iron	SAE J431-43500
Material 2	Ductile iron	EN-GJS 418
Material 3	S.G. iron	BS 2789
Material 4	Cast alloy steel	BS 2795
Material 5	Through hardened carbon steel	SAE 4140
Material 6	Surface hardened alloy steel	SAE 8620
Material 7	Carburised steel	SAE 8620
Material 8	Nitrided steel	EN40B
Material 9	Through hardened carbon steel	817M40

Table 2

The selection criteria are as follows:

C1	Surface Hardness (Bhn)
C2	Core Hardness (Bhn)
C3	Surface Fatigue Limit (MPa)
C4	Bending Fatigue Limit (MPa)
C5	UTS (MPa)
C6	Cost (INR) Per kg
C7	Supply Lead Time (In week)

Out of 7 criteria, 5 criteria viz. C1: Surface Hardness (Bhn), C2: Core Hardness (Bhn), C3: Surface Fatigue Limit (MPa),C4: Bending Fatigue Limit (MPa),C5: UTS (MPa) are beneficial criteria because their higher values are desirable and remaining viz. C6: Cost (INR) Per kg,C7: Supply Lead Time(In week) are non-beneficial criteria because their lower values are desirable.

Formation of decision matrix:

The objective of the decision maker is to assess the performance of the materials. Counseling the above 7 criteria to ultimately select the best material. The decision maker applied SAW, TOPSIS and MOORA methods for their simplicity, adaptability, applicability and is of applications. The decision matrix for the materials with respect to the criteria shown below:

Table: Suggested materials and their properties in a gear material selection problem[A]

Table 3

MATERIAL	Grade	Surface (Bhn) Hardness (C1)	Core (Bhn) Hardness (C2)	Surface Fatigue Limit (MPa) (C3)	Bending Fatigue Limit (MPa) (C4)	UTS (MPa) (C5)	Cost (INR) Per kg (C6)	Supply Lead Time (In week) (C7)
Cast iron (M1)	SAE J431-43500	200	200	330	100	380	55	2
Ductile iron (M2)	EN-GJS 418	220	220	460	360	880	55	2
S.G. iron (M3)	BS 2789	240	240	550	340	845	47	3
Cast alloy steel (M4)	BS 2795	270	270	630	435	845	66	4
Through hardened carbon steel (M5)	SAE 4140	270	270	670	430	620	58	5
Surface hardened alloy steel (M6)	SAE 8620	542	229	1160	680	1850	60	6
Carburised steel (M7)	SAE 8620	647	297	1500	920	2300	60	5
Nitrided steel (M8)	EN40B	693	297	1250	760	1250	72	5
Through hardened carbon steel (M9)	817M40	185	185	500	430	635	74	5

AData(except material grade,cost and supply lead time) are taken form Hofmann (1990) where Vickers hardness values have been converted to Brinell values using conversion tables in http://www.gordonengland.co.uk/hardness/brinell_conversion_chart.htm

AData (material grade,cost and supply lead time) are taken form Bill Forge Private Limited (Plant I) 9C, Bommasandra Industrial Area,Hosur Road,Bangalore - 562 158, India

SOLUTION METHODOLOGY:

Simple Additive weighting method (SAW)

Step 1: Formation of decision matrix

Step 2 Formation of Weight Matrix,

$$\mathbf{W = [W_1 \ldots . W_j \ldots \ldots W_n]} \quad (2)$$

Different importance weights to various criteria may be awarded by the decision makers. These importance weights forms the weight as follows.

Step 3 Normalization of performance rating

Units and dimensions of performance ratings of columns under criteria differ. For the purpose of comparison, these performance ratings are converted into dimensionless units by normalization using following equations

$$\bar{x}_{ij} = \frac{x_{ij}}{\max_i \left(x_{ij}\right)} \text{ for benefit criteria } \boldsymbol{j} \quad (3)$$

$$\bar{x}_{ij} = \frac{\min_i \left(x_{ij}\right)}{x_{ij}} \text{ for non-benefit criteria } \boldsymbol{j} \quad (4)$$

Normalized decision matrix

$$\bar{X} = \begin{matrix} A_1 \\ \vdots \\ A_2 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} \bar{x}_{11} \cdots & \ldots \bar{x}_{1j} \ldots & \bar{x}_{1n} \\ \vdots & \vdots & \vdots \\ \bar{x}_{i1} \ldots & \ldots \bar{x}_{ij} \ldots & \bar{x}_{in} \\ \vdots & \vdots & \vdots \\ \bar{x}_{m1} & \bar{x}_{mj} & \bar{x}_{mn} \end{bmatrix}_{m \times n} \quad (5)$$

Step 4 composite score: Computation of composite score (CS_i) for alternative *i*

$$CS_i = \sum_{j=1}^{n} \left(\overline{w}_j * \bar{x}_{ij}\right)$$

Step 5 Ranking and selection of best alternative: Ranking of products in descending order of composite scores (CS_i).

TECHNIQUE FOR ORDER PREFERENCE BY SIMILARITY TO IDEAL SOLUTION (TOPSIS)

Algorithm of TOPSIS method under MCDM

The idea of TOPSIS can be expressed in a series of steps:

Step1 All the original criteria receive tendency treatment. We usually transform the cost criteria into benefit criteria, which is shown in detail as follows;

(i) The reciprocal ratio method ($X\ ij = 1/X\ ij$), refers to the absolute criteria;

(ii) The difference method ($X\ ij = 1 - X\ ij$), refers to the relative criteria.

After tendency treatment, construct a matrix

$$A = \left\lfloor a_{ij} \right\rfloor_{n \times m}, \quad i = 1,2,\ldots,n; \ \ j = 1,2,\ldots,m. \quad (6)$$

Step2 Calculate the normalized decision matrix A. The normalized value *aij* is calculated as:

$$A = \left[a_{ij}\right]_{n \times m}, \ \ a_{ij} = X_{ij}^{/} \Big/ \sqrt{\sum_{i=1}^{n} \left(X_{ij}^{/}\right)^2} \ \ i = 1,2,\ldots,n; \ \ j = 1,2,\ldots,m. \quad (7)$$

$$A = \left[a_{ij}\right]_{n \times m}, \ \ a_{ij} = X_{ij}^{/}$$

Step3 Determine the positive ideal and negative ideal solution from the matrix *A*.

$$A^{+} = \left(a_{i1}^{+}, a_{i2}^{+}, \ldots, a_{im}^{+}\right), \ \ a_{ij}^{+} = \max_{1 \le i \le n} \left(a_{ij}\right), \ \ j = 1,2,\ldots,m \quad (8)$$

$$A^{-} = \left(a_{i1}^{-}, a_{i2}^{-}, \ldots, a_{im}^{-}\right), \ \ a_{ij}^{-} = \max_{1 \le i \le n} \left(a_{ij}\right), \ \ j = 1,2,\ldots,m \quad (9)$$

Step4 Calculate the separation measures, using the *n*-dimensional Euclidean distance. The separation of each alternative from the positive ideal solution is given as:

$$D_i^{+} = \sqrt{\sum_{j=1}^{m} W_j \left(a_{ij}^{+} - a_{ij}\right)^2} \quad (10)$$

Similarly, the separation from the negative ideal solution is given as

$$D_i^- = \sqrt{\sum_{j=1}^{m} W_j \left(a_{ij}^- - a_{ij}\right)^2} \qquad (11)$$

Step5 For each alternative, calculate the ratio R_i as:

$$R_i = \frac{D_i^-}{D_i^- + D_i^+}, \quad i = 1,2,...,n \qquad (12)$$

Step 6 Rank alternatives in increasing order according to the ratio value of R_i in step5.

MULTI OBJECTIVE OPTIMIZATION RATIO ANALYSIS (MOORA):

Algorithm of MOORA method under MCDM

The MOORA method starts with a matrix of responses (performance measures) of different alternatives on different criteria (objectives or attributes).The matrix is shown below (Equation 1).

$$X = \begin{array}{c} \\ A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & \cdots & C_j & \cdots & C_n \end{array} \\ \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \end{array} \qquad (6)$$

Where x_{ij} is the performance rating (response) to the *i*th alternative (A_i) under *j*th criterion (C_j). *m* is the number of alternatives and *n* is the number of criteria.

The MOORA method employs a ratio system in which each response of an alternative on an attribute (criterion) is compared to a denominator. The denominator is a representative for all alternatives concerning that attribute (Brauers et al. 2007; Kalibatas and Turskis, 2008).

Brauers et al. (2008) considered various ratios such as the square root of the sum of squares of each alternative per objective, total ratios, Scharlig ratios, Weitendorf ratios, Jutter ratios, Stop ratios, Van Delft and Nijkamp ratios of maximum value, Korth ratios, Peldschus *et al.* and Peldschus ratios for nonlinear normalization. They concluded that the square root of the sum of squares of each alternative per objective is the best one for the denominator which is given below.

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} \left(x_{ij}^2\right)}} \qquad (7)$$

x_{ij}^* is normalized value of response *i* with respect to attribute *j*. In the current research work, the maximum score under each attribute has also been used as the denominator of the ratio system and an effort has been made to exhibit that this ratio system is also suitable for finding the optimal solution. The following ratio system is the second best for normalization process in MOORA.

$$x_{ij}^* = \frac{x_{ij}}{\max_i \left(x_{ij}\right)} \qquad (8)$$

For the computation of normalized response using the above Eq. (2b), first the maximum score under each attribute is found. Then all the scores under certain attribute irrespective of benefit or non-benefit are divided by the concerned maximum score using Eq. (2b). x_{ij}^* is a dimensionless quantity in the interval [0,1] representing the normalized score of alternative *i* on attribute *j*. However, sometimes the interval could be [-1; 1]. For example in the case of productivity growth of some factories, industries, sectors, regions or countries may be negative instead of positive thus the interval becomes [-1;1] (Brauers *et al.*, 2008).

For multi-objective optimization these normalized performances are added in case of maximization and subtracted in case of minimization. Then the optimization problem becomes

$$y_i^* = \sum_{j=1}^{g} x_{ij}^* - \sum_{j=g+1}^{n} x_{ij}^* \qquad (9)$$

Where *g* is the number of benefit criteria to be maximized and *(n-g)* is the number of non-benefit criteria to be minimized. y_i^* is final score of i^{th} alternative with respect to all the attributes. In the above case it is assumed that all the attributes are of same importance.

$$y_i^* = \sum_{j=1}^{g} w_j * x_{ij}^* - \sum_{j=g+1}^{n} w_j * x_{ij}^* \qquad (10)$$

Where w_j^* is the weight of jth attribute (criterion), which can be evaluated using any well-known approach either AHP or Entropy method.

The value of y_i^* may be positive, negative or zero. These y_i^* values are arranged in descending order. The best alternative is one which is associated with highest y_i^* value and the worst alternative is one which is associated with the lowest y_i^* value.

ENTROPY

Step1 Calculate p_{ij} (the i_{th} scheme's j_{th} indicator value's proportion).

$p_{ij} = \frac{r_{ij}}{\sum_{j=1}^{m}} = r_{ij}$, r_{ij} is the i_{th} scheme's j_{th} indicator value

Step2 Calculate the jth indicator's entropy value ej.ej = -k $\sum_{j=1}^{m}$ pij ln p_{ij}, k=1/ln m, m is the number of assessment schemes.

Step3 Calculate weight w_j (j_{th} indicator's weight).

$w_j=(1-e_j) / \sum_{j=1}^{n}(1-ej)$,n is the number of indicators, and $0 \le w_j \le 1, \sum_j^n w_j=1$

In entropy method, the smaller the indicator's entropy value ej is, the bigger the variation extent of assessment value of indicators is, the more the amount of information provided, the greater the role of the indicator in the comprehensive evaluation, the higher its weight should be.

MATLAB

MATLAB supports a variety of graphs that enable you to present information effectively. The type of graph you select depends, to a large extent, on the nature of your data. The following list can help you select the appropriate graph:

- ✓ Bar and area graphs are useful to view results over time, comparing results, and displaying individual contribution to a total amount.
- ✓ Pie charts show individual contribution to a total amount.
- ✓ Histograms show of data values.
- ✓ Stem and stair step plots display discrete data.
- ✓ Compass, feather, and quiver plots display direction and velocity vectors.
- ✓ Contour plots show equivalued regions in data.
- ✓ Interactive plotting enables you to select data points to plot with the pointer.
- ✓ Animations add an addition data dimension by sequencing plots.

Computational result by MATLAB:

ENTROPY METHOD:

RESULT:

ENTROPY METHOD							
criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7
weighted values	0.1635	0.1129	0.1634	0.1290	0.1143	0.1336	0.1833

SAW METHOD									
Material	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	M_9
The values of (s)	**3.3105**	**3.9933**	**3.9247**	**3.7710**	**4.0601**	**4.9866**	**6.1170**	**5.2557**	**3.0018**
Arranging the final value in descending order:-				M7 > M8 > M6 > M5 > M2 > M3> M4 > M1 > M9					

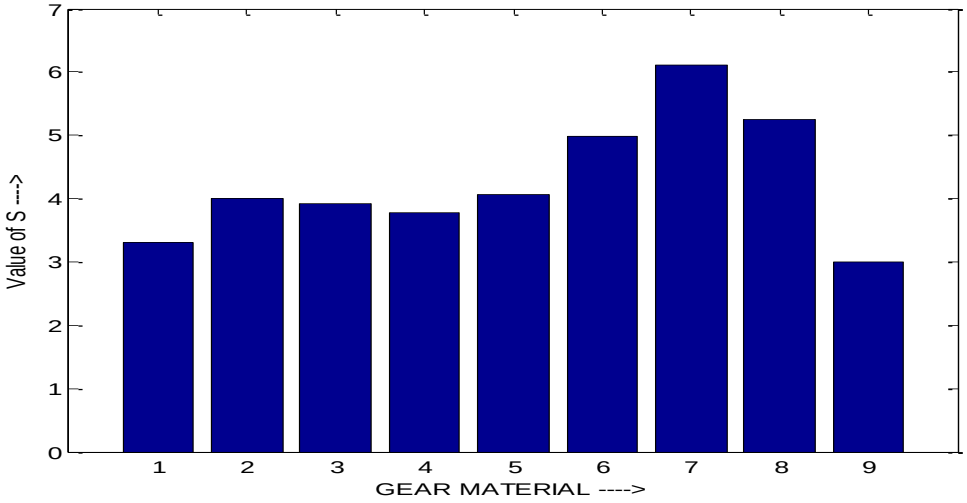


Figure 6

MOORA METHOD:

RESULT:

STEP 1 Determination of normalized decision matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
M_1	0.1623	0.2685	0.1258	0.0597	0.1000	0.2990	0.1538
M_2	0.1785	0.2953	0.1754	0.2149	0.2316	0.2990	0.1538
M_3	0.1948	0.3222	0.2097	0.2029	0.2224	0.2555	0.2308
M_4	0.2191	0.3625	0.2402	0.2596	0.2224	0.3588	0.3077
M_5	0.2191	0.3625	0.2555	0.3223	0.3131	0.3153	0.3846
M_6	0.4398	0.3074	0.4423	0.4058	0.4868	0.3262	0.4615
M_7	0.5250	0.3987	0.5720	0.5491	0.6052	0.3262	0.3846
M_8	0.5623	0.3987	0.4767	0.4536	0.3289	0.3914	0.3846
M_9	0.1501	0.2484	0.1907	0.2566	0.1671	0.4023	0.3846

STEP 2 Determination of weighted normalized decision matrix:

	C_1	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**
M_1	0.0268	0.0301	0.0203	0.0075	0.0113	0.0409	0.0287
M_2	0.0295	0.0331	0.0283	0.0270	0.0261	0.0409	0.0287
M_3	0.0322	0.3222	0.2097	0.2029	0.2224	0.2555	0.2308
M_4	0.2191	0.3625	0.2402	0.2596	0.2224	0.3588	0.3077

M_5	0.0362	0.0406	0.0413	0.0404	0.0353	0.0431	0.0717
M_6	0.0727	0.0344	0.0715	0.0509	0.0548	0.0446	0.0860
M_7	0.0868	0.0446	0.0924	0.0689	0.0682	0.0446	0.0717
M_8	0.0929	0.0446	0.0770	0.0569	0.0371	0.0535	0.0717
M_9	0.0248	0.0278	0.0308	0.0322	0.0188	0.0550	0.0717

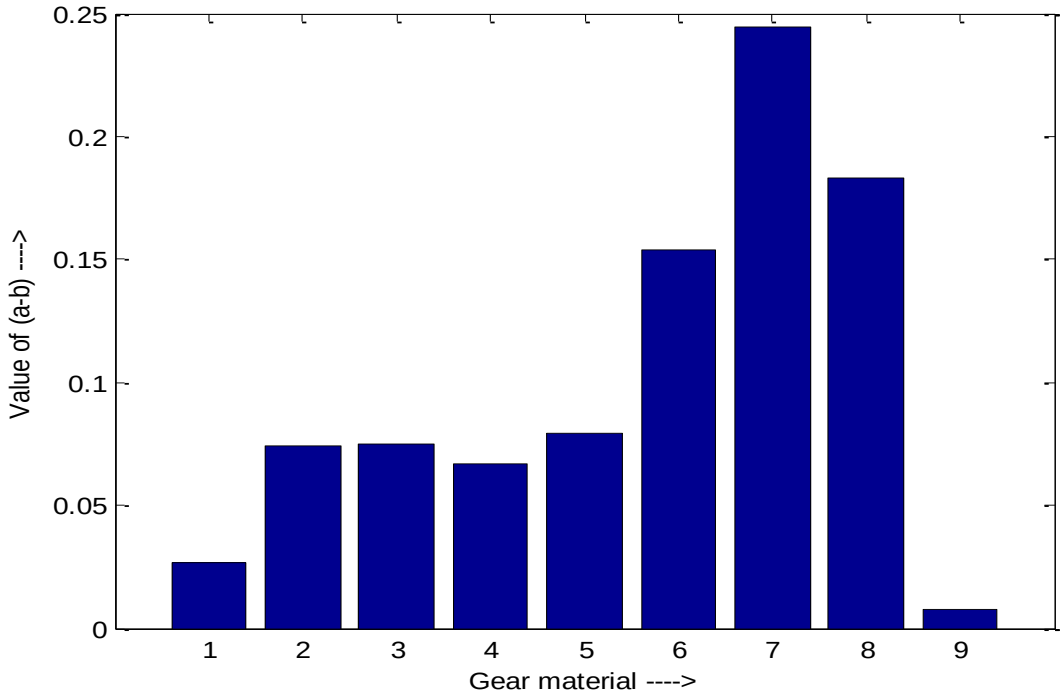
STEP 3: Determination of weighted multi objective optimization:
(the value of a is the sum of all weighted normalized values for all beneficial column)

Material	**M_1**	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**	**M_7**	**M_8**	**M_9**
The values of (a)	0.0960	0.1439	0.1526	0.1732	0.1938	0.2843	0.3609	0.3085	0.1344

The value of b is sum of all weighted normalized values for all non-beneficial column

Material	**M_1**	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**	**M_7**	**M_8**	**M_9**
The values of (b)	0.0696	0.0696	0.0779	0.1064	0.1148	0.1306	0.1163	0.1252	0.1267

Material	**M_1**	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**	**M_7**	**M_8**	**M_9**
The values of (a-b)	0.0264	0.0744	0.0747	0.0668	0.0790	0.1537	0.2446	0.1833	0.0077
Arranging the final value in descending order:-	M7 > M8 > M6 > M5 > M3 > M2> M4 > M1 > M9								



TOPSIS METHOD BY USING MATLAB:

Material	**M_1**	**M_2**	**M_3**	**M_4**	**M_5**	**M_6**	**M_7**	**M_8**	**M_9**
The values of R_i	**0.3286**	**0.3944**	**0.3273**	**0.2967**	**0.3508**	**0.5560**	**0.6905**	**0.5941**	**0.1932**
Arranging the final value in descending order:-	M7 > M8 > M6 > M2 > M5 > M1> M3 > M4 > M9								

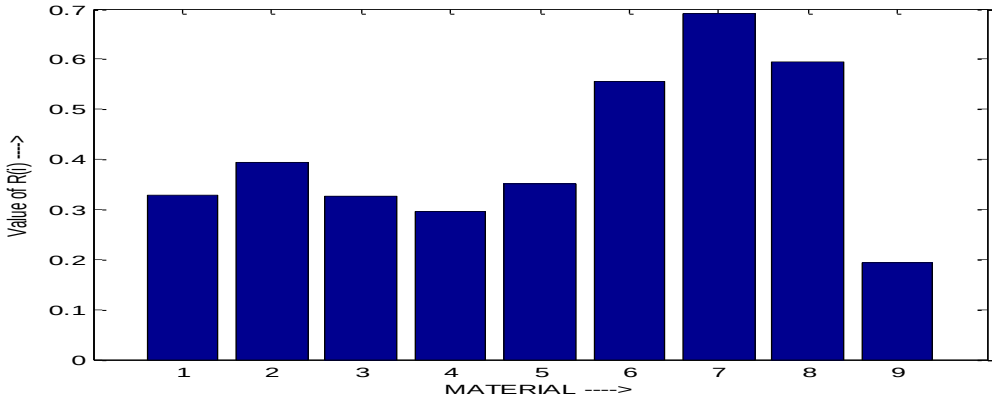


Table-4

Comparative analysis of ranking of gear materials using MCDM methods:

MATERIAL	SAW (RANK)	MOORA (RANK)	TOPSIS (RANK)
M1	8	8	6
M2	5	6	4
M3	6	5	7
M4	7	7	8
M5	4	4	5
M6	3	3	3
M7	1	1	1
M8	2	2	2
M9	9	9	9

DISCUSSION:

From the result we see that for the three different process of MCDM, the result is almost same. The ranking of 1^{st} ,2^{ND} ,3^{RD} and 9^{th} Materials are same for those three different processes. For the simplicity, prompt result getting the accurate value and also getting the best ranking we have used the MATLAB software. By this software we can also make rank of any system for any number of alternatives and criteria within a fraction of second with accuracy.

CONCLUSION

It is quite clear that selection of a proper Gear Materials for a given manufacturing application involves a large number of considerations. The use of SAW, TOPSIS and MOORA methods are observed to be quite capable and computationally easy to evaluate and select the proper material from a given set of alternatives. These methods use the measures of the considered criteria with their relative importance in order to arrive at the final ranking of the alternative Gear Materials. Thus, these popular MCDM methods can be successfully employed for solving any type of decision-making problems having any number of criteria and alternatives in the manufacturing domain. Use of MATLAB software makes MCDM problem simple and gives prompt results which is very essential in today's decision making environment.

As far as design is concern fatigue life is very much important factor that influence the overall working life of the machine as well as the performance efficiency throughout its life span.

References:

1. Ashby MF (2017) Multi-objective optimization in material design and selection. Acta Mater. 48(1), 359–369.
2. Ashby MF (2005) Materials Selection in Mechanical Design.Elsevier, Boston, 2005.
3. Collette Y, Siarry P (2003) Multiobjective Optimization. Springer-Verlag, New York, 2003.
4. Dehghan-Manshadi B, Mahmudi H, Abedian A, Mahmudi R (2007) A novel method for materials selection in mechanical design: Combination of non-linear normalization and a modified digital logic method. Mater. Des. 28(1), 8–15.
5. Milani AS, Shanian A, Madoliat R, Nemes JA (2005) The effect of normalization norms in multiple attribute decision making models: a case study in gear material selection.Struct. Multidisciplinary Optim. 29, 312–318.
6. BRECHT Y, et al. (2001) Challenges in materials and process selection, Progress in materials Science 46, 2001, p. 407-428.
7. SHANIAN A, SAVADOGO O (2006) A material selection model based on the concept

of multiple attribute decision making, Material in Design, 27, 2006, p. 329-337.
8. GLIGORIJEVIĆ R (1976) Materials for gears manufacturing, their dynamic and structural
9. characterisics and heat- tretment, Journal of terotchnology, V.5, No.6, 1976, p.367-379.
10. MILANI A, SHANIAN A (2006) Gear material selection with uncertain and incomplete data, Journal of Mechanics and Material in Design, 3, 2006, p. 209- 222.
11. JUVINALL C, MARSHEK M (2017) Fundamentals of Machine Component Design, Wiley, New.

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SECTION 21. Pedagogy. Psychology. Innovation in Education.

PEDAGOGICAL INNOVATIONS IN THE CONTEXT OF FORMING THE PROFESSIONAL COMPETENCE OF ENGINEERING SPECIALISTS OF THE MARINE BRANCH

Abstract: *Pedagogical innovations in the context of forming the professional competencies of specialists of the navy. Special attention is paid to innovative didactic technologies as a way to increase the efficiency of general scientific training at the Maritime University.*

Key words: *pedagogical innovations, professional competence, system of higher marine education.*

Language: *Russian*

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УДК 372.851

ПЕДАГОГИЧЕСКИЕ ИННОВАЦИИ В КОНТЕКСТЕ ФОРМИРОВАНИЯ ПРОФЕССИОНАЛЬНОЙ КОМПЕТЕНТНОСТИ ИНЖЕНЕРНЫХ СПЕЦИАЛИСТОВ МОРСКОЙ ОТРАСЛИ

Аннотация: *Рассмотрены педагогические инновации в контексте формирования профессиональных компетенций специалистов морского флота. Особое внимание уделено инновационным дидактическим технологиям как способу повышения эффективности общенаучной подготовки в морском университете.*

Ключевые слова: *педагогические инновации, профессиональная компетентность, система высшего морского образования*

Introduction

Одной из важных задач реформирования российской системы высшего образования в целом и инженерно-морского, в частности, осуществляемое в настоящее время в нашей стране, является разработка и внедрение инновационных технологий обучения в учебный процесс высшей школы с целью повышения качества подготовки будущих специалистов.

Инновационный педагогический потенциал России достаточно велик и определяется следующими факторами: наличием развитой системы университетского и высшего педагогического образования;существованием по некоторым направлениям психолого-педагогических исследований признанных научных школ мирового уровня; наличием значительного количества квалифицированных кадров, занятых в системе образования; настоятельной и все возрастающей потребностью в технологическом обновлении учебного процесса[1].

Materials and Methods

Однако указанные факторы не реализуются автоматически. На пути их превращения в источники инновационного роста в сфере инженерно-морского образования встает целый ряд проблем, требующих актуального решения. Дело в том, что инновационная составляющая в этой сфере технического образования проявляет себя недостаточно активно. Поэтому без выявления причин, препятствующих широкой реализации инновационного педагогического потенциала в высших морских учебных заведениях, нельзя предложить эффективную

инновационную модель подготовки специалистов морской отрасли.

В российской системе высшего технического образования как в целом, так и инженерно- морского в частности, в настоящее время наблюдается, на наш взгляд, отсутствие достаточно масштабных перспектив реализации инновационного педагогического потенциала и создания инновационных моделей обучения, основанных на рыночных требованиях к подготовке современных инженерных кадров. Распад плановой экономики привел к нарушениям в работе отдельных звеньев образовательной сферы, для устранения которых и придания целостного характера системы образования необходимо:

- повысить эффективность подготовки педагогических кадров для инновационной деятельности в сфере образования;
- создать центры национальной координации инновационной педагогической деятельности;
- организовать и финансировать масштабные научно-педагогические исследования;
- расширить систему научно-педагогической информации;
- развернуть масштабную реализацию педагогических инноваций в высших учебных заведениях.

Заметим, что реализация педагогических новшеств в учебных заведениях воздействует одновременно на различные структуры педагогической системы, такие как подготовку педагогических кадров, организацию научных исследований, внедрение инновационных технологических разработок и др. Необходимо также учитывать, что сфера создания педагогических новшеств является частично автономной, а частично испытывает воздействие новых общественных потребностей, формирующихся в ходе потребления результатов предыдущих инноваций. При этом каждая связка в сложной цепочке взаимодействий конкретных структур педагогической системы требует выработки специфических педагогических механизмов и методов управления педагогическими инновациями [2,3].

Реформирование системы высшего образования, происходящее в нашей стране, разумеется, предполагает реформирование и школьного образования. В современных условиях высшая школа ощущает, что качество традиционно сложившегося школьного образования из-за низкого уровня финансирования постепенно ухудшается. Не найдены пока формы и методы ориентации школьного образования на потребности общественного развития. Реформа высшего образования, как и средней школы, требует модернизации технологий и программ обучения, что тесно связано с осуществлением педагогических инновационных процессов в образовательной сфере. Однако решение этой проблемы невозможно без широкой мобилизации социальных стимулов и превращения обучения и воспитания в творческий процесс [4,5].

Применительно к системе высшего инженерно-морского образования наиболее актуальными инновациями, на наш взгляд, являются технологии обучения, направленные, прежде всего, на переориентацию целей высшего морского образования на опережающую подготовку специалистов и профессионалов, обладающих оптимальным набором инженерно-морских компетенций, позволяющим выпускникам морского университета быть конкурентоспособными на рынке труда, готовыми к осуществлению инновационной инженерной деятельности при переходе из одной морской производственной сферы в другую.

Профессиональная компетентность инженерных специалистов морской отрасли имеет сложную структуру, в которой целесообразно, на наш взгляд, выделить инвариантную и вариативную оболочки. Каждая из этих оболочек может включать соответствующий ряд уровней. Так, в качестве ядра инвариантной оболочки мы рассматриваем базовый, инженерно-технологический, специально-морской уровни, а так же интегративно-контекстный уровень иноязычной подготовки морских инженеров. В составе вариативной оболочки можно выделить общекультурный, социально-правовой и личностно-креативный уровни.

Все обозначенные выше уровни содержат адекватный профилю формируемого специалиста набор компетенций, включающий предметно-специфические, общекультурные и профессиональные составляющие. В процессе общенаучной подготовки специалистов морского флота формируются компетенции базового уровня. В морском университете математические, естественнонаучные и другие дисциплины цикла общенаучной подготовки обеспечивают инструментарий формирования совокупности ведущих предметно-специфических, общекультурных и профессиональных компетенций специалистов инженерно-морского профиля [6].

Особо отметим, что организация общенаучной подготовки в системе высшего морского образования на базе инновационных компьютерных и дидактических технологий требует пересмотра не только содержания и структуры, но и способов усвоения общенаучных дисциплинарных курсов, которые наряду с

системой предметно-специфических знаний должны формировать адекватные виды учебной квазипрофессиональной деятельности, включающие механизмы саморазвития и личностного профессионального роста будущих специалистов морского флота [7].

Реализация педагогических инноваций на этапе общенаучной подготовки в морском университете открывает возможности преобразования традиционного обучения по общенаучным дисциплинам из недостаточно эффективного и устаревшего по своей организации и методике в высокоэффективный профессионально ориентированный учебный процесс, соответствующий новым образовательным стандартам последнего поколения [8,9,10]. Развитие базы данных педагогометрических моделейформирующего эрцгаммного анализа образовательных объектовпри формированииматематических моделей учебной деятельности относительно способа достижения критериев эрцгаммности на различных целостно-системных представлениях о профессиональной практической деятельности связывается с различными информационными представлениями об ориентировочных, исполнительных и контрольных качествах технологических процессов [10].

Conclusion

Комплексный подход к организации этапов обучения по циклу общенаучных дисциплин, включающий в качестве основных составляющих системно-деятельностный, компетентностный, личностно-ориентированный и интерактивный подходы, может выступать основным ориентиром перестройки учебно-воспитательного процесса, гарантирующим создание действительно современной системы обучения, отвечающей вызовам современного рынка труда и обеспечивающей достаточно высокие результаты общенаучной подготовки в морском университете.

References:

1. Balyaeva SA, Khvingiya TG (2013) Innovacionnyy pedagogicheskiy potencial i ego realizaciya v sfere inzhenerno-morskogo obrazovaniya// Izvestiya Yuzhnogo federalnogo universiteta. Pedagogicheskie nauki. 2013. №3. p.21-27.
2. Balyaeva SA, Uglova AN (2014) Teoreticheskie osnovy pedagogicheskikh innovaciy// Ekspluataciya, bezopasnost i ekonomika vodnogo transporta. Vestnik GMU im. adm. F.F. Ushakova.- Novorossiysk: izd-vo GMU im. adm. F.F. Ushakova. 2014. №2 (7). p. 79-82.
3. Balyaeva SS, Uglova AN (2014) Innovacionnye didakticheskie tekhnologii kak sredstvo formirovaniya universalnykh professionalnykh kompetenciy inzhenerov morskogo flota / V kn.: Obrazovatelno-innovacionnye tekhnologii: teoriya i praktika: monografiya; pod obshchey red. Prof. O.I. Kirikova.-Kniga 19.- Moskva: Nauka: inform; Voronezh: VGPU. 2014. - p.121-136.
4. Mishchik SA (2016) Pedagogometricheskoe modelirovanie obrazovatelnoy deyatelnosti//Uspekhi sovremennoy nauki i obrazovaniya. - 2016, №8, Tom 1 – Belgorod, p.85-87.
5. Mishchik SA (2016) Erczgammnost – bazisnyy princip podgotovki shirokoprofilnykh specialistov/Obrazovatelno-innovacionnye tekhnologii: teoriya i praktika [Tekst]: monografiya / [K.I.Alieva,D.O.Alimova, V.V.Arkhipov i dr.]; pod obshchey red. prof. O.I.Kirikova – Kniga 26.- Voronezh: VGPU; Moskva: Nauka: inform, 2016. – 198 p. (25-36 p.) ISBN978-5-00044-416-0
6. Tokmazov GV, Pankina SI (2009) Strukturno-soderzhatelnaya model formirovaniya issledovatelskikh umeniy // Vysshee obrazovanie segodnya. 2009. № 1. p. 63-66.
7. Balyaeva SA (1999) Teoreticheskie osnovy fundamentalizacii obshchenauchnoy podgotovki v sisteme vysshego tekhnicheskogo obrazovaniya.Avtoref. diss. dokt. ped. nauk Moskva: Izd-vo MPGU, 1999.- 32 p.
8. Balyaeva SA (2016) Information modelasameans of for mationof professional integrity of knowledge of maritime transport [Tekst] /S.A.Balyaeva // Materialy Mezhdunarodnoy nauchnoy konferenctsii «Global Science» – 30.04.2016 ISJ Theoretical & Applied Science, 04 (36): 141-143. Lancaster, USA. http://dx.doi.org/10.15863/TAS.2016.04.36.23

9. Balyaeva SA, Uglova AN (2012) Povyshenie effektivnosti obshchenauchnoy podgotovki specialistov morskoy otrasli na baze innovacionnykh didakticheskikh tekhnologiy // Nauchnye problemy gumanitarnykh issledovaniy. 2012. №5. p. 95-106.

10. Balyaeva SA, Uglova AN (2016) Tekhnologicheskie podkhody k proektirovaniyu soderzhaniya kursa fiziki v morskom vuze // Obshchestvo: sociologiya, psikhologiya, pedagogika. 2016. №5. p.93-96.

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	ISI (Dubai, UAE) = **0.829**	**РИНЦ** (Russia) = **0.234**	**PIF** (India) = **1.940**
	GIF (Australia) = **0.564**	**ESJI** (KZ) = **1.042**	**IBI** (India) = **4.260**
	JIF = **1.500**	**SJIF** (Morocco) = **2.031**	

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SECTION 27. Transport.

FACTORS INFLUENCING THE LIKENESS OF IMPORTED AND LOCAL CARS

Abstract: *This is a field based exploratory study around automobile industry of Pakistan. The aim of this research was to identify and evaluate the key factors that were influencing the likeness of imported and local cars in general public. To conduct this research, a structured questionnaire wasprepared to collect data from various car owners and potential buyers from selected areas of Pakistan. The structured nature of the investigation around hundreds of respondents generated a large amount of quantitative data. Statistical Package for Social Sciences (SPSS) was applied for the analysis of the data. The results indicate that although the trend of purchasing imported cars is increasing day by day but still the local car industry is dominant. The interesting finding is that the respondents acknowledged and favored the durability, comfort-ability, and innovative features of imported cars over local cars but still they are purchasing local cars to reduce the cost of after sale services and to have more resale value.The extreme likeness of imported cars indicates that they can easily compete the local car industry by simply reducing import costs and by providing reasonable after sales services. The resale value of imported cars will automatically increase when after sale services for imported cars will be up to the mark.This study clearly indicates that although local cars are dominant because of their resale value and reasonable after sales services but the trend of switching from local to imported cars is increasing day by day because of the innovative features and latest models of imported cars.*

Key words: *imported cars, automobile industry of Pakistan.*

Language: *English*

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1. Introduction of Auto Industry

Auto industry is referred to as 'Industry of Industries' in the developed world. The auto industry of many regional countries is playing a vital role in transforming those countries into economic tigers.Pakistan is amongst the group of 40 countries in the world that produce automobiles. The Automotive industry is one of Pakistan's growing industries dominated by Japanese-manufacturer's, most of whom have their plants in the country. Pakistan's market is considered among the smallest but the fastest growing in South Asia, with 180,000 cars were sold in the 2014-15 fiscal year, rising to 206,777 units during 2015-16 fiscal year. The auto policy passed on March 19, 2016, offers tax incentives to new entrants to help them establish manufacturing units. In response, Renault-Nissan, Kia Motors and Audi have expressed interest in entering the Pakistani automobile industry. The local market is dominated by three Japanese automobile companies Toyota, Honda and Suzuki. Two of them have assembly plants in Karachi and Honda has its plant in Lahore, all co-owned with local partners.

The production data analysis of all the subsectors revealed that the growth of production remained negative over the period of 2006-07 to 2015-16. At the same time the imports of Pakistan in auto industry has increased, which shows inverse relationship between production of domestic vehicles and parts and import of vehicles and auto parts;average sales value of Rs 1.5 million per unit and import of 36,000 vehicles per year.

2. Background

According to Ministry of Industries, Pakistan produced its first vehicle in 1953, at the National Motors Limited, established in Karachi to assemble Bedford Trucks. Subsequently buses, light trucks and cars were assembled at the same plant. The industry

was highly regulated until the early 1990s. After deregulation, major Japanese manufacturers entered in the market and created some competition in this sector. Assemblers of Hino Trucks, Suzuki Cars (1984), Mazda Trucks, Toyota (1993) and Honda (1994), entered once deregulation was introduced. Assembly of Daihatsu and Hyundai cars (1999) and various brands of LCVs and range of mini-trucks commenced recently. Following are the some well-known locally assembled car models and imported car Models:

Locally Assembled Cars	Imported Cars
Suzuki (Wagon-R)	Toyota Vitz
Suzuki (Liana)	Toyota Aqua
Suzuki (Khyber/ Cultus)	Suzuki Every
Suzuki (Baleno)	Dihatsu Mira ES
Suzuki (Alto)	Toyota Prius
Suzuki (Swift)	Toyota Passo
Suzuki (Margalla)	DihatsuHijet Van
Suzuki (Mehran)	Toyota Land Cruiser Prado
Honda (Civic)	Toyota Land Cruiser
Honda (City)	Honda Fit Hybrid
Toyota (Corolla XLI)	Honda Vezel
Toyota (Corolla GLI)	Suzuki Alto
Toyota (Corolla ALTIS Grande)	
Hyundai (Santro)	
Nissan (Sunny)	
Daihatsu (Cuore)	

3. Factors Influencing the Likeness of Imported and Local Cars

Nowadays trend of imported cars is increasing. People are shifting their minds. Few years back people were not taking risks to buy imported vehicles but now there is an increasing trend for imported vehicles. Competition for local industry has been increased. Local industry is frequently launching new innovational models like imported cars to compete imported car industry. Mainly there are two types of cars: one is sedan and second is hatchback. Local industry is also launching new innovative model of sedan but still local industry is suffering in launch of hatchbacks at low cost, consequently trend of imported hatchback has been increased. Thisresearch has investigated the factors which influence the likeness of the imported and local vehicles. The research identified and investigated the lead factors which were playing their role in shaping buying behavior towards local and imported cars.

4. Statement of the problem

Buying behavior of customers towards local or imported cars depends on their potential satisfaction. Their satisfaction is influenced by a range of factors including price, quality, safety, durability and overall performance of the vehicle. The focus of this study is to identify and investigate the key factors which are playing their role in determining priorities for local or imported cars. The purpose of the research is to develop substantive understanding among automobile companies about buying trends and satisfaction parameters of customers towards local or imported cars. The findings will guide them in reshaping their marketing strategies to grow and succeed in the market.

5. Previous research

Noany previous research was found on similar topic in Pakistan. There were some researches related to auto industry with different directions and conclusions. So this research is unique in its nature and discovered some valued facts and figures about people's buying behavior and their level of satisfaction towards local and imported cars.

6. Nature of the research

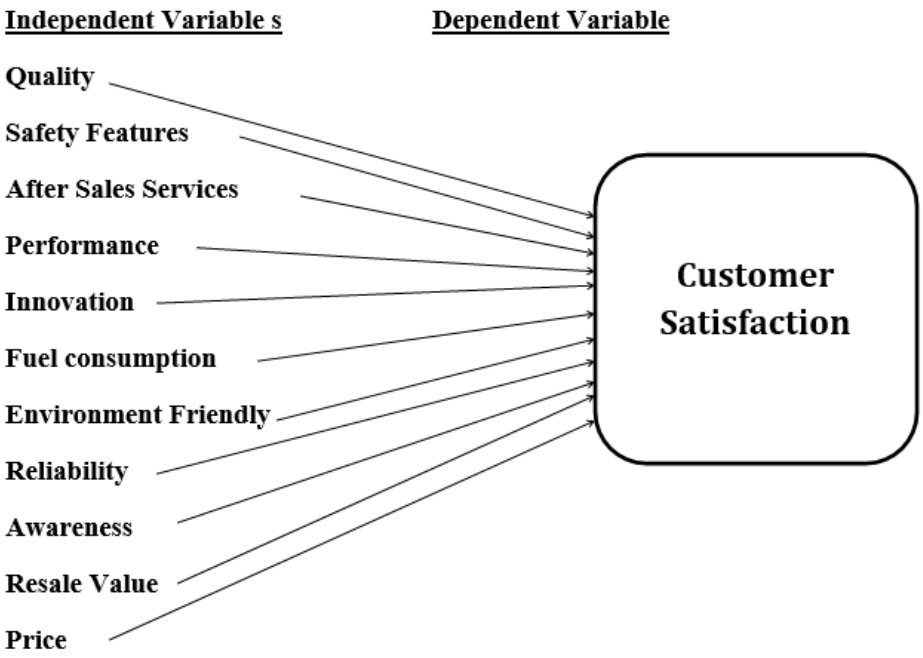
It was exploratory research in its nature. The investigation wasundertaken through face to faceinterviews and questionnaire based field survey around a wide range of respondents. Interviews were conducted with dealers of local cars as well as with those who were inclined to import foreign cars.Thereafter an extensive questionnaire was designed and circulated among hundreds of respondents to collect their views about leading factors playing their role in shaping buying behavior and patterns among customers to have local or imported cars. The dual approach of gathering data gathering process through interviews and survey contributed a lot in getting diversified findings/results with different angles and perspectives.

7. Research questions and objectives

After completing interviews and field survey, the research figured out some important relationships between dependent and independent variables. Drivervariables like age, gender, income, marital status, occupation, etc.have strong relationship with the research problem. Therefore, this research was designed to discover the relationship between our chosen variables based on pre-study to research and satisfaction for an existing car.The researchers figured out that there are some independent factors which affect the likeness of imported and local cars e.g. quality and satisfaction. Satisfaction depends on quality of car. Quality is an independent variable measuring the attributes of the car either local car is of good quality or imported one.

The driver variables (as referred above) drive the research in a particular direction. For example, our null hypothesis is a person who is earning handsome amount will go for imported car because he/she can bear risk of buying that car, but average earning person can't take that risk. Our research conclusion will tell us the true picture. The other question will be related to the risk factor which may resist customers to buy imported car. The most probably the answer to this question will be the lack of after sale service for imported cars. So it means there is a relationship between after sale service and satisfaction; therefore after sale service is another factor which affects the likeness of imported and local vehicle. The research measures the effects of independent variables with satisfaction level of car owner.

Conceptual Model



8. Variables

Driver variables and independent variables

These variables were drawn after an exploratory research (based on interviews) and literature reviews (facts and figures, auto policy). Initially the model included complicated and large number of variable which were interrelated but to squeeze or keep the questionnaire short, the researcher made logical relationships between some independent variables and dependent variables and excluded some extraneous relationships.

8.1 Driver variables

8.1.1 Age

Age is the main driver variable which has relationship between dependent and independent variables. It is so because lower the age, there will be lesserincome or pocket money. So low age customers are expected to have less costly cars. On the other hand, higher aged customers who are married and have large family size would prefer car having maximum seating capacity. Nowadays youth is tech driven or attracts towards the technology. They always prefer cars having more technological operations.

8.1.2 Gender

Our society is male dominant society. A family will have a car which was purchased by the decision of male member. On the other hand, females avoid going for maintenance of car on weekly or monthly basis so they will buy the new car which serves them in long term.

8.1.3 Income

It is another driver variable which tellsabout the capacity of person to buy new or used car. He will buy risky imported car or locally assembled new or used car. Income of person also tells us that how much person is conscious about the fuel consumption,maintenance cost, cost of spare parts of a car etc.

8.1.4 Family type

If there will be joint family system than they will have more than 1 vehicle or 7 seated vehicle. Now they will do market research which 7 seatedvehicle is more comfortable and durable - imported or local. If there will be nuclear family system, then they might go for two door hatchback or sports car depends on their decision. They may also go for less engine power vehicle.

8.1.5 Marital status, number of family members

Like family type, the choice and preferences to buy a car differ with marital status and number of family members.

8.1.6 Occupation

It is another basic driver variable. Income case applies here e.g. if person have its own business he may afford luxury cars. So he might have unique opinion for that specific high model either for imported or local. If a person is employed in small organization he will prefer a car which is more economical and have good fuel consumption.

8.2 Independent variables

8.2.1 Quality

It is the main independent variable. Quality mainly depends on finishing of car, instruments used in and attributes or characteristics of that car. Quality also depends on comfort-ability(Auto, power seats, retractable power mirrors & windows, push start, external locking).So it has direct relationship with satisfaction level of a car. So this research will tell us which car is of best in quality - imported or local.

8.2.2 Performance

Performance is another independent variable. The research revealed that people are inclined to compare the cars' performance on different basis. They compare the cars on the basis ofthe network where they drive. For example, our null hypothesis is: people prefer sedan cars with good performanceon highways as compared with the city drive. People compare which car performs better having same engine power. Either 1000 cc imported car performs better or 1000cc Local car. So performance depends on durability, engine performance and type of drive of a car.

8.2.3 Safety features

Now in 21st century, world is forcing auto company to bring as much safety features as they can. So to measure safety features in a car ABS (Antilock Braking System) new enhanced breaking technology which stops the car very quickly with minimum jerk. Airbags have become a basic safety feature which comes out from steering during accidents keeps driver and other passengers safe from fatal injuries. Cruise control is control of maximum speed. The driver sets the maximum speed of car during drive so that car does not cross that level and very indeed security system. It keeps the car safe from thieves.In short, more the safety features more the satisfaction level of owner for that particular car.

8.2.4 Innovation

Innovation is all what customers eagerly wait for in any product. So same is the case with auto industry. This is human nature that he/she attracts towards new and innovative things. Auto transmission, Hybrid technology, Power steering, Push start, Remote based or Keyless entry, Eco Idle feature and climate control are some features which tell us how much vehicle is innovative according to 21st century which brings satisfaction for the owning vehicle in the mind of owner.

8.2.5 Resale factor

Resale is another factor which has direct connection with likeness of imported or local vehicle or it affects the decision of purchase of imported and local car. Some people are very conscious about resale value of car and some prefer brand and some go for the features of the car. So this is also a result driven approach.

8.2.6 After sales services

Availability of mechanics, spare parts and price of spare partsdetermine quality of after sale services being provided by the company. Furthermore, after sale services of local vehicles are easily available or not and what sort of after sale services of imported cars aremore important for owners of these vehicles.

8.2.7 Fuel consumption

This will tell us whether our respondent is satisfied with the fuel consumption of imported car or local car, or which car gives better millage than other. As revealed by our exploratory research nowadays this is a major concern of customers while buying any car.

8.2.8 Price

Last but not least, price is a unique factor which is dependent as well as independent. It is independent because satisfaction of owner depends on price which is independent variable. On the other hand, price depends on all other features respondent will consider but in less price. So price to features ratio determines which car gives a lot of features in minimum price than other. The researchers have made a 3 price brackets in thequestionnaire which will determine that what people prefer in that specific price range. So it will give us interesting figures.

9. Method of the study

Mixed method of research design was adopted because the purpose of this study was to examine the factors that were Influencing the likeness of imported and local cars. Though many inquiry forms could have beenused, but this mixed design was the most appropriate for the completion of the task. It was easy and comfortable with respect to time saving and for analysis of the received data.

9.1 Target Population/Respondents

The participants were the university students and employees who owned a car either imported or local. Other than university, questionnaires were filled by several government and public sector employees, businessmen, lawyers, car dealers, bankers etc. In addition through online questionnaire we got random respondents from all over the Pakistan belonging do different fields. Close-ended questions were asked to get quantitative data.

9.2 Sampling Frame

The sampling frame or working population for this study wasthe car owners from all over the Pakistan. We targeted University students and employees on first priority basis. Then we got questionnaires filled by friends and family. Due to lack of time it was not possible to approach respondents from all over the Pakistan in this short time, so through online questionnaire we got respondents from all over the Pakistan. Questionnaires were also filled by different car dealers based in Islamabad after undertaking their interviews.

9.3 Sample Size

We planned to get 100+ questionnaires filled by random respondents including students, employed and unemployed car owners, government servants and businessmen from different urban and rural areas of Pakistan. It was anticipated that by simply following the random sampling procedures, we will achieve our desired results without any effort given to purposely selecting men or women, employed or unemployed to balance the study.

9.4 Sample Unit

Sampling units were the car owners selected using the random sampling method outlined below in sampling methods and sampling procedures.This survey is the combination of nominal, ordinal, category and constant some scale. This survey was administered by using random sampling method throughout Pakistan.

9.5 Sampling Method

Simple random sampling (also referred to as random sampling) was used to collect data from different car owners. Each member of population irrespective of age, gender, occupation, employment status, income etc. has equal chance to be chosen as part of the sample. The logic behind simple random sampling is that itremoves any biasness. We randomly distributed questionnaires among students, university employees, businessmen, lawyers, bankers and many other respondents from different fields and occupations. We personally visited some car showrooms in Islamabad and got the responses of Imported and Local car dealers through questionnaires. We made sure that the respondent completely understands the questions by explaining the questionnaire to respondents who were confused about some questions.

During our visit to car showrooms in Islamabad we had an extensive discussion with dealers of imported and local cars about the current purchasing trend of imported and local cars and the factors that are influencing the customers purchase decision to

buy an imported or a local car.We also created an online questionnaire to target those car owners to whom we were unable to distribute questionnaires because they were from other cities of Pakistan. We searched famous blogs, forums and social media groups related to auto industry and shared the link of our online questionnaire in those groups. We got a huge response through online questionnaire.

Online Questionnaire Link: https://www.goo.gl/ZQKxBY

9.6 Sampling Procedure

a) We distributed questionnaires randomly among the university students and employees.
b) Each member personally visited some of his family and friends who owned a car and got the questionnaire filled by them.
c) The respondents were properly guidedabout questionnaire so they were more comfortable while filling the questionnaire.
d) The link of online questionnaire was shared in renowned blogs, forums and social media groups related to auto industry.
e) The link of online questionnaire was also shared with family members and friends, who were far away, through WhatsApp and Facebook.
f) Group members managed to visit some renowned showrooms and administered extensive interviews and gathered detailed information.

10. Questionnaire

To introduce our questionnaire to the respondents we created a short cover letter and attached it to the front of each questionnaire. This short cover letter helped in giving the study an increased level of credibility which in return helped in achieving high response rate.

11. Research Design

This research was a field study and the research design was descriptive in nature. The study was undertaken in order to understand the factors that were influencing the likeness of imported and local cars in general public. The researchers utilized questionnaire as a primary data collection mode. It was realized that field study is appropriate for this research topic because researchers were interested in connecting the large number of car owners in a short span of time. The questionnaire method enabled the researchers to evaluate the large sample of population quickly at low cost.

The researchers also created an online questionnaire and shared it to different social media groups related to auto industry and in different forums of online websites to get maximumresponses from the public. We got random respondents from all over Pakistan through the online questionnaire. The link of online questionnaire was shared with all family members and friends on WhatsApp and Facebook to get maximum responses.

Other than questionnaire method, we conductedin-depth interviews from some renowned imported and local cars dealers in Islamabad for secondary data collection. Through these interviews we gathered a lot of information about customers' preferences and priorities about the car and the factors that were influencing their choice, either to buy local or imported cars.

We used quantitative research method instead of qualitative method because respondents were not willing to spend more time to fill up the questionnaire. We selected this method so that the respondent can easily respond us.

12. Budget, Schedule and Resources

This research had a modest budget of Rs.5000 that covered the cost of photocopies to produce the questionnaires, stationary expensesand fare for visiting different dealer showrooms in Islamabad. It took two weeks to get all the questionnaires filled. For in-depth interviews the researchers were already prepared about the queries to be asked from the dealers. They visited three renowned showrooms in Islamabad and met the car dealers and asked several questions related to the customer's buying behavior and priorities to buy a car and the factors that were influencing their choice, either to buy a local or imported car.

13. Results

We strived to meet at least 95% significance for all our tests. All of our analysis achieved the 95% significance level. Although we realized that everything with high significance level is not always relevant. Unless otherwise noted we stated only significant and relevant results.**The table below summarizes general descriptive statistics of sample population.**

Descriptive Statistics:The table summarizes general descriptive statistics of sample population.

Sample Mean Age	26.88						
Gender	Male		Female				
	92.4%		5.1%				
Marital Status	Single	Married	Divorced	Widow			
	69.6%	27.8%	--	--			
Family System	Nuclear		Joint				
	55.7%		41.8%				
No. of Family Members	Sample Mean						
	5.55%						
Education	Uneducated	Primary	Middle	Matric	Intermediate	Graduate	Post Graduate
	---	1.3%	---	5.1%	5.1%	**51.9%**	**34.2%**
Employment Status	Employed		Self-Employed		Unemployed		
	38%		25.3%		**34.2%**		
Occupation	Student	Government Job	Private Job	Businessmen	Banking/Finance	Teaching	Lawyer	None
	29.1%	**17.7%**	15.2 %	19.0%	6.3%	1.3%	1.3%	7.6%
Income	0-30K	30-70K	70-100K	100-125K	125-150K	150-175K	175-200K	200K or above
	36.7%	**22.8%**	11.4%	2.5%	6.3%	5.1%	1.3%	5.1%
Residential Location	Rural		Urban				
	58.2%		39.2%				

14. Inferential Statistics

Anova

➢ **Age to car you own**

Method Used One-Way ANOVA; Sig = .072, [Appendix A].The result shows that the respondents from 20-26 years of age preferred to have an imported used car. On the other hand, Appendix A is showing that the respondents from 30 or above age either have a locally assembled new or used car.

➢ **Marital Status to Features Given in less price**

Method Used One-Way ANOVA; Sig = 0.066 [Appendix B]. There is a significant relationship between marital status and buying behavior towards local or imported car. Graph in Appendix B is

showing that married persons were more inclined towards imported because of more features in less price compared to local cars but single persons were inclined towards local cars and they were less in favor of the statement that imported cars give more features with price.

➢ **Family system**

Method Used One-Way ANOVA Sign=.033, [Appendix C]. The perception that buying a car is investment varies from joint to nuclear family system. According to Appendix C Joint families think buying a car is an investment but Nuclear have a mindset that buying a car is not investment. There can be reasons that Joint family members have responsibilities to feed whole family; whereas, nuclears have small family size so they don't think buying a car is an investment. This is also the reason that there is the significance relationship between family system and effects of resale value on purchase decision.

➢ **Education to quality of imported car**

Method Used One-Way ANOVA. Sign=.062, [Appendix D]. There is a significant relationship between education and quality of imported car. As per Appendix D there is a mix and interesting trend. The people who are less educated think that quality of local car is satisfactory; same is the opinion of highly educated people. On the other-hand the respondents whose education is in progress or who have achieved some medium level of education were found of the opinion that quality of imported cars is highly satisfactory.

➢ **Education to consciousness for safety features**

Method Used One-Way ANOVA. Sign=.024, [Appendix E]. There is a very interesting relationship between education and consciousness for safety features. Appendix E is telling us that if a person is uneducated or just primary pass that person is less conscious about safety features in a car and vice versa. This may be because of less education and traditional thinking that he doesn't think about new safety features in car.

➢ **Employment Status to Consciousness about Resale value**

Method Used One-Way ANOVA. Sign: 0.082, [Appendix F]. There is a little but note-able significant relationship between above given variables. Salaried and Unemployed persons are more conscious about resale value of car because they have limited or low income as compared with those who are running their own businesses or self-employed. graph is given in Appendix F.

➢ **Occupation to Buying a car is Investment**

Method Used One-Way ANOVA. Sign: 0.098, [Appendix G]. There is a significant relationship between occupation and thinking of people either buying a car is investment or not. There is mix trend but it is clear that no one strongly agreed that buying a car is an investment except teachers. Graph is attached in Appendix G which is telling us that a person is earning higher slabs of income doesn't care much about resale value of car.

➢ **Monthly Income to Effect of Resale value on purchase decision**

Method Used One-Way ANOVA; Sig = 0.010, [Appendix H]. It means there is a significant relationship between what people earn and effect of resale value on purchase decision. According to appendix 20 the persons who have lower income, there purchase decision mainly depends on resale value of car and those who have higher income level, there purchase decisions are not affected by resale value of car. It means Lower income people also think that buying a car is an investment and they will not purchase out of market car either it is imported or local.

➢ **Monthly Income to car purchase in 2 Million**

Method used ANOVA. Sign: 0.014, [Appendix I]. It means there is a significant and important relationship between these two above given variables. According to Appendix 2 the person whose income is low thinks that if he/she has two million he/she would go for new imported car but on the other-hand the people who are earning handsome amount they prefer new local assembled car. It has already explained that local industry is launching new and innovative models but in sedans with higher price bracket so people don't go for imported car if they have 2 million. It is so because that they don't face any issue in after sale service for local cars.

➢ **Residential Location to Quality of Local car**

Method Used One-Way ANOVA. Sig: 0.007, [Appendix I]. According to appendix I there is a significant relationship between residential location and quality of local car. Urban say quality of local cars is just satisfactory but rural based customers think that quality of local cars is dissatisfactory. It means marketing team of local industries should consider the views of rural customers.

15. Frequencies

➢ **Car you own**

According to **Appendix 1,**people have 35% locally assembled new cars, 31% have imported used cars and 29% have locally assembled used car. It

means the market is still dominant of local assembled used and new cars. The results also show us that people don't import new cars because their cost is high.

- **Car Company and Model**

According to **Appendix 2,** the results are revealing that 34.21% of people have Suzuki local assembled car while 19.7% have Toyota imported cars and 16% have Honda local assembled cars and 15% have Toyota local cars it means Suzuki in Pakistan is dominating its competitors.

- **Quality of Imported Cars**

According to **Appendix 3,** the results reveal that 51% of our respondents are highly satisfied with quality of imported cars and 38% are satisfied with quality of imported cars. It means people perceive that quality of imported cars is better compared to local ones. s

- **Quality of Local Cars**

According to **Appendix 4,** the results are showing that 53.25% of respondents are satisfied with the quality of local cars and 28% were not clear (Neutral) about the quality of local cars. It means most of the people are just satisfied with the quality of local cars. On the other hand, 51% of people are highly satisfied with the quality of imported cars.

- **Comfortable and durable Cars**

According to **Appendix 5,**60% of people were found of the opinion that imported cars were more durable and comfortable, while 29% said that both imported and local cars were comfortable and durable and 11% said local cars were more comfortable and durable.

- **Consciousness of safety features and their priority Levels**

According to **Appendix 6,** the results reflect that 66% of people are highly conscious and 21% are conscious up to some extent about safety features in a car. 74 and 71% think that ABS and airbag respectively are their first priority in safety features. Furthermore 64% say cruise control is their 2nd and 3rd priority. In the case of cars security system, 58% of respondents see this safety feature as first priority, so it concludes that ABS, Airbag and Safety System are the major safety features which affect the people's behavior of buying a car.

- **Car equipped with more safety features**

According to **Appendix 7,**82% of people said that imported cars are equipped with more safety features. As in appendix 6, it has been informed that majority of the people are highly conscious about safety features and this result is revealing that imported cars have more safety features, so it is obvious fact that people prefer imported cars over local cars in case of safety features.

- **Buying a Car as an investment and consciousness about resale value of car**

According to **Appendix 8,** the results are showing that 50% of people agree that buying a car is an investment, 29% were neutral about this. However, 53% of people are less conscious about the resale value of car but 33% are highly conscious about resale value of car. So to find interesting results we will briefly explain the relationship between these two questions in ANOVA technique. Appendix 9 is also giving hint that majority of the people are less conscious about the resale value of car. It means there is attractiveness for foreign investors to invest in Pakistan in auto industry. Newly established auto company can sell its product to Pakistani just by little efforts because buyer is conscious to some extent about the Resale value of car. It can also be the reason of emerging trend of imported vehicles in Pakistan.

- **Performance in hilly areas, highways and cities**

According to **Appendix 9,** the results are showing that 36.8% of people think local car performs better in hilly areas and 31% says both imported and local cars perform better on hilly areas and 23% says imported cars are better in hilly areas than local cars.With respect to highways drive 46% people prefer imported Vehicles and 38% says both imported and local cars perform equally on highways. With respect to cities people says imported car performs better in cities having 49% over local cars and 33% says both imported and local cars perform equally with in a city

- **Fuel Consumption**

According to **appendix 10,** 57% are highly conscious about fuel consumption of vehicles and it was surprising that 29% remaining respondents are less conscious about fuel consumption of the vehicle.As per as fuel consumption on highways is concerned 58% Respondents said imported cars consumes less fuel on highways and 20% said both are equal. Same is the case in city driving. It can be threat in near future for local industry that local cars are less fuel efficient in both type of driving conditions.Imported cars are double in number than local cars.

- **Price to Features Ratio**

As shown in**appendix 11,** according to 75% of respondents, imported cars are giving more features than local cars which is a big figure and can be threat for local industry.12% said local car gives more features in less price so **appendix 12** is revealing that price is the basic factor which influence buyers towards imported cars.

16. Conclusion

Results of this study allowed us to know exactly about the factors that are influencing the likeness of imported and local cars.

- The result indicates that, although the trend of purchasing imported cars is increasing day by day but still the local car industry is dominant.

- This study clearly indicates that although local cars are dominant because of their resale value and reasonable after sales services but the trend of switching from local to imported cars is increasing day by day because of the innovative features and latest models of imported cars.

- Lack of auto quality policy provides room for lack of implementation of safety and quality standards for vehicles in Pakistan.

- There is an extreme likeness of imported cars because these cars are loaded with various features including ABS brakes, power steering, air bags etc. they are considered a very attractive and cost effective.

- The after sale services of imported cars is non-existent and most of the times cars are left at the mercy of unskilled technicians for service and repairs.

- The availability of spare parts at fixed prices and on the spot is non-existent in most of the cases. The cost of parts being imported from Japan or any other country is very high.

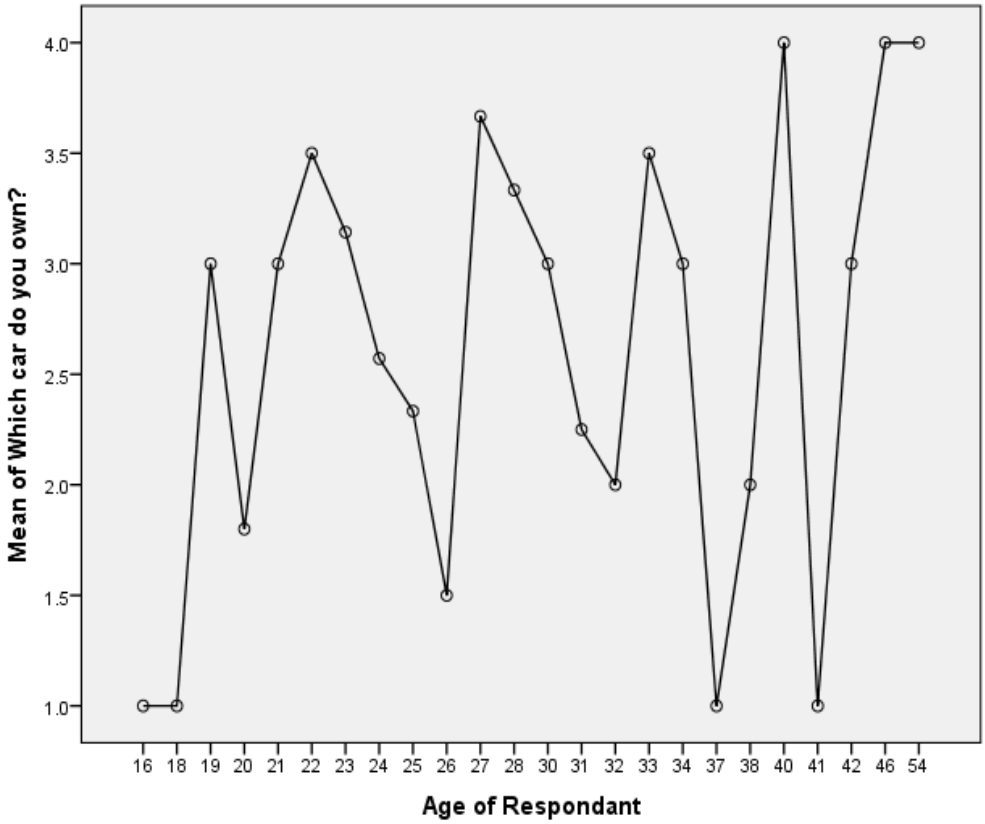
- The research indicates that imported cars can easily compete the local car industry by simply reducing import costs and by providing reasonable after sale services. The resale value of imported cars will automatically increase when after sale services for imported cars will be provided.

- The interested finding is that the respondents acknowledged and preferred the durability, comfortability, and innovative features of imported cars over local cars but still they are purchasing local cars to reduce the cost of after sale services and to have more resale value.

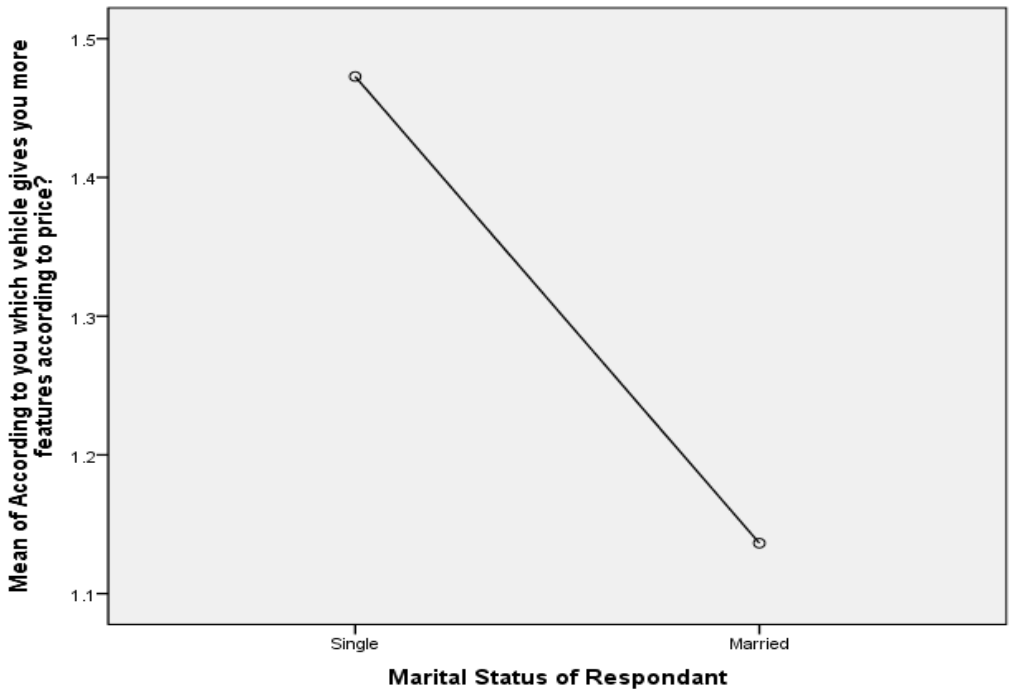
- We found a significant relationship between the car respondent owns and the satisfaction level for his car. The results indicate that owners of Toyota imported cars are highly satisfied with their cars; whereas, owners of Toyota local cars are just satisfied.Owners of Honda imported cars are highly satisfied with the cars even more than the satisfaction level of Toyota imported cars.On the other hand the person who owns the Suzuki local cars were less satisfied with their cars.

Appendices providing above stated facts and figures are given below

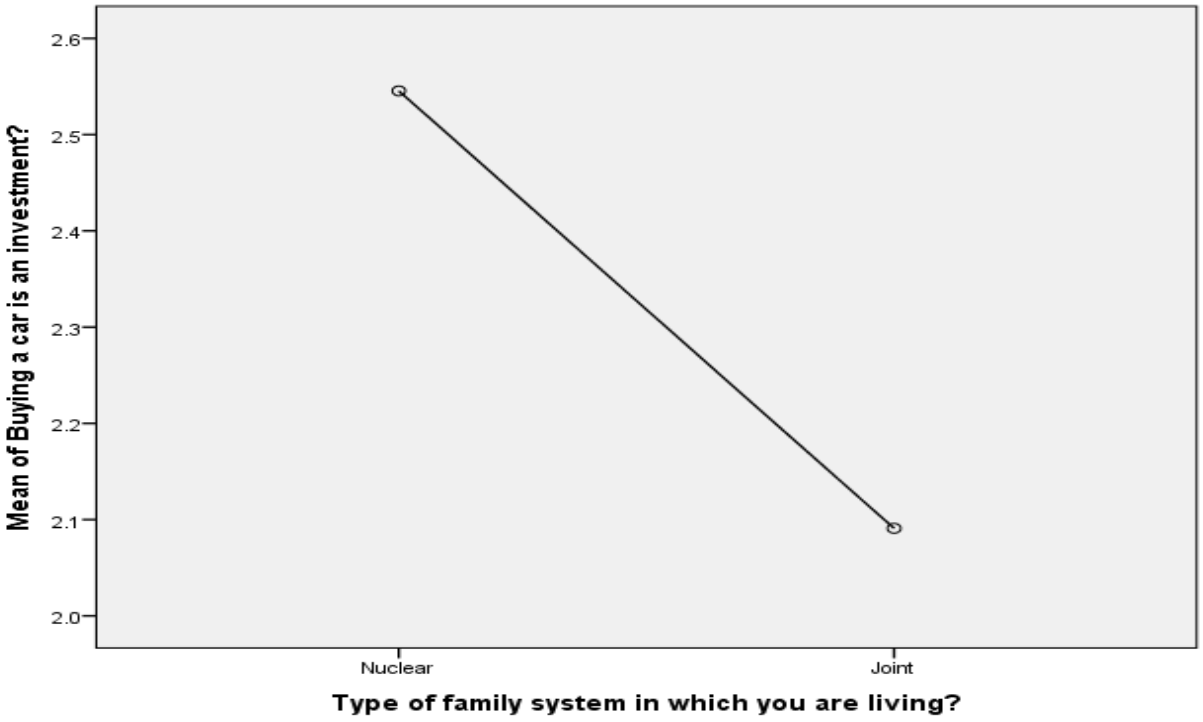
Appendix A



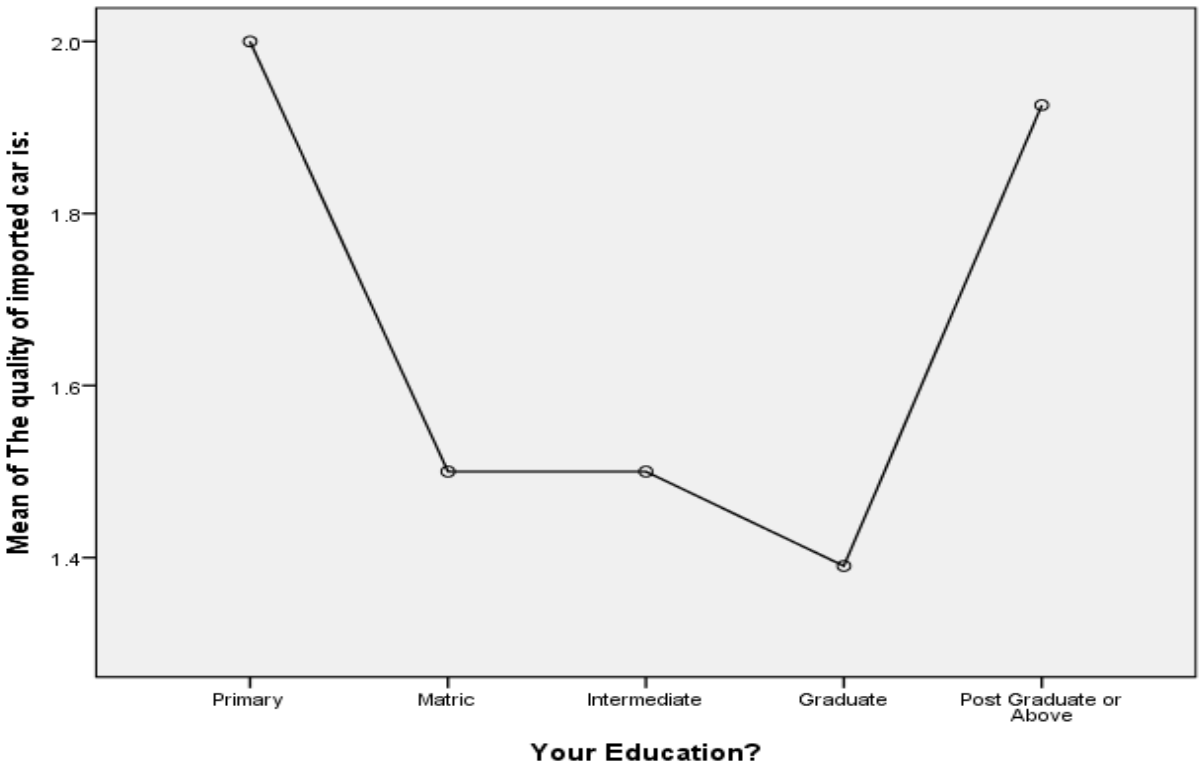
Appendix B



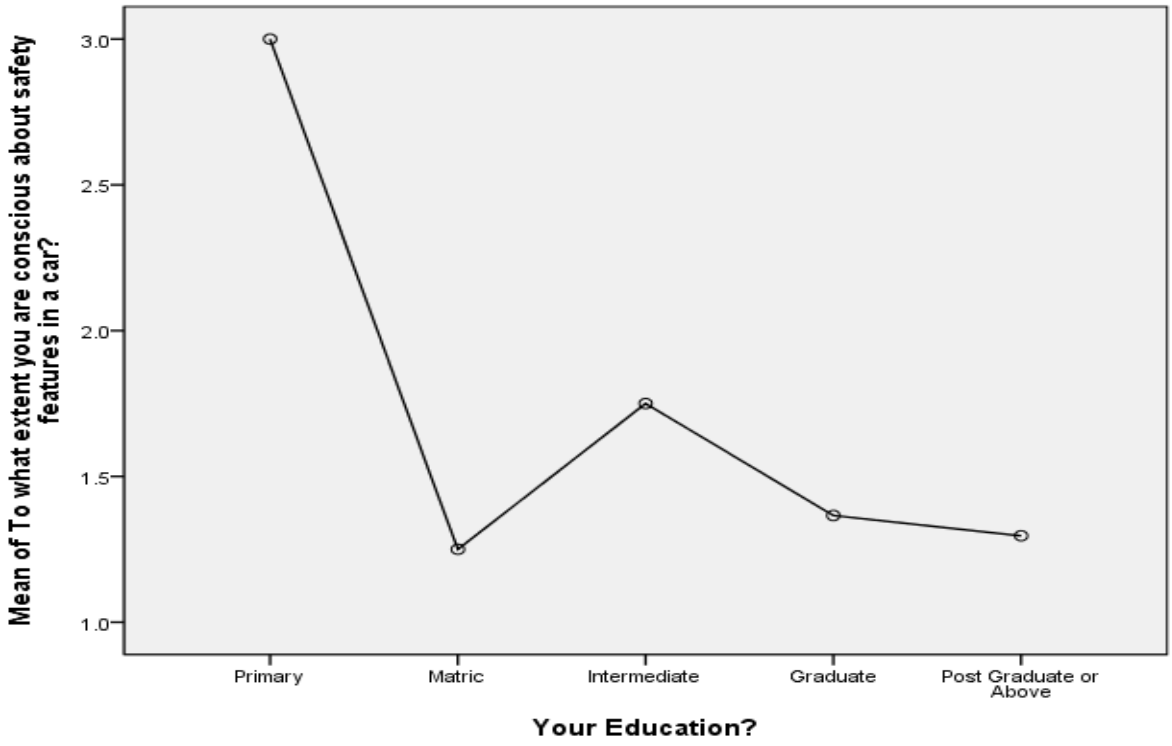
Appendix C



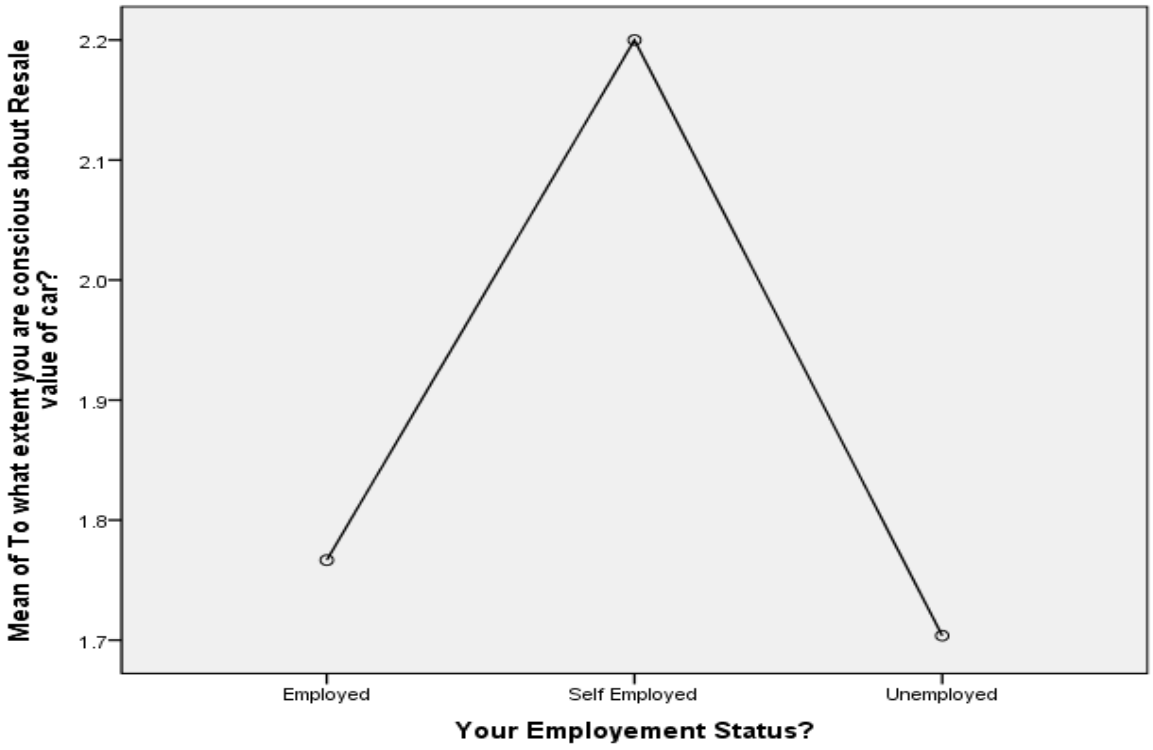
Appendix D



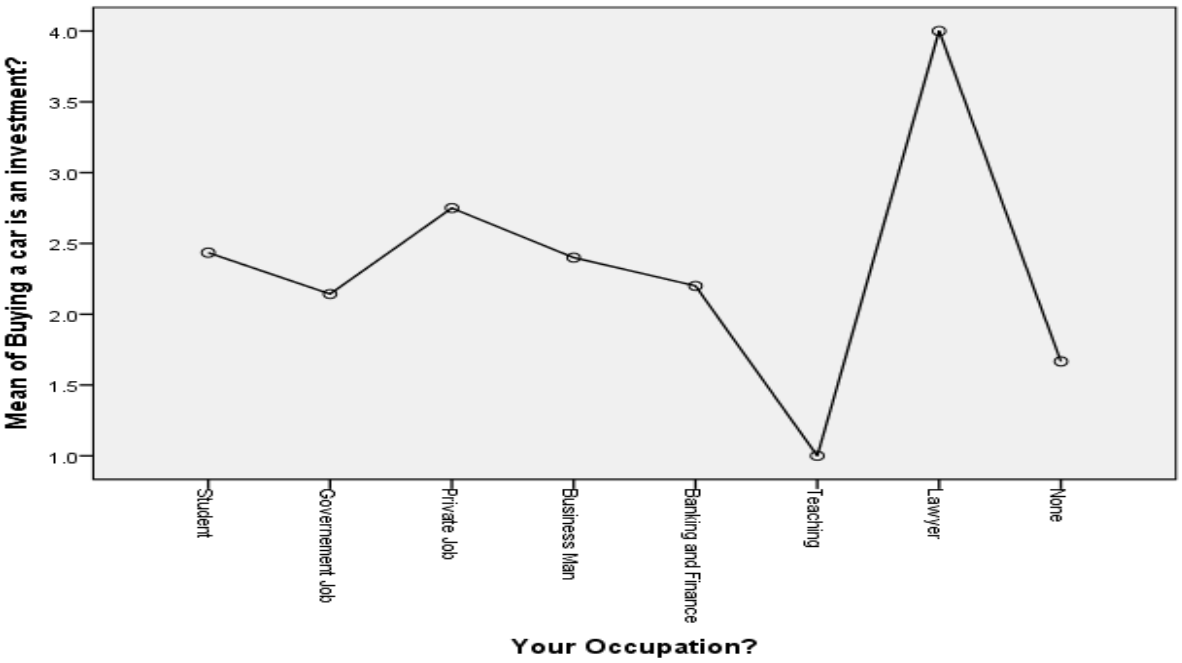
Appendix E



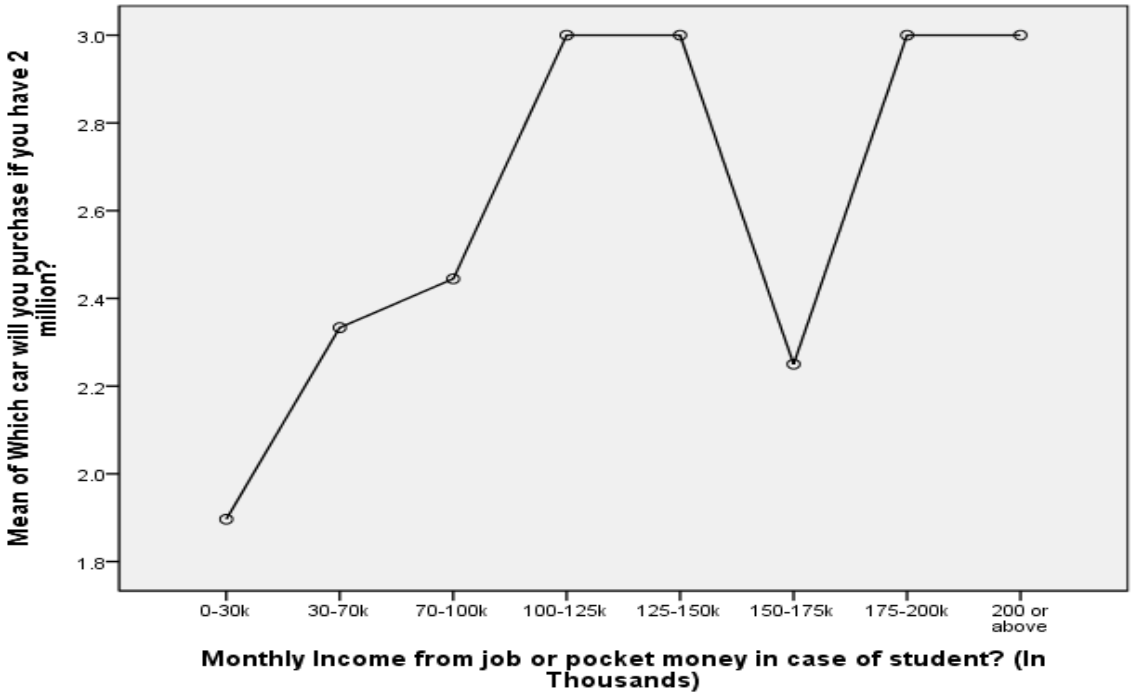
Appendix F



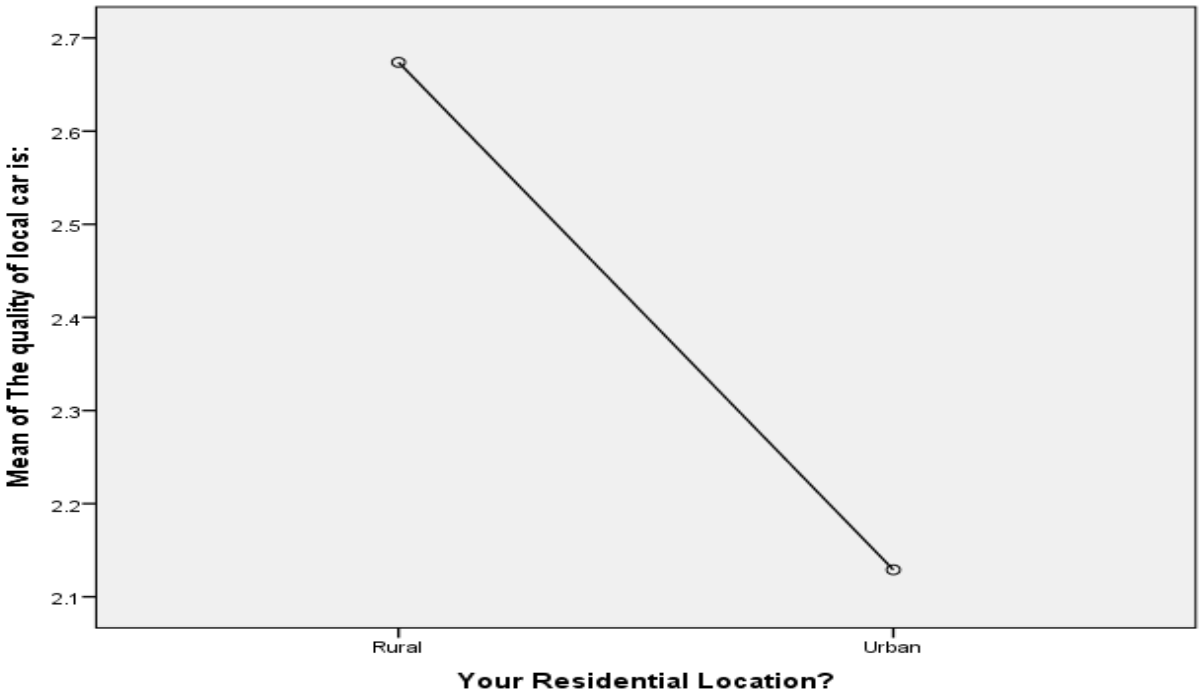
Appendix G



Appendix H

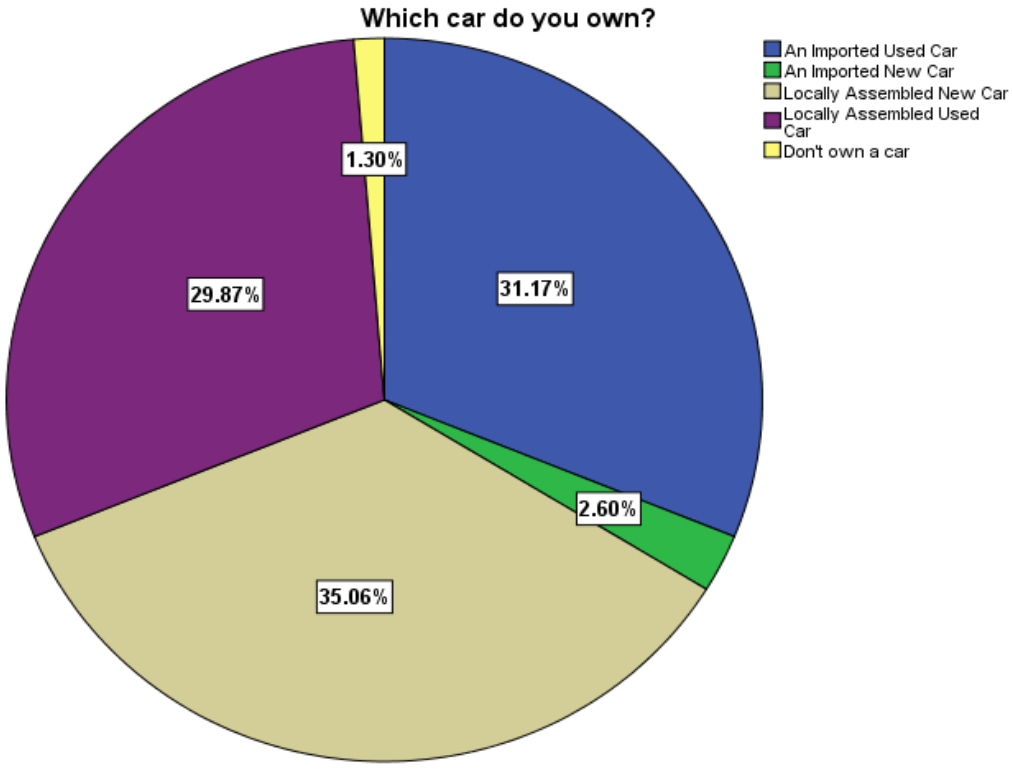


Appendix I

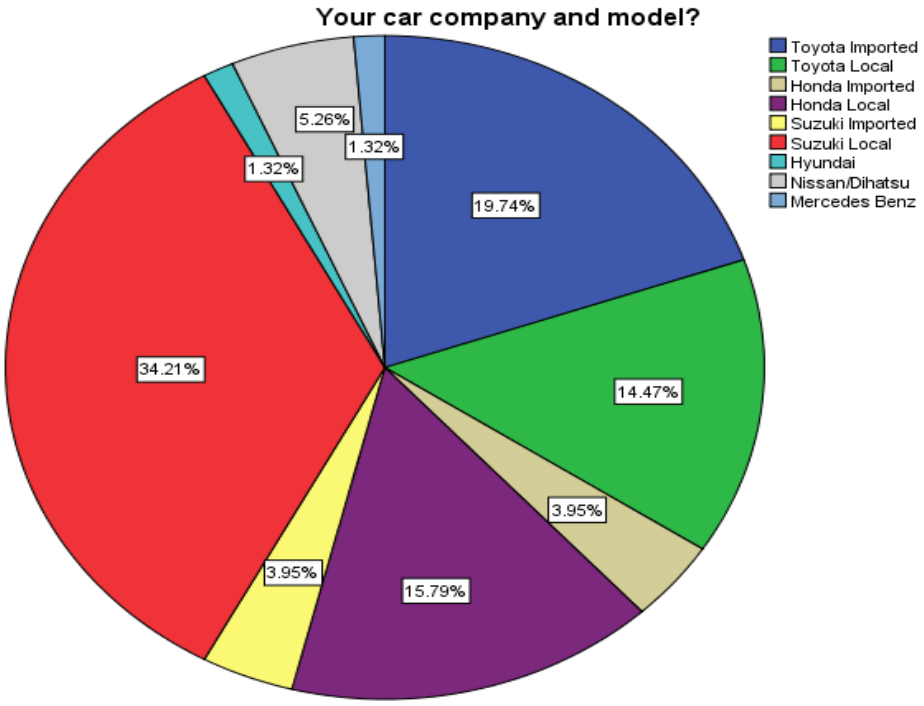


Frequencies

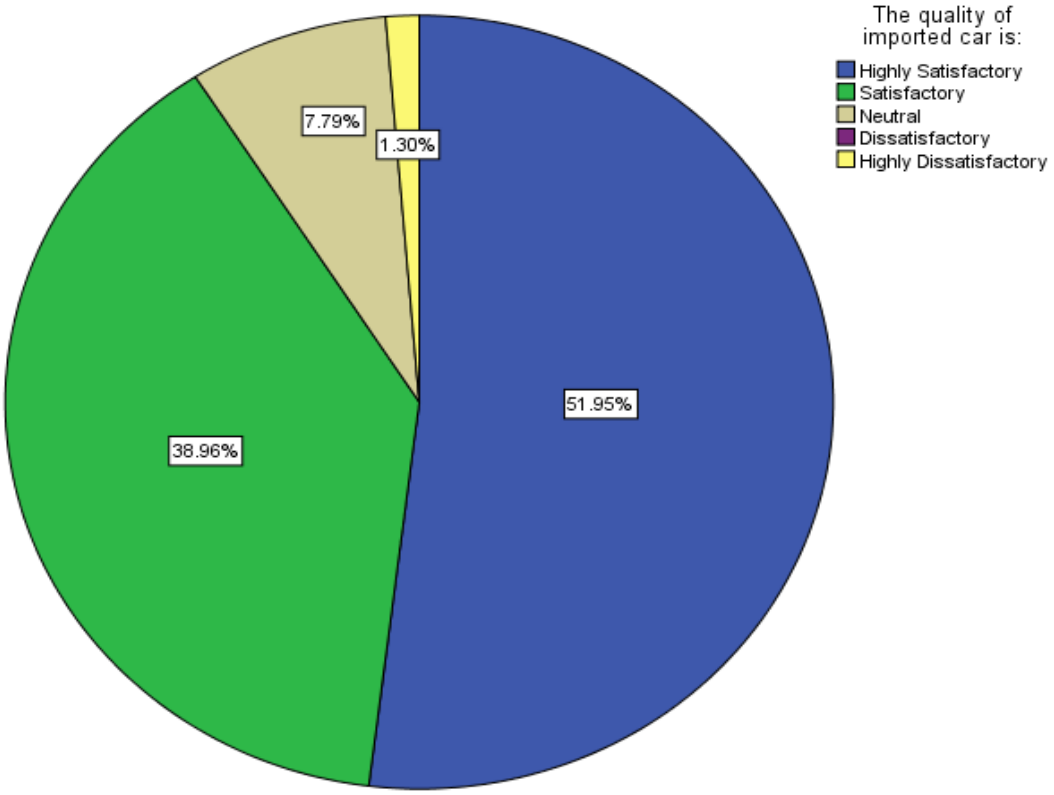
Appendix 1



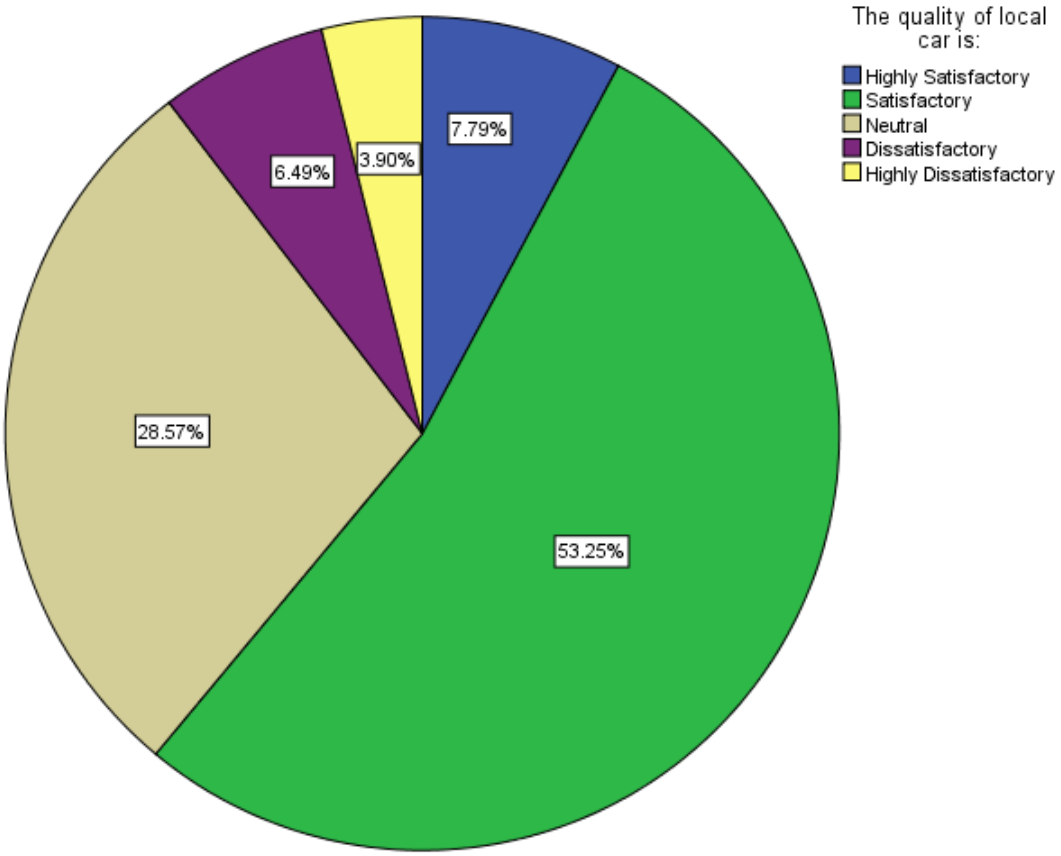
Appendix 2



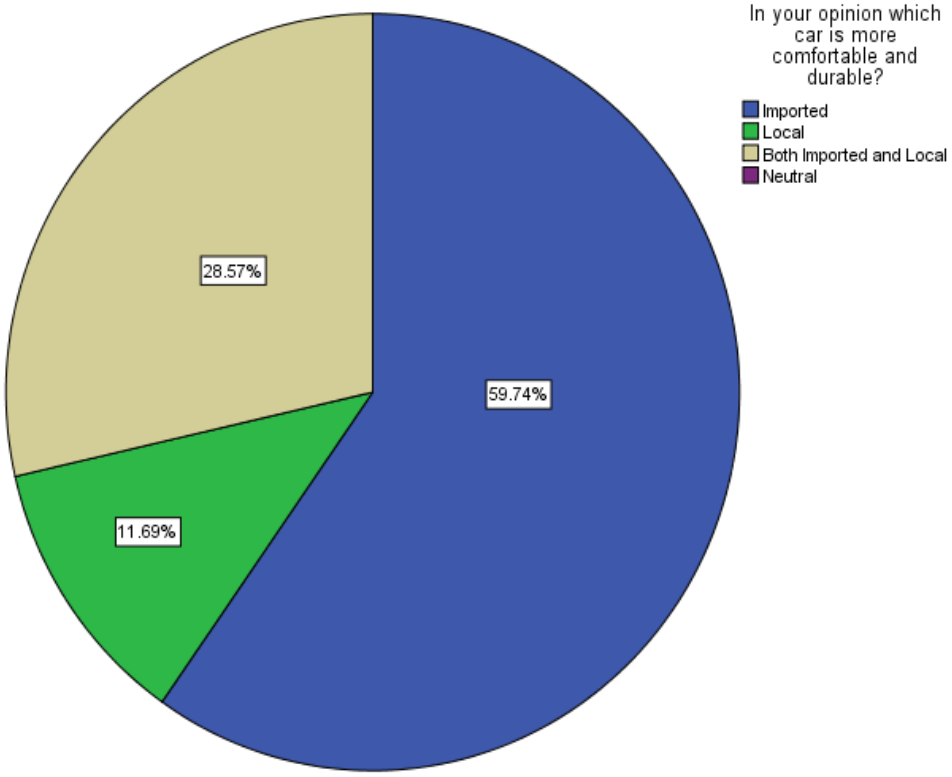
Appendix 3



Appendix 4



Appendix 5



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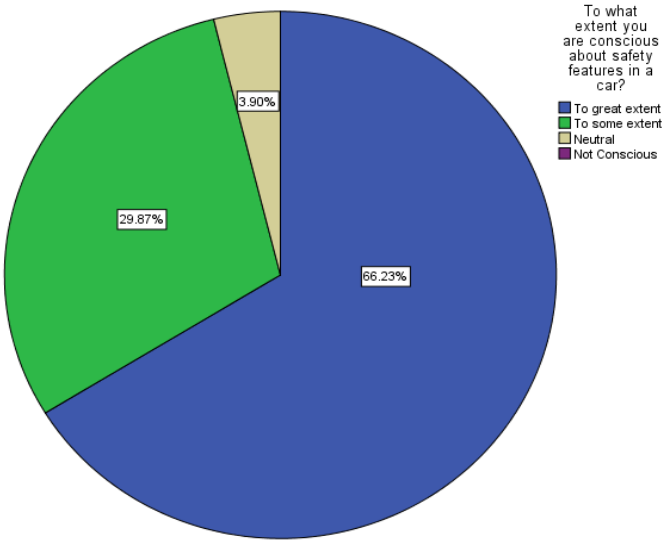
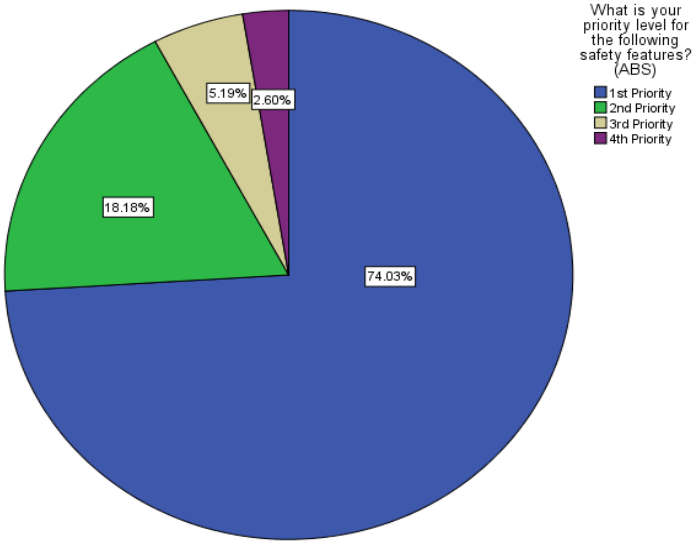
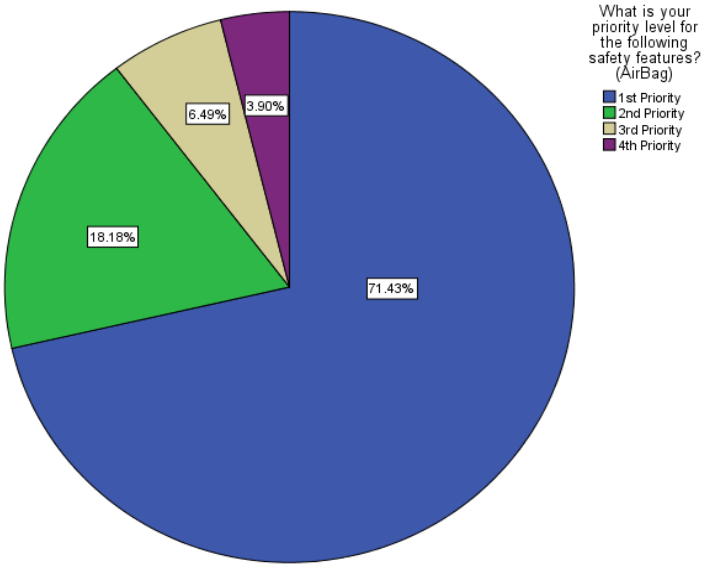
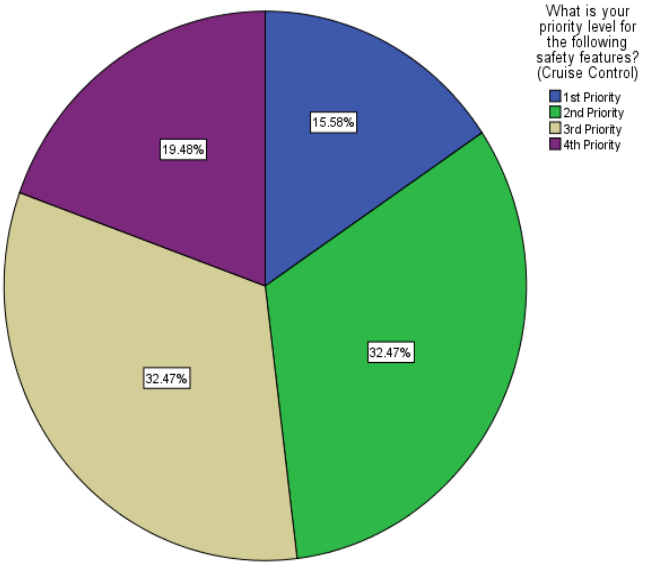
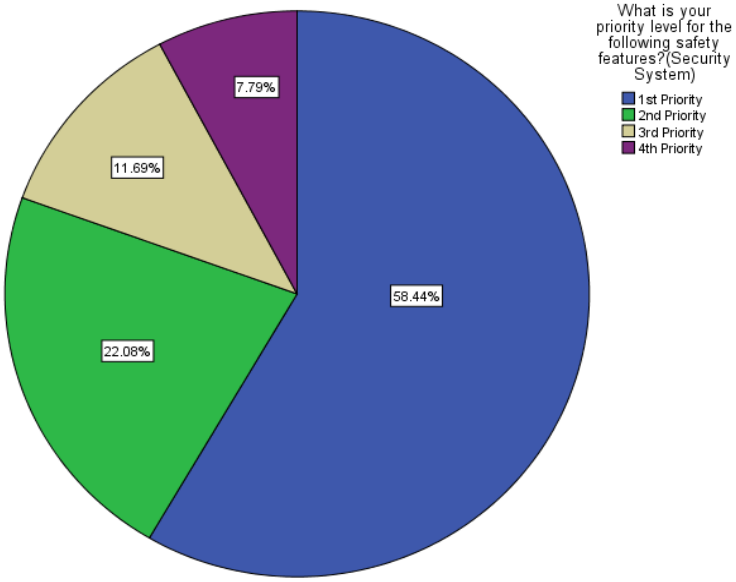

To what extent you are conscious about safety features in a car?
To great extent
To some extent
Neutral
Not Conscious
3.90%
29.87%
66.23%

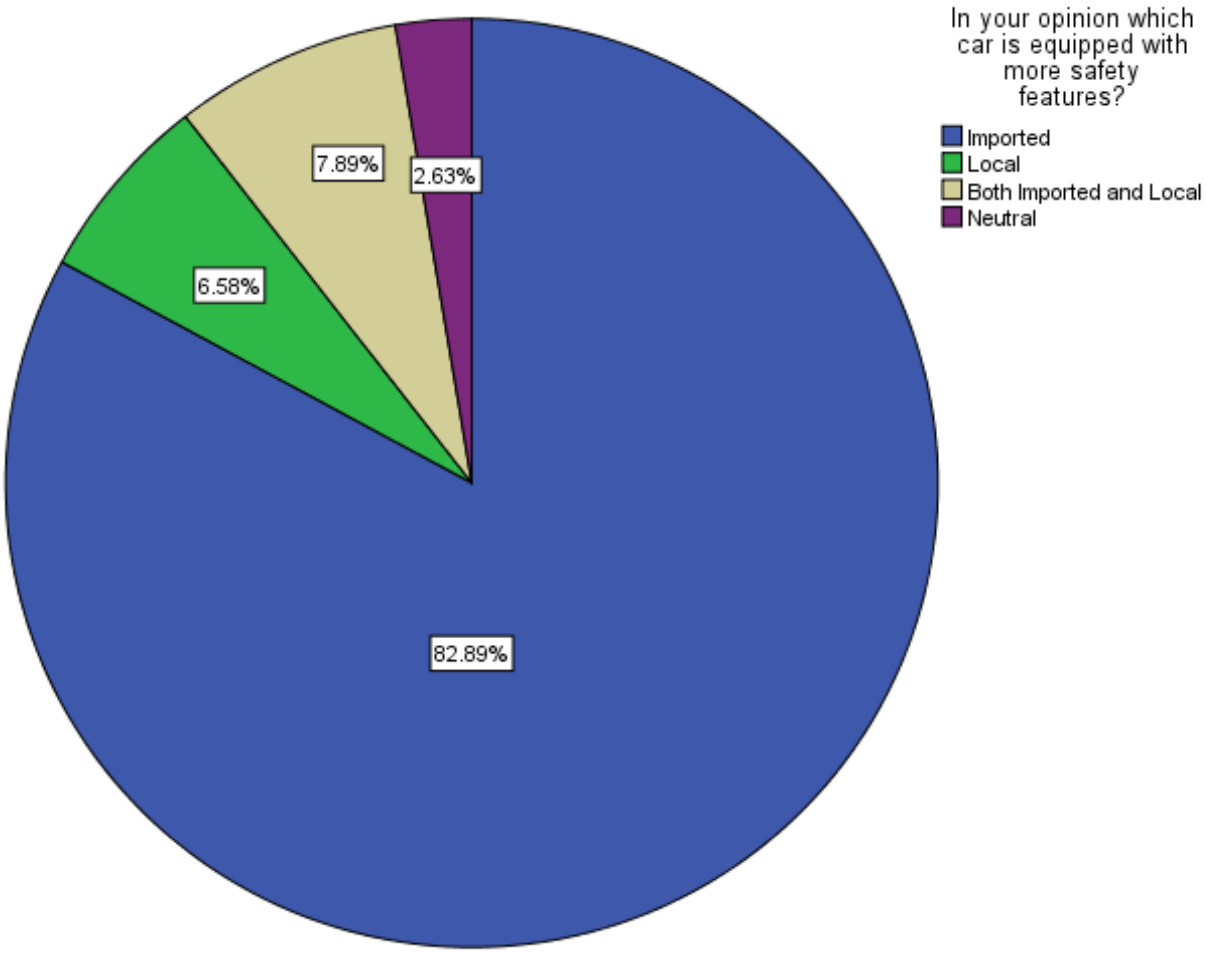

What is your priority level for the following safety features? (ABS)
1st Priority
2nd Priority
3rd Priority
4th Priority
5.19%
2.60%
18.18%
74.03%


What is your priority level for the following safety features? (AirBag)
1st Priority
2nd Priority
3rd Priority
4th Priority
6.49%
3.90%
18.18%
71.43%


What is your priority level for the following safety features? (Cruise Control)
1st Priority
2nd Priority
3rd Priority
4th Priority
15.58%
32.47%
32.47%
19.48%


What is your priority level for the following safety features?(Security System)
1st Priority
2nd Priority
3rd Priority
4th Priority
58.44%
22.08%
11.69%
7.79%

Appendix 7



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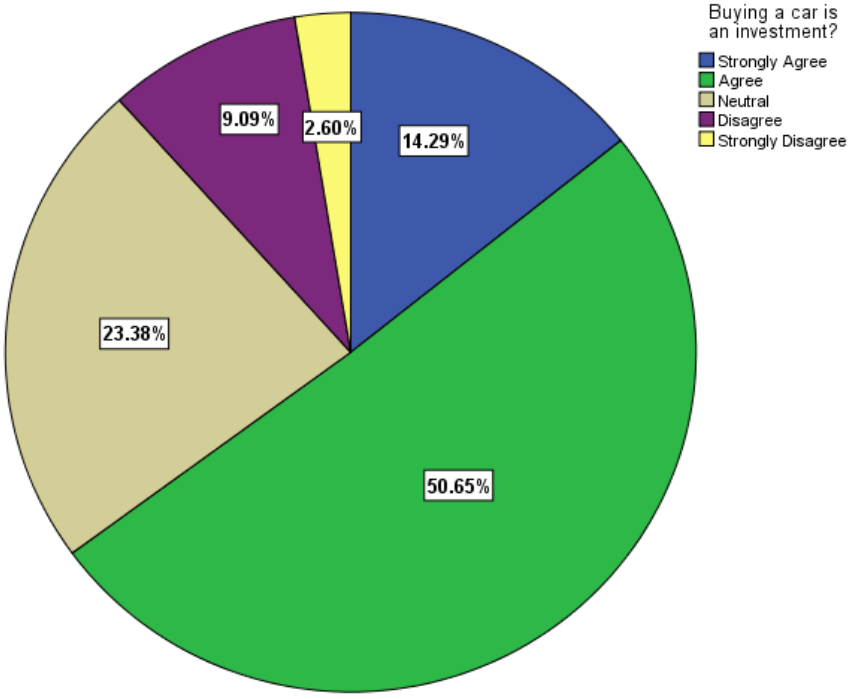
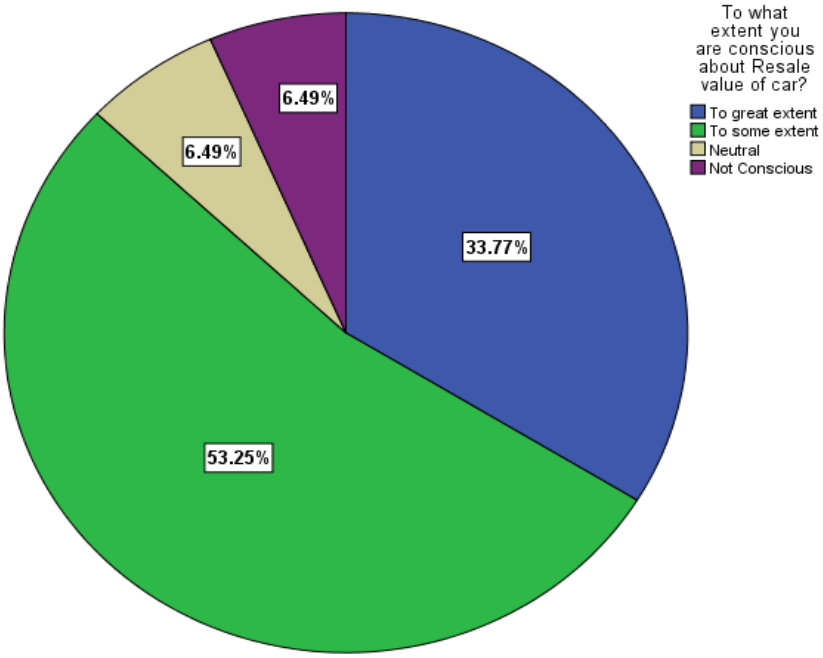
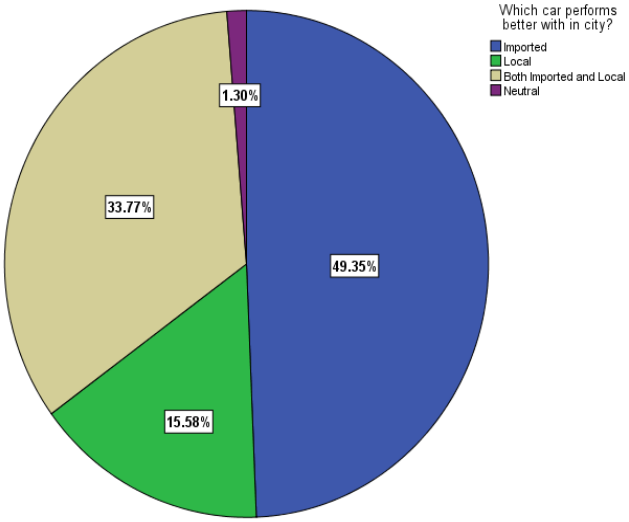
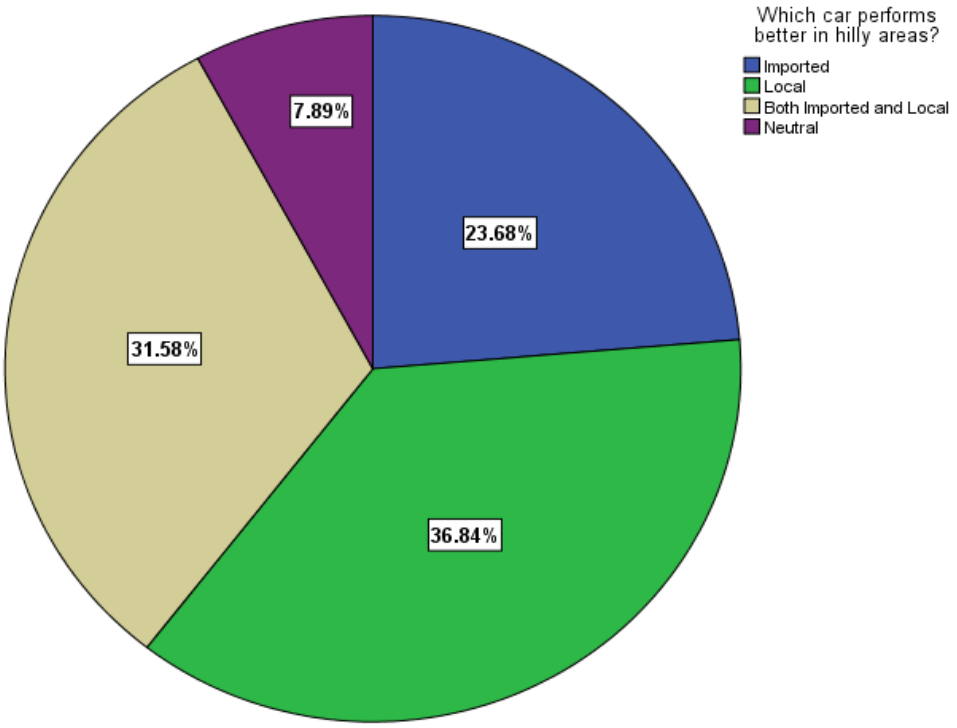
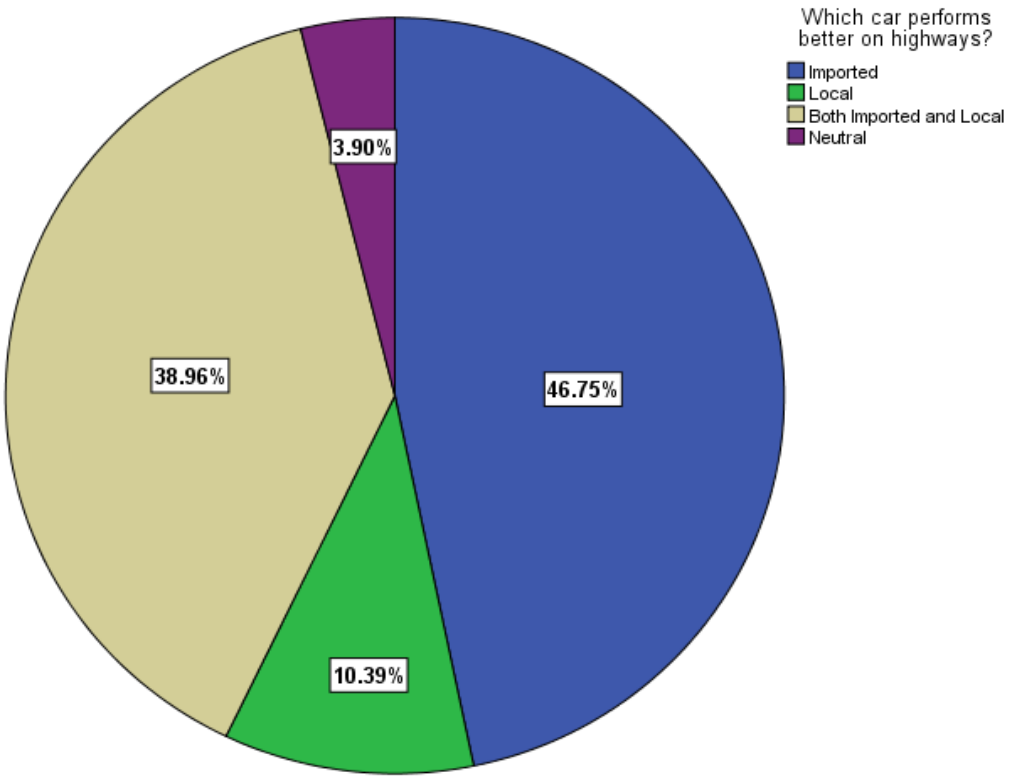



To what extent you are conscious about Resale value of car?
To great extent
To some extent
Neutral
Not Conscious
6.49%
6.49%
33.77%
53.25%

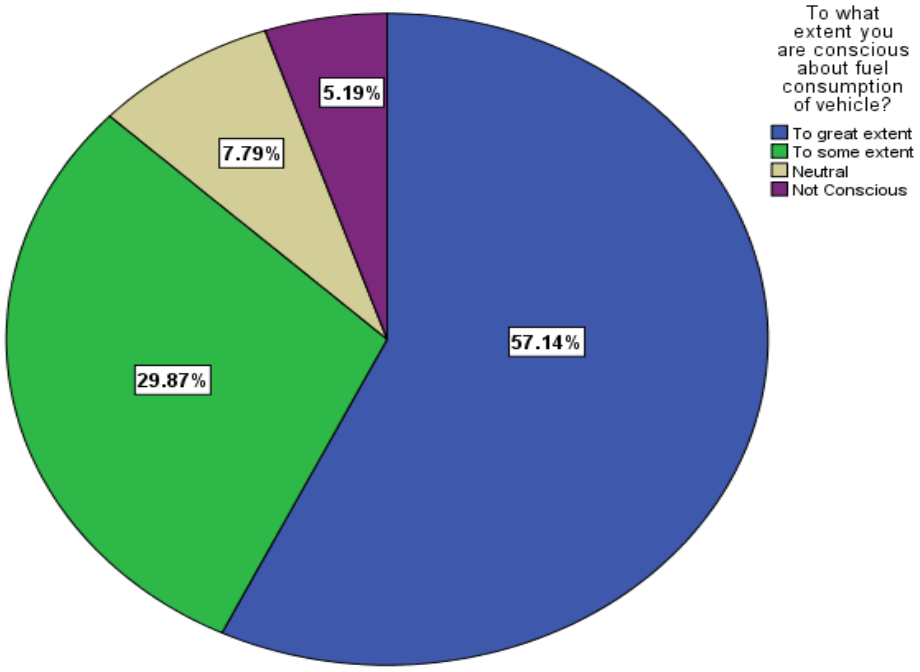

Which car performs better with in city?
Imported
Local
Both Imported and Local
Neutral
1.30%
33.77%
49.35%
15.58%

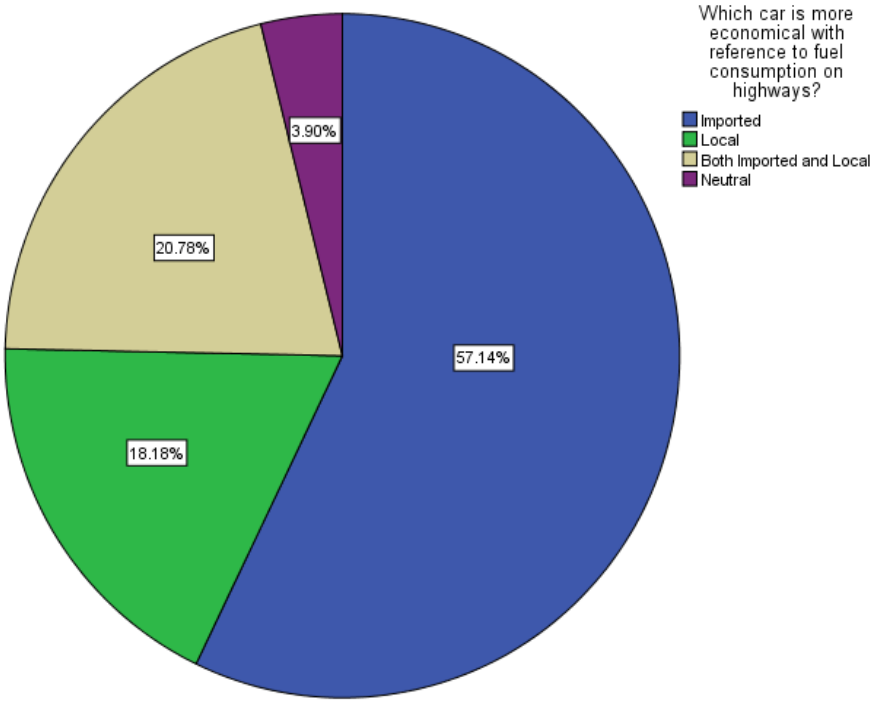
Appendix 9

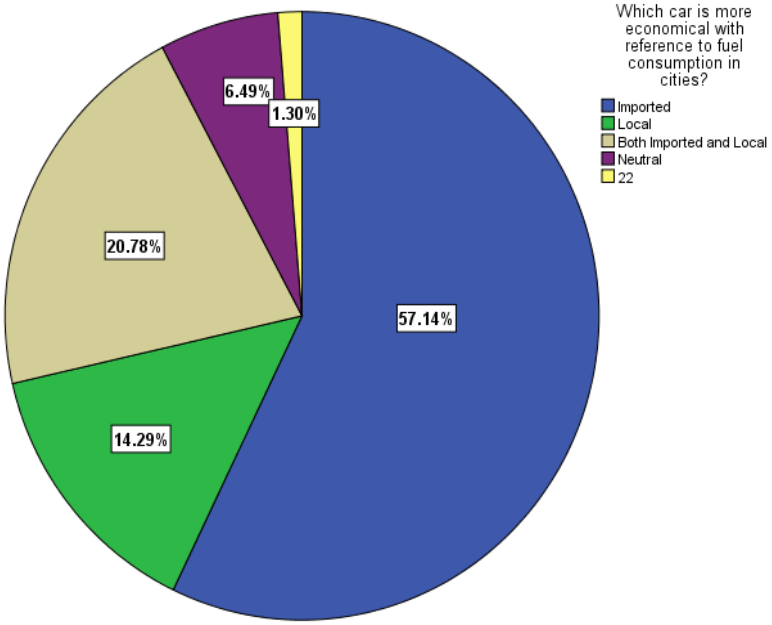

Which car performs better in hilly areas?
Imported
Local
Both Imported and Local
Neutral
7.89%
23.68%
31.58%
36.84%


Which car performs better on highways?
Imported
Local
Both Imported and Local
Neutral
3.90%
38.96%
46.75%
10.39%

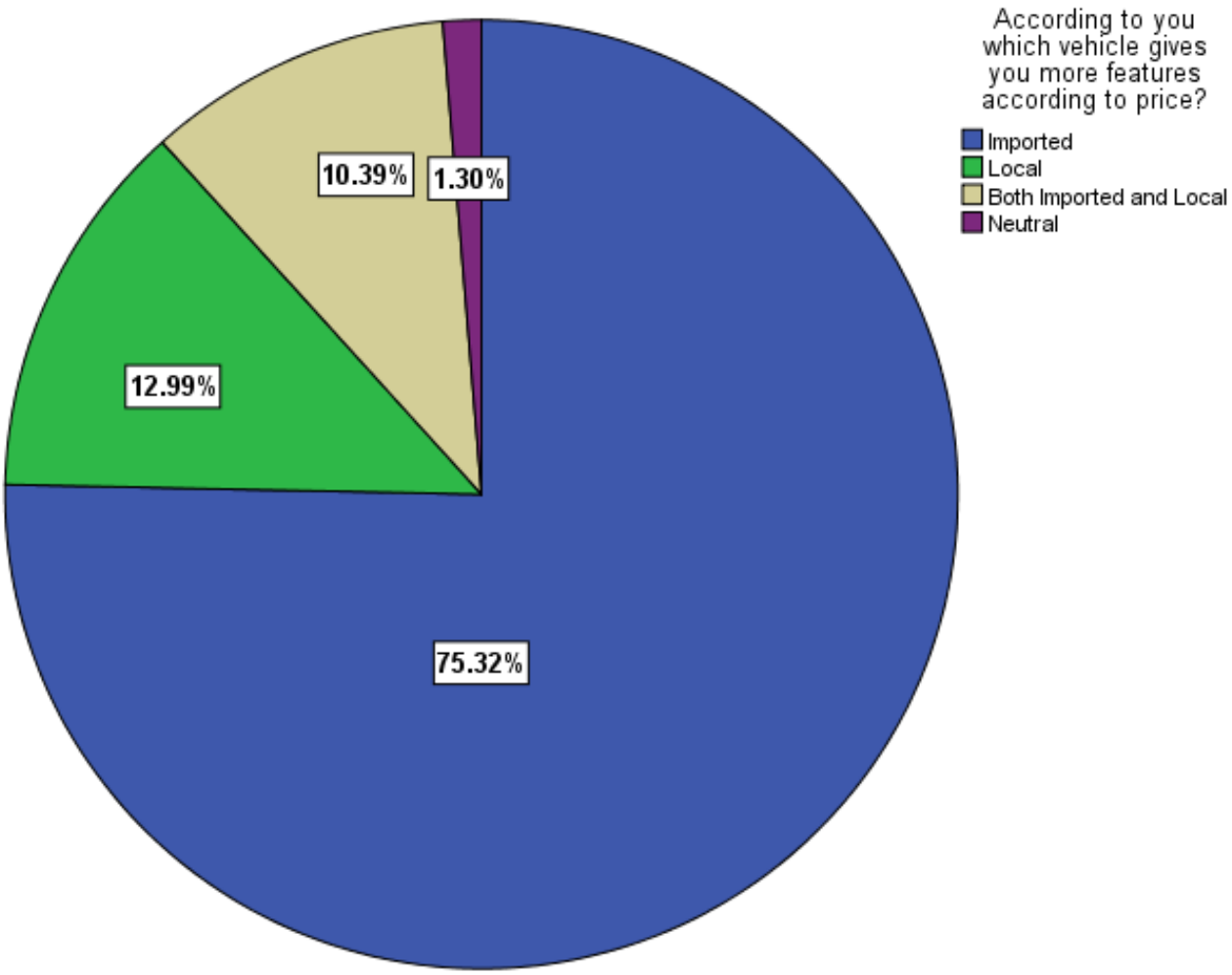
Appendix 10


To what extent you are conscious about fuel consumption of vehicle?
To great extent
To some extent
Neutral
Not Conscious
5.19%
7.79%
29.87%
57.14%

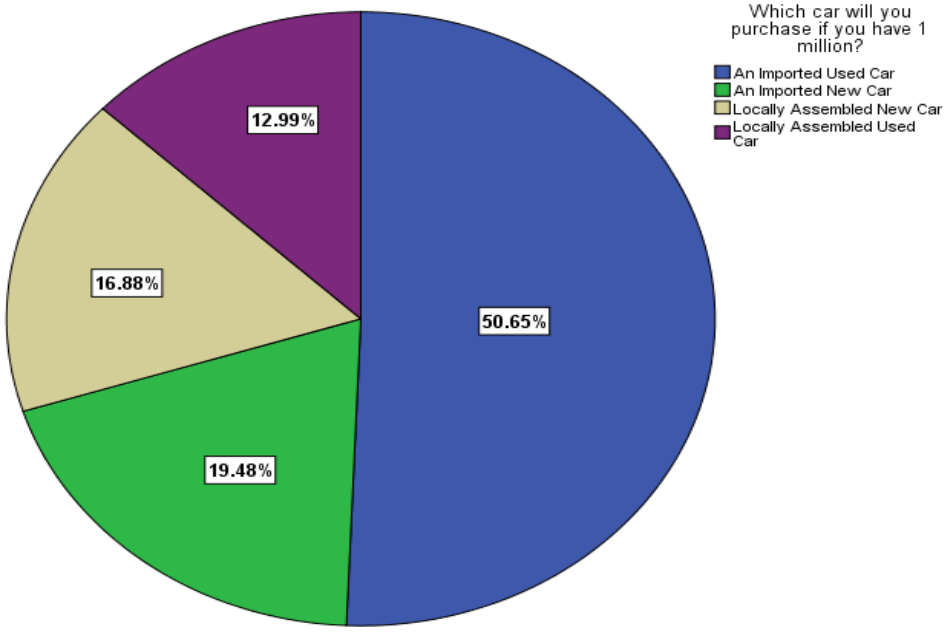

Which car is more economical with reference to fuel consumption on highways?
Imported
Local
Both Imported and Local
Neutral
3.90%
20.78%
57.14%
18.18%

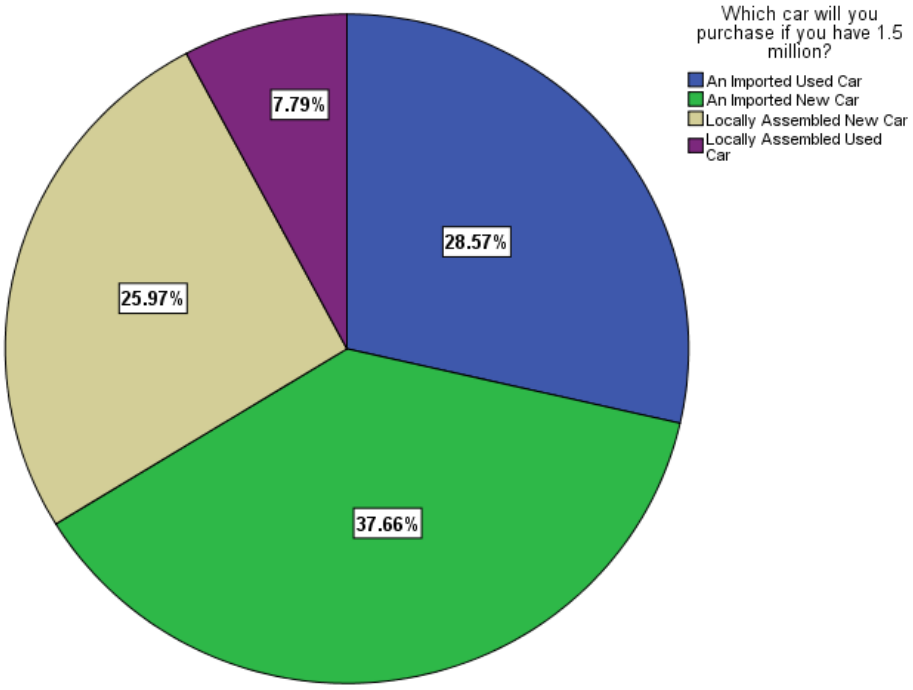

Which car is more economical with reference to fuel consumption in cities?
Imported
Local
Both Imported and Local
Neutral
22
6.49%
1.30%
20.78%
57.14%
14.29%

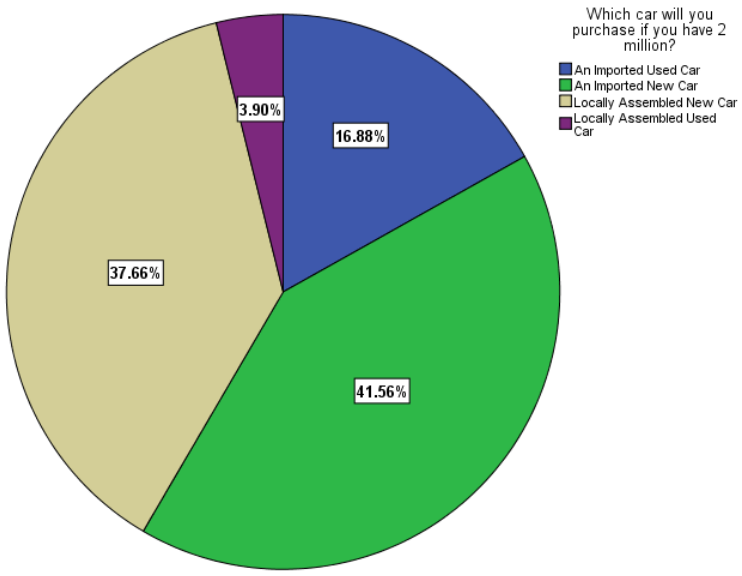
Appendix 11



Appendix 12




Which car will you purchase if you have 1.5 million?
An Imported Used Car
An Imported New Car
Locally Assembled New Car
Locally Assembled Used Car
7.79%
28.57%
25.97%
37.66%


Which car will you purchase if you have 2 million?
An Imported Used Car
An Imported New Car
Locally Assembled New Car
Locally Assembled Used Car
3.90%
16.88%
37.66%
41.56%

Appendix 13 **Questionnaire**

Factors Influencing the Likeness of Imported and Local Cars

1. Age ☐ Years
2. Gender ☐ Male ☐ Female
3. Marital Status? ☐ Single ☐ Married ☐ Divorced ☐ Widow
4. Type of family system in which you are living? ☐ Nuclear ☐ Joint
5. Number of family members? ☐
6. Your education?

☐ Uneducated	☐ Primary	☐ Middle	☐ Matric	☐ Intermediate	☐ Graduate	☐ Post Graduate or above

7. Your Employment status: ☐ Employed ☐ Self-Employed ☐ Unemployed
8. Your Occupation: ☐
9. Your Monthly Income from Job/Business or Pocket Money in case of student? (In Thousands)

0-30k	30-70k	70-100k	100-125k	125-150k	150-175k	175-200k	200 or above

10. Your residential ☐ Rural ☐ Urban location?
11. Which car do you own?

☐ An Imported Used car ☐ An Imported New car ☐ Locally assembled New car

☐ Locally assembled Used car ☐ Don't own a car

12. Your Car Company and Model?

Company Name	Model Name	Year

13. The car you own is:

☐ Given by Parents ☐ Self Purchased ☐ Leased ☐

Other_____

14. For what purposes you use your car on daily basis, tell us in percentage out of 100%?

For Office purpose	For Shopping	For Outing/ Trips	For Rent	For Family use

15. How much do you spend on maintenance for your car in a year? (In thousands)

☐ 0-15 ☐ 15-30 ☐ 30-45 ☐ 45-60 ☐ 60-75 ☐ 75-90 ☐90-100

16. Type of location where you drive your car, tell us in percentage out of 100%?

Rural	Urban	Highway

17. The quality of imported car is:

☐ Highly Satisfactory ☐ Satisfactory ☐Neutral ☐ Dissatisfactory ☐Highly Dissatisfactory

18. The quality of local car is:

☐ Highly Satisfactory ☐ Satisfactory ☐Neutral ☐ Dissatisfactory ☐Highly Dissatisfactory

19. In your opinion which car is more comfortable and durable?

☐Imported ☐Local ☐ Both Imported and Local ☐ Neutral

20. To what extent you are conscious about safety features in a car?

☐ To great extent ☐ To some extent ☐ Neutral ☐ Not Conscious

21. What is your priority level for the following safety features?

Sr. No	Safety Features	1st Priority	2nd Priority	3rd Priority	4th Priority
1	Anti-lock Braking System				
2	SRS Airbag				
3	Cruise Control				
4	Security System				

22. In your opinion which car is equipped with more Safety features?

☐Imported ☐Local ☐ Neutral ☐ Both

23. Which of the following Innovative features are more important to you than other?

Sr. No	Features	1st Priority	2nd Priority	3rd Priority	4th Priority	5th priority
1	Automatic Transmission					
2	Hybrid Technology					
3	Power Steering					
4	Push Start					
5	Keyless Entry					
6	Eco Idle Feature					
7	Climate Control					

24. Buying a car is an investment?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

25. To what extent you are conscious about Resale value of car?

☐ To great extent ☐ To some extent ☐ Neutral ☐ Not Conscious

26. Resale value effects your decision of purchasing a car?

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

27. Which car has more resale value?

☐Imported ☐Local ☐Both ☐ Neutral

28. Which of the following after sale services for imported vehicle is more important than other?

Sr. No	After Sale Services	1st Priority	2nd Priority	3rd Priority
1	Mechanics Availability			
2	Spare parts Availability			
3	Cheap spare parts			

29. After Sale service for local cars is up to the mark:

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

30. Which car performs better in hilly areas?

☐Imported ☐ Local ☐Both Imported and Local ☐ Neutral

31. Which car performs better on highways?

☐Imported ☐Local ☐Both Imported and Local ☐ Neutral

32. Which car performs better with in city?

☐Imported ☐Local ☐Both Imported and Local ☐ Neutral

33. According to you which car performs better having same engine power?

☐Imported ☐Local ☐Both are equal ☐ Neutral

34. To what extent you are conscious about fuel consumption of vehicle?

☐ To great extent ☐ To some extent ☐ Neutral ☐ Not Conscious

35. Which car is more economical with reference to fuel consumption on highways?

☐Imported ☐Local ☐Both are equal ☐ Neutral

36. Which car is more economical with reference to fuel consumption in cities?

☐Imported ☐Local ☐Both are equal ☐ Neutral

37. Have you done market research before purchase decision of car?

☐Yes ☐No ☐ Neutral

38. If yes, then from which source you got maximum information?

☐Social Media ☐Online information review ☐Suggestions from friends and family

☐Other_____

39. To what extent you compare price of imported and local vehicles while making purchase decision?

☐ To great extent ☐ To some extent ☐ Neutral ☐ Don't Compare

40. According to you which vehicle gives you more features according to price?

☐Imported ☐Local ☐Both are equal

☐Neutral

41. Which car will you purchase if you have 1 million?

☐An Imported Used car ☐An Imported New car

☐Locally assembled New car ☐Locally assembled Used car

42. Which car will you purchase if you have 1.5 million?

☐An Imported Used car ☐An Imported New car

☐Locally assembled New car ☐Locally assembled Used car

43. Which car will you purchase if you have 2 million?

☐An Imported Used car ☐An Imported New car

☐Locally assembled New car ☐Locally assembled Used car

44. Are you satisfied with your existing car?

☐Highly Satisfied ☐Satisfied ☐Neutral ☐Dissatisfied ☐Highly Dissatisfied

45. Are you satisfied with the car you own? Kindly rate the satisfaction level of your Ride:

Features	**Highly Satisfied**	**Satisfied**	**Neutral**	**Dissatisfied**	**Highly Dissatisfied**
Price	☐	☐	☐	☐	☐
Quality	☐	☐	☐	☐	☐
Fuel Efficiency	☐	☐	☐	☐	☐
After Sale Services	☐	☐	☐	☐	☐
Exterior Design	☐	☐	☐	☐	☐
Interior Design	☐	☐	☐	☐	☐
Innovation	☐	☐	☐	☐	☐
Performance	☐	☐	☐	☐	☐
Resale Value	☐	☐	☐	☐	☐
Reliability	☐	☐	☐	☐	☐
Environment Friendly	☐	☐	☐	☐	☐

Thank you for completing this questionnaire. We appreciate your feedback.!

Impact Factor:	ISRA (India) = 1.344	SIS (USA) = 0.912	ICV (Poland) = 6.630
	ISI (Dubai, UAE) = 0.829	РИНЦ (Russia) = 0.234	PIF (India) = 1.940
	GIF (Australia) = 0.564	ESJI (KZ) = 1.042	IBI (India) = 4.260
	JIF = 1.500	SJIF (Morocco) = 2.031	

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(99890)7150466

SECTION 9. Chemistry and chemical technology.

A STUDY ON THE EFFECTS OF TEMPERATURE, TIME FLUSHING AND COMPOSITION OF PRINTING PAINT ON THE THICKENER WASHING-OFF

Abstract: *Developed polymer composition consisting of starch, CMC and sericine as a thickener has the characteristics of the highest washability. At a temperature that equals to 800C, for 40 minutes washing circuit about 75% of thickener formulations of polymeric composition are removed from the fabric, in case of the conventional starch thickener only 10% of thickener formulations are removed.*

Key words: *Polymer composition, a thickener, washing, washability characteristics of thickener, he degree of removing, the dye.*

Language: *English*

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INTRODUCTION

In this research paper, several factors such as the temperature, time flushing and composition of printing dye and their effects on thickener wash ability and ink compositions were studied.

Table 1 shows the thickener compositions and printing dyes investigating in printing cotton material in a laboratory setting with engraved print shaft [1]

Table 1

Thickener compositions and printing dyes.

№ p/n	Thickener	№ p/n	Printing dyes (ink)
1	Thickener consisting of simple starch	4	Thickener 1, 2, 3 with active dye
2	Polymer composed thickener consisting of starch and CMC	5	Components of printing ink without dye
3	Thickener on the base of polymer composition, consisting of CMC and sericine	6	Components of printing ink with active dye

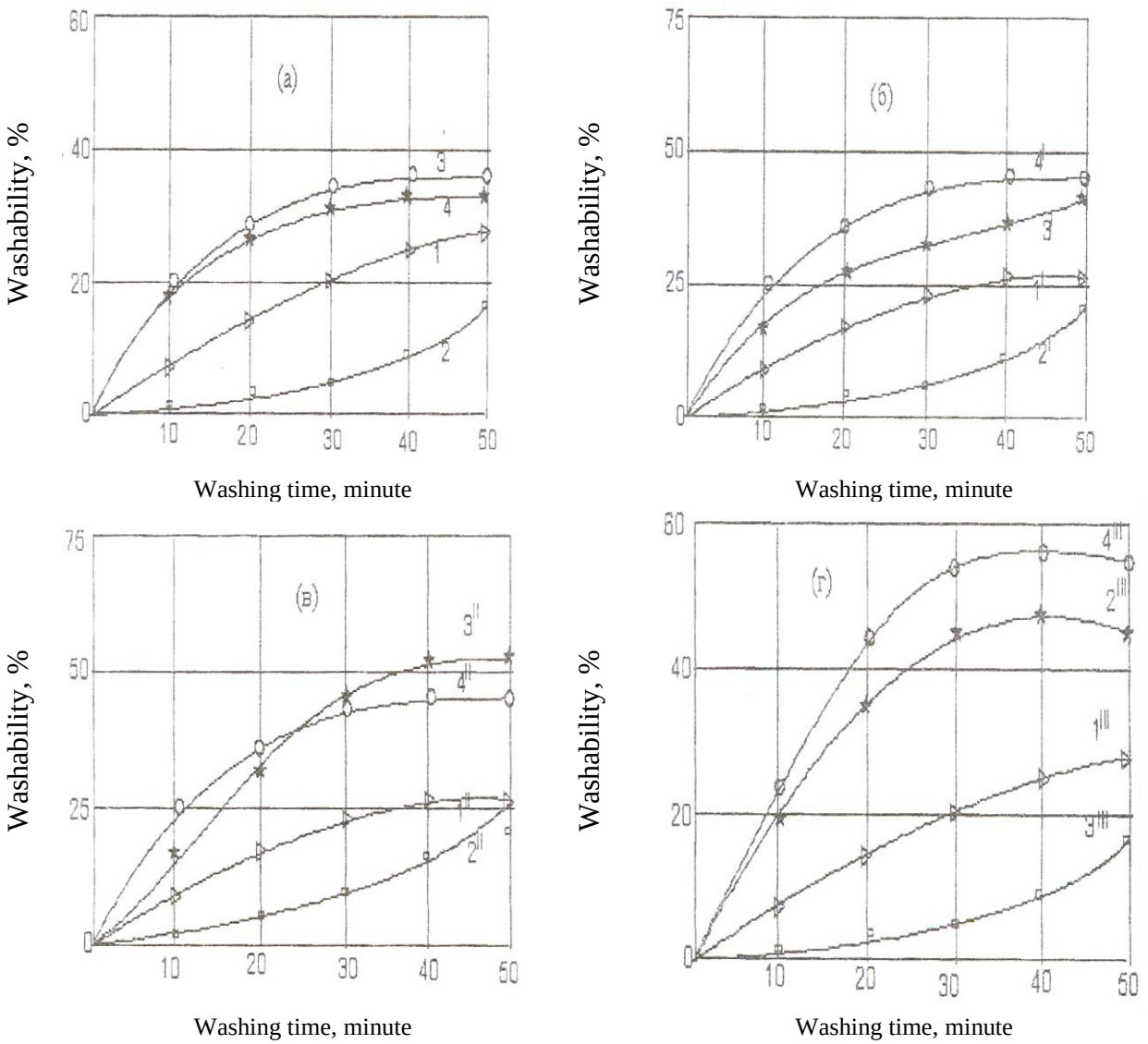
MATERIALS AND METHODS IN THE STUDY

Two coloring agents have been selected for the study, they are: monochlorotriazine bright purple 4K and dichlortriazine bright-red 5CK. After printing and drying the samples have steamed. Flushing process was carried out on a laboratory model setting, which is considered to be a unit of aggregate, where the sample was directed to the expanded state. The machine does not allow water removability.

The dependence of thickener removal of the water temperature and the washing time at constant movement speed -60m/min was studied [2]

According to data presented in Figure 1, a conventional thickener and modified starches washed away approximately in 40 minutes at 500C, which corresponds to the curves I, I `, I ``, in Figure 1 a, b, c. The degree of cleansing consists of 24-27% from initial amount. However, as the curve I ‴ in picture 1(g) reveals the thickener of manutex is removed better, at 34%.

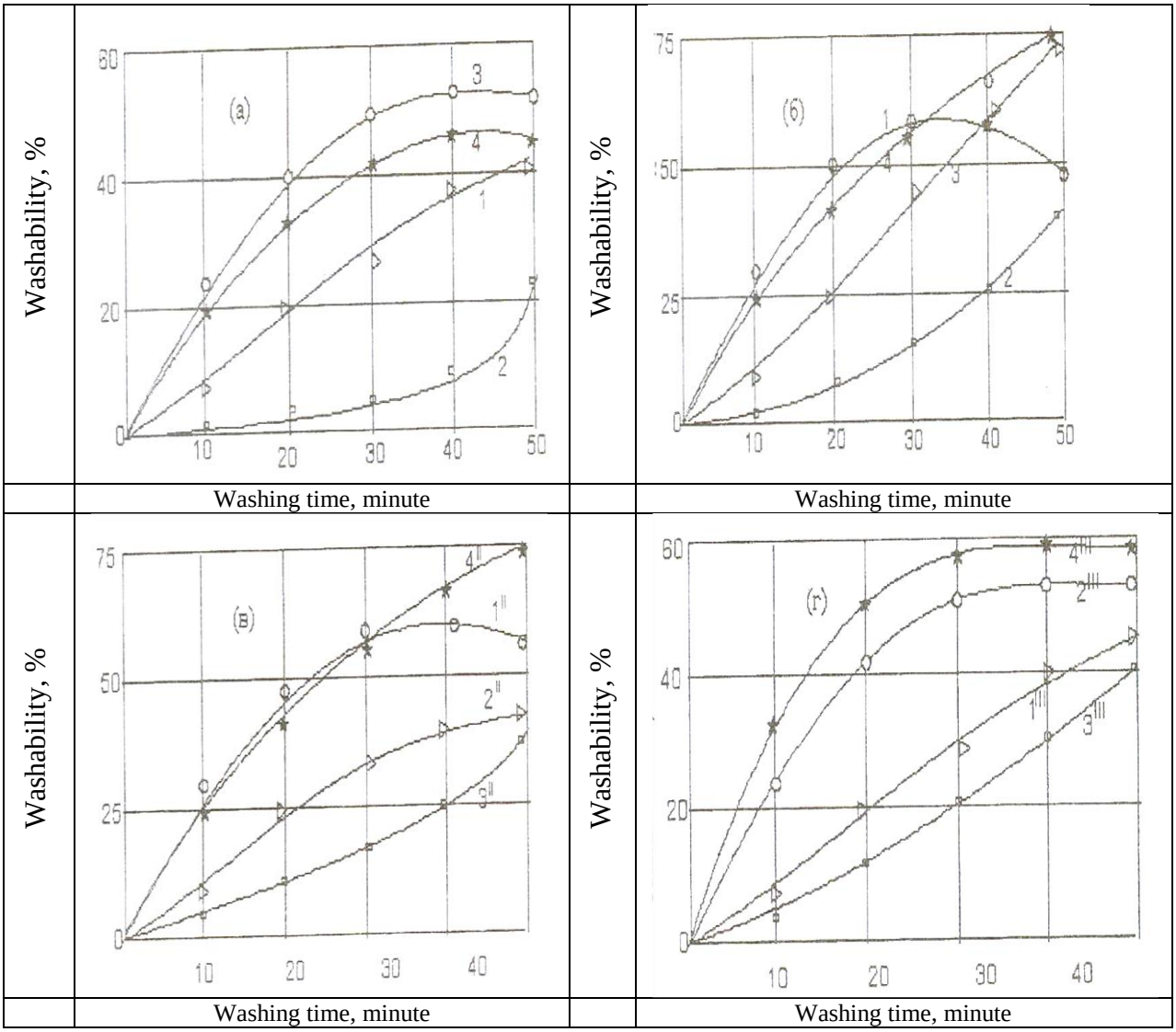
Temperature rise of washing tub has a weaker effect on manutex RC removal compared to starch thickeners as shown in Figure 2 (g), the curve I ‴



Picture 1. The Kinetics washability of various printed compositions at 500 ° C, I, I ', I ", I ‴ - a thickener; 2, 2 ', 2', 2 ‴ - thickener with dye; 3, 3 ', 3 ", 3 ‴ -printing paint without pigment; 4, 4 ', 4 ", 4 ‴ - printing ink dye; a-native starch; b, v - polymer composition; g - manutex.

However, taking into account the rigidity of washed samples it is possible to make a conclusion that even with a small degree of the stiffness of washed samples, which are printed manutexRS thickeners, are significantly less in toughness rather than the samples printed with starch thickeners. Apparently, the film of manutex is less in stiffness.

The presence of the dye in the thickener causes a nucleation of printed structure, due to the reactivity of active dyes which form a covalent chemical bond with the hydroxyl groups of the starch and reduces the degree of thickeners removal from the tissue that does not occur in the case of manutex thickener as shown in curve 2 ‴ , picture (g)



Picture 2. The Kinethics of various printed compositions at 80^{0}C , I,I′,I″, I‴- a thickener; 2, 2′, 2″,2‴- a thisckener with dye; 3, 3′, 3″,3‴ -printing paint without pigment; 4, 4′, 4″,4‴- printing ink with dye; а- native starch; б,в- polymer composition; г- manutex.

Degree of thickener removal increases significantly through adding urea and alkalic agent to the printing composition. Apparently, the washabilty of thickener gets better, comparing to the both cases0 with printing composition without dye and full composition of printing ink.

It is clear that urea, which provides the inturgescence of thickener pellicle, provides better removal of thickener.

Coloring agent and other components of printed ink effect approximately equally on the removal of thickener from the material in washing process, at 50^{0}C. According to data presented in picture 1 (g), the curve 3‴ and 4‴, the washability of thickener stands at 37-53%. In case with starch thickener, the addition of dyes decreases the washability of thickeners dramatically, whereas, the addition of urea and alkali agent rises this figure up to 6-21% for usual starch thickener that has been shown in the curves 3, 4, picture 2; and 18-25% for the thickener of polymer composition appropriately to the curves 3′,4′, 3″ and 4″, picture 1 (a, b), at 50^{0}C temperature of washing tub in the interval of 40 minutes.

The same results can be observed in the usage of fully composed printing dye. At the temperature of 80^{0}C with 40 minutes time interval, the washing process removes printed compositions with the thickeners from polymer compositions at about 75% as it was clearly stated in the picture 2 (b), the curves 3′, 3″, 4′ ; and in case of simple starch thickener only 10% of the mass is removed.

CONCLUSION

In conclusion, water-miscible polymer composition can be removed easier and fully compared to ordinary starch consistency. What is more, the highest degree of washability belongs to the polymer composition consisting of starch, CMC, and sericine.

References:

1. Amonov MR, Ikhtiyarova GA, Yaryev OM (2004) Study of the color characteristics of printed cotton fabrics using a polymer composition // Plastic masses, 2004. №2. -p. 43-44.
2. Ikhtiyarova GA, Amonov MR, Yariev OM (2004) Evaluation of the structural and mechanical properties of the clot of printed fabrics with polymer compositions // Plastic masses, 2004. No.2.-p. 44-45.
3. Ikhtiyarova GA, Amonov MR, Yariev OM (2004) Investigation of rheological properties of a thickener based on the developed polymer composition // Composite materials. 2004 - №4. -p.27-29.
4. Ibragimova FB, Amanov MR, Sodikova SS (2001) A polymer composition based on the interaction of a, g-dichlorohydrin-glycerol with polyphosphoric acid and its application. M. Zh / Journal. Plastic masses. 2001., No.4., p. 42-44.
5. Ibragimova FB, Amanov MR, Yaryev OM (2001) Thermodynamic aspects of the formation of potassium polyphosphate and the polycondensation reaction based on it with dichlorohydrin-glycerol. M.: // Journal. Plastic masses. 2001. № 4, p. 37.
6. Ibragimova FB, Amonov MR, Ikhtiyorova GA (2002) Evaluation of the influence of the affinity of the composition of a thickener on the yield point and the fixation of printing ink. // Plastic masses. -M., 2002.-No.10. -p. 42.
7. Amonov MR (2002) Optimization of the composition of the composition for the thickening of the tissue. // Plastic masses. -M., 2002.-№9. -p. 44-45.
8. Amonov MR, Ikhtiyarova GA, Yaryev OM (2003) The use of polymer compositions as a thickener for printing paints. // Plastic masses. -M., 2003. -No.7. -p. 48.
9. Melnikov BN, Zakharova TD, Kirillova MN (1982) Physical and chemical foundations of finishing manufacturing processes. -M.: Light and food industry, 1982. -p. 281.
10. Glubish PA (1975) The use of polymers of acrylic acid and its derivatives in the textile and light industries. -M.: Light industry, 1975.-205 p.
11. Amonov MR, Ikhtiyarova GA, Yariyev OM, Ravshanov KA (2002) Blisters based on natural and synthetic polymer compositions for printing fabrics //Uzbek Chemical Journal. 2002. - №4. -p.71-77.

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SECTION 25. Technologies of materials for light and textile industry.

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ANTIMICROBIAL FIBERS FOR TEXTILE CLOTHING AND MEDICINE: CURRENT STATE

Abstract: *This article is a review devoted to polyester fibers with antimicrobial properties and includes the description of antiseptic components of fibers, testing methods and fiber's properties. The final part is devoted to application of antimicrobial fibers (as well as natural and synthetic ones) in medicine and clothing.*

Key words: *biodeterioration, antiseptic components, Triclosan, silver nanoparticles, antimicrobial activity, properties and application.*

Language: *English*

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INTRODUCTION

Since ancient times the mankind uses fibrous materials for production of clothes, tools, as well as for medical purposes. For example, the use of fibers in medicine was first mentioned in '*Surgical Papyrus*' nearly 4,000 years ago. In the Indian manuscript *'Susanta Sambita*' written approximately 2,500 years ago, a variety of fibrous materials are mentioned such as horse hair, leather strips, cotton, animal sinews and fibrous tree bark. At present, textiles have found their way into a variety of medical applications. In addition to protective medical clothing, textiles in the form of fibers and fabrics are used as implants, filters and surgical dressings. Recent decades have witnessed major development in the production of medical textiles, as well as in materials and technologies used to manufacture them.

The global problem of technogenic deterioration of environmental conditions for life on the Earth have been considerably aggravated in the 21st century. The problems of local reduction of detrimental effects of the changed environment on human beings and the sphere of their existence have become topical as never before.

In the system "human – textile product – habitat", the textiles act as protection for a person. The new generation textile products which are produced taking into account the adverse changes in the ecological environment are actively minimizing their effect. Additional functional properties are being imparted to polyester fibers which are traditionally incorporated into the composition of practically all textile fabrics to increase their wear- and crease-resistance. The best world samples of polyester fibers possess antimicrobial activity, ability to discharge static electricity, demonstrate the reduced combustibility and have other special properties. American, Chinese, Japanese and other textile products have appeared in the market which react "smartly" on the change of the parameters of the environment reducing its harmful effects on a human being. Targetedly modified polyester fibers are an indispensable component of such products.

Chemical fibers are obtained from products of chemical processing of natural polymers (artificial fibers) or from synthetic polymers (synthetic fibers). Despite continuous improvement of the textile production and advancement in technologies for chemical fibers, not so many methods to impart them with special properties are developed. Classical methods for filling and plasticization of the polymer base have long remained a sole instrument to regulate the chemical fiber properties. Currently, the targeted modification of the surface layer of fibers which does not affect their core has become the leading trend in the textile materials science. Such modification is implemented predominantly by the diffusion mechanism using the technological

environments which are thermodynamically compatible with the polymer base of the fibers. The latter condition is a significant limitation to the range of technological impact on the surface layer structure, thus making it impossible to introduce a lot of very effective target modifiers into it.

As an alternative, production of multilayer fibers consisting of polymer core (which properties essentially determine the deformation-strength characteristics of the fiber) and one-two external layers which impart the fiber with special properties (wettability/non-wettability, frictionality/anti-frictionality, high fusibility/low fusibility, etc.) has experienced active growth in many countries in the 1990s. However, interest in them quickly faded due to high costs of the considerably sophisticated industrial equipment, low stability of technological process of extrusion "facing" of the fibers, unreliability of multitubular extrusion heads and complexity of their repair.

The situation was radically changed at introduction of the methodology of surface modification of chemical fibers based on implementation of the crazing phenomenon. Crazing is a process of plastic deformation of polymers which brings them into a specific structural state. At loading levels and properties of the environment (which are individual for each material), special areas of the oriented state – crazes – occur in the specimen. These are microcracks which walls are connected by fibrils less than 10 nm in diameter. The extent of crazes opening in the polyester fibers (in glassy state at room temperature) subjected to orientational drawing in the surface-active liquid media which promote cracking of fibers provides for the possibility to introduce into the surface layer of the fiber any substances irrespective of their physico-chemical nature. At first, crazing was used in the processes of water-repellent fibers dyeing, and in the 1980-90s – to produce semiconductor and low-combustible chemical fibers.

Nevertheless, crazing has not found application yet in large-scale production of chemical fibers and is very seldom used in the technology for their processing. As a rule, basic methods for chemical fibers modification by the mechanism of crazing are *know-how* of the leading manufacturers of fibers with special properties which are closed to third-party experts.

1. PROBLEM OF TEXTILE FABRICS BIODETERIORATION

"Biodeterioration" is defined as the damage of materials, raw materials or products under the influence of biological factors [1] – microorganisms (bacteria, microfungi), insects (moths, khapra beetles, wood-boring beetles, termites, cockroaches) and mammals (rat and mice).

Materials biodeterioration can be classified into three main categories [2]: actual biodeterioration, biofouling, biological contamination.

Actual biodeterioration takes place by two mechanisms: 1) use of organic substances by microorganisms as the source of nutrients and energy (assimilation); 2) damage of materials caused by microbial products (destruction). *Biofouling* is the accumulation of aquatic organisms (bacteria, algae, sponges, etc.) on the surfaces of products. *Biological contamination* is the colonization of dust layers, mineral and organic matters on hard materials' surfaces by microorganisms.

Textile fabrics biodeterioration occurs at various stages of their life cycle: in the course of fiber preliminary processing at spinning, weaving and finishing stages due to high temperatures and humidity; during storage, transportation and operation when the standard conditions are not met. Most of the damage caused to textile fibers occurs due to putrefactive bacteria (*Bacillus, Pseudomonas, Bacterium*) and mold fungi (*Aspergillus, Penicillium, Trichoderma*). The deteriorating effect of bacteria is due to their ability to use practically any nitrogen- and carbon-containing sources of energy and nutrients of organic and inorganic origin [3]. Biodeterioration caused by mold fungi takes place due to stress rupture of the product surface layer by the expanding mycelium in combination with biochemical enzymatic effect. Characteristic features of biodeterioration are fabric discoloration and sheen, appearance of spots with putrefactive smell, decrease in acid- and alkali resistance and strength characteristics, loss of weight, damage of surface layer and fibers stratification [4]. Mechanisms of textile fibers biodeterioration are determined by their origin and chemical composition.

Natural fibers are the most affected by the adverse effects of biodeterioration. Destroying agents are proteolytic enzymes (i.e. the ones that catalyze the breakdown of proteins) produced by microorganisms. Biodeterioration of wool fiber protein basis starts at pH 8.5. Ammonia accumulation in fibers leads to pH increase, following which alkaline enzymes that are actively destroying fibers come into action [5]. Self-heating of insufficiently dry cotton and wool in the pile occurs due to intensive development of microorganisms in them. Heat energy is released when organic compounds of fibers are oxidized by waste products of aerobic bacteria. Microbiological stability of wool fibers is higher than that of cotton. Deterioration of wool takes place at a higher moisture content in it (over 24 %) whereas development of microorganisms on cotton starts at 9 % [6].

Process of synthetic fibers biodeterioration starts with adsorption of microorganisms on them. Their metabolites (intermediate products of

metabolism) are diffused into the fiber micropores and cracks. Process of biological degradation is facilitated by availability of functional groups in macromolecules, weak orderliness of supramolecular structures, low degree of polymer material crystallinity. Therefore, fibers based on heterochain polymers – polyether, polyamide, etc. – are less bioresistant. Bacterium and fungus colonies occur on lavsan on the 30th day when kept in the active microbial environment. Carbochain polymer based fibers (chlorin and ftorlon) are more resistant to microbiological damages [7].

Methods of textile material protection against biodeterioration are applicable at the stages of textile products handling and consumption, as well as in their manufacturing process.

The first group contains the following methods [7]:

− creation of temperature and humidity conditions for products storage and transportation under which the microorganisms lose their ability to reproduce (T = 12÷18 $^{\circ}C$, humidity 50÷70 %);

− short-term exposure to radiation and UV-rays;

− purification of the air inside the warehouse;

− using ultrasound for product processing;

− airtight packaging;

− textile products dry cleaning and washing using disinfectants.

Since these methods do not produce a long-term effect, antiseptic properties are imparted to textile materials in the manufacturing process. Antimicrobial activity of synthetic fibers is created using three groups of methods:

1) Composite methods of modification [8]: polymer granulate processing with metal cations; introduction of bactericide agents into the melt or solution of fiber-forming polymeric compound;

2) Methods of surface modification [9]: impregnation of fibers and threads with bactericides; imparting antimicrobial properties to textile materials in the process of their dyeing and final finishing; target impregnation of fabrics, knitted goods, non-woven fabrics with solutions of antimicrobial preparations; hydrophobization of fibers' and threads' surface; crazing technology by introducing antiseptic substances into the crazes;

3) Crazing technology by introducing antiseptic substances into the crazes on the fiber's surface [10].

2. ANTISEPTIC COMPONENTS OF FIBERS

Antiseptic additives to synthetic fibers shall meet two basic requirements: suppression of growth of microorganisms and safety to human health. Various additional aspects of the production schedules defining technological effectiveness and consumer properties of textile products make it more difficult to meet these requirements.

The antimicrobial substances used in chemical industry are usually classified according to three criteria: 1) origin and chemical composition, 2) mechanism of action against microorganisms, 3) spectrum of action.

By origin and chemical composition, antimicrobial components are divided into [11]:

– inorganic substances (silver, calcium, magnesium, copper compounds);

– organic compounds (nitrofuran class derivatives; benzene derivatives; 8-Oxyquinolines; sulfonamide compounds; aldehydes; organic acids and their salts; surface-active substances (SAS) and compositions on their base;

– bioorganic substances which are created by processing bacteria, fungi, plants or their waste products (antibiotics).

By mechanism of action against microorganisms, the following substances are distinguished [12]:

–bactericidal, i.e. the ones that kill microorganisms;

–bacteriostatic, i.e. the ones that inhibit their reproduction.

By efficiency of impact on various classes of microorganisms, antimicrobial substances are divided into groups which spectrum of action can be defined as [13]:

– broad spectrum, if antimicrobial substances kill or inhibit a wide range of Gram-positive and Gram-negative bacteria (in 1884 Danish microbiologist H. Gram developed a method for differentiating bacteria: when stained (using the method proposed by him) cells of one type of bacteria – Gram-positive ones – get colored, while cells of other bacteria – Gram-negative ones – are decolorized);

– limited spectrum, if they are effective against certain types of Gram-positive and Gram-negative bacteria or bacteria and fungi;

– narrow spectrum, if antimicrobial substances are active against representatives of a relatively small number of taxons of microorganisms, for example, against Gram-positive or Gram-negative bacteria.

Characteristics and a list of basic groups of antimicrobial substances used in the commodity production are given below.

2.1. Silver-based colloidal systems

Silver is the most active antiseptic agent among metals [14-16]. It's no secret that silver has been used to combat bacteria throughout history. The earliest records show that in ancient days, silver was used to

line water vessels during long sea-going voyages. In the middle ages, Church made its chalices and Eucharist trays of silver to prevent the spread of disease. Although some other metals, such as copper, zinc and cobalt, have attracted attention as effective antimicrobial agents for textiles, silver is by far the most widely used in general textiles as well as in wound dressings.

For about a thousand years, silver is known to be a very efficient agent against infection. However, only application of nanotechnology made it possible to obtain a long lasting antimicrobial effect by means of silver compounds. The reason for this is as follows. Silver (in the form of metal blocks) deliver Ag^+ ions to the environment in insignificant quantities while soluble silver salts are strong antiseptic agents which act, however, for a very short period of time. Silver particles with sizes between 10-30 nm provide for optimum ratio between antimicrobial activity and antiseptic effect duration.

Silver, as compared to other disinfecting preparations, has the following advantages:

- broad spectrum of action covering about 600 microorganisms (the majority of antiseptic agents and antibiotics are active against no more than 20 microorganisms),
- high activity at low concentrations of about $5 \cdot 10^{-5}$ g/l,
- harmless to humans and warm-blooded animals,
- long-lasting antiseptic action.

Silver biological activity pertains to the fact that Ag^+ ions, firstly, connect to the membrane proteins of microorganisms thus disturbing the membranes' function, and, secondly, produce solid complexes with DNA nucleotides as a result of which DNA helical structure is broken. Both of these factors stop bacteria from reproducing.

The kinetics of microbes dying off under the antiseptic agent influence is one of its key characteristics. Die-off rate of *E.Coli* bacteria (colibacillus) under the influence of silver ions depends on ion concentration. So, at a concentration of 1 mg/l the colibacillus is killed in 3 min., at a concentration of 0.5 mg/l – in 20 min., and at a concentration of 0.2 mg/l – in 50 min. At a concentration of 0.05 mg/l it takes two hours to obtain complete bactericidal effect [13].

Effect of silver salts solutions is 1750 times stronger than that of carbolic acid with the same concentration, and 3.5 times stronger that that of corrosive sublimate. According to [14], antimicrobial action of silver ions is stronger than that of chlorine, chlorinated lime, sodium hypochlorite and other strong oxidizers with the same concentration. Comparative data of disinfecting preparations are presented in Fig. 1 as dependences of the number of the killed bacteria versus time of contact *t*.

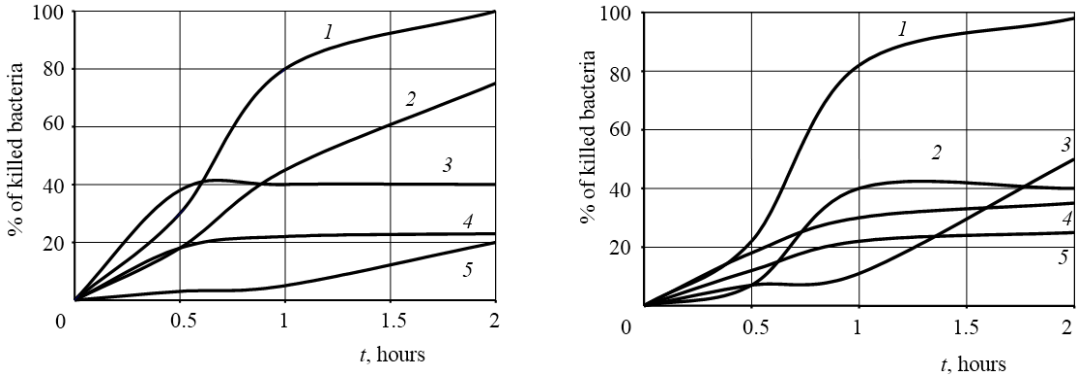


Figure 1 - Comparison of bactericidal action of some disinfectants against colibacillus (*a*) and fecal bacteria *Str. Faecalis* (*b*): 1- silver water; 2 – ammargen; 3 – phenol; 4 – chlorine; 5 – chlorinated lime. Reagent concentration 1 mg/l, temperature 7 $^{\circ}C$ [14]

E. Coli bacteria are more sensitive to silver ions action than *Str. Faecalis*. Complete inactivation (loss of activity) of *Str. Faecalis* bacteria in water with concentration of 10^4 species/l occurs after 3 ÷ 4 hours of contact with silver solution (0.2 mg/l), while one hour is enough to suppress *E. Coli* under the same conditions [15].

Besides the listed bacteria, causative agents of typhus, olm, salmonella, chromobacteria, vibrioes, causative agents of diphtheria and other dangerous microorganisms are killed rather quickly under the influence of silver ions. It is characteristic that newly identified strains are more resistant than the old ones which are stored in a laboratory. Silver does not kill spore-forming bacteria, but spore germination in the presence of silver ions is delayed. Gram-negative bacteria are more sensitive to silver than the Gram-positive ones. Yeast and yeast-like fungi are poorly

suppressed by silver. Silver has no effect on mold fungi [17]. As a rule, pathogenic (disease-producing) microorganisms are more sensitive to silver than saprophytes (organisms that feed on organic substance of dead material). Silver solution with concentration of 0.5 mg/l at temperature of 37 $^{\circ}C$ and time of contact of 1–2 days deprives bacteriophages (bacterial viruses) of life.

Temperature increase reduces resistance (endurance) of microorganisms to silver. These data are well agreed with the ideas on silver effect upon bacterial enzyme systems: enzymes activity decreases as temperature increases and they are easier inactivated by inhibitors.

The bactericidal effect of silver is higher at alkaline values of pH environment. Thus, test experiments showed (at pH = 8 ÷ 9) a significant growth in *E. coli* bacteria, while the growth of microbes was not registered after 30 minutes of bacteria contact with 0.2 mg/l silver solution. At pH < 7, silver has no noticeable bactericidal effect on collibacillus [18].

For synthetic fibers, silver particles can be incorporated into the polymer before extrusion or before nanofiber formation using electro spinning. The treatment of natural fibers with metals can only be undertaken at the finishing stage and various strategies have been devised to enhance the uptake and durability. Cotton has been pretreated with succinic acid anhydride, which acted as ligand for metal ions to enhance the subsequent adsorption of metallic salts (Ag^{+} and Cu^{2+}) and to provide very effective antibacterial activity.

Concerning the studies of fiber/silver nanocomposites, most researches have been interest in preparations of ultrafine fiber containing silver nanoparticles. Surface modification of cotton microfibers with silver nanoparticles can increase both the price and purpose of the fibers. [19]. For example, today, AgION Technologies, a Nexera trusted technology partner is using its patented silver based antimicrobial compound to control destructive microbes for use in medical applications, food packaging and more. And now, the same silver based technology incorporated into the Nexera's SpectraShield-9900 Series of respirator masks can provide protection from these microbes [20].

The materials impregnated with silver salt solutions (silvered water, silver citrate or lactate, as well as silver chloride) promote wound healing and prevent its suppuration. However, practical application of silver is not feasible in view of its high cost. Besides, direct sunlight causes the decomposition of silver salts resulting in discoloration of the material [21].

2.2. Organic antimicrobial substances

At the current stage of polymer products manufacture, organic antimicrobial substances are becoming more effective than inorganic ones thereby forcing the latter out of the market. By chemical nature, the following groups of antimicrobial additives used in polymer materials are distinguished [22, 23].

Aldehydes, organic acids and their derivatives. *Salicylanilid* is a colorless and odorless crystal powder; soluble in alcohols, ethers, benzene; poorly soluble in water; $T_m \approx 136 \div 138$ °C; used as a fungicide (agent that destroys or suppresses pathogenic fungi) for non-metallic materials and as an antiseptic agent in production of film materials and artificial leather. *Methoxyacetaldehyde*, which is used as the antimicrobial plastics modifier, is soluble in water, alcohol, acetone, less soluble in ether; possesses sweet taste; T_b = 92.3 °C. *Benzoic acid* is a white crystal powder having a characteristic odor; poorly soluble in water, freely soluble in alcohol, ether, benzene; T_m = 122.3 °C, T_b = 249.2 °C; it is an antiseptic and preservative agent used in production of dyes, medicines, fragrances. *Sodium benzoate* has long been known as a preservative agent, stabilizer for polymers and corrosion inhibitor; it is a crystal powder that is soluble in water and alcohol. *Copper naphthenate* (technical product) is a greenish-blue pasty substance; insoluble in water; marginally soluble in organic solvents; fungicide, antiseptic agent for wood, ropes, fabrics. *Magnesium acetate* is a crystal substance; soluble in water, methanol; T_m = 323°C (with decomposition); deodorizing, antiseptic and disinfecting agent; main field of application: disposable non-woven products (napkins, towels).

SAS and SAS-based compositions. Cationic antimicrobial agent *Katamin AB* is a colorless or yellow transparent liquid; soluble in water; used to disinfect fabrics, surfaces of metal and wooden products; can be introduced into the cement mix. *Altosan MB* is a transparent colorless liquid; soluble in water; used as a bactericide, de-emulsification agent and corrosion inhibitor; it has a wide range of antimicrobial activities. *Katapins* are brown liquids or salvy substances; soluble in water, alcohols, benzene; insoluble in ethers; used as corrosion inhibitors, broad-spectrum antimicrobial agents, wetting agents, emulsifiers.

Compound ethers, phenols and their derivatives. The most common *parabens* (paraben acid derivatives) are *methylparaben* and *propylparaben* – white or yellowish crystal substances with slight specific ("phenolic") odor; they are soluble in alcohols, partially soluble – in water; they are used as preservatives in cosmetics [24]. *Triclosan* – white color powder with slight pleasant odor; poorly soluble in water, freely soluble in alcohols, organic solvents; $T_m \approx$ 55-60 °C, is used as a broad-spectrum antimicrobial component for a large number of cosmetics and perfumery products [25].

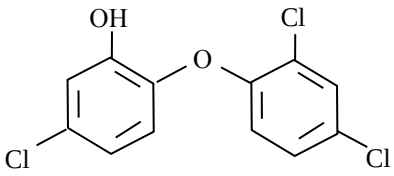
Other antimicrobial substances. In the last decades, a new class of substances – water-soluble polymers (polyguanidines) with broad-range and stability of antimicrobial action and low toxicity – has occupied its niche within the biocides market [26]. *Metacide* – salvy substance of light yellow color, odorless, soluble in water and organic solvents – is a typical representative of substances of this class. It is used to impart antimicrobial activity to genuine leather, paint coatings and products made of polymer materials. Polyguanidines are a part of antiseptic agents allowed for household use (*Inkrasept*). *Copper 8-oxyquinolate* (Cuprocin) is used to protect fabrics, paper, wood, paints and plastics against microbial damage.

According to hygienic classification, all listed antimicrobial substances are related to Class 3 (moderately hazardous) and Class 4 (slightly hazardous). For example, LD_{50} indicator (lethal dose which causes the death of 50% of a group of test animals, in grams per kilogram of animal body weight) for methyl- and propylparabens is about 8 g/kg; benzoic acid – 1.7 g/kg; salicylic acid – 0.89 g/kg [24]; thriclosan – 4.3 g/kg; values for polyguanidines are within the range 0.2 to 0.4 g/kg [18].

The analysis of the list of antimicrobial agents used by modern industry has led to the following conclusion. Triclosan and colloidal silver solutions are best suitable for use (by criteria of antimicrobial activity, safety to human health and technological effectiveness) as basic biocides for PET fibers modification using the crazing technology. Development of modifying compounds based on these substances is addressed in the following paragraphs.

2.3 Modifying compounds based on Triclosan

Triclosan is a substituted diphenyl ether, to be more precise, 2.4.4-trichlor-2-hydroxydiphenyl ether with the molecular weight of 289.5. Its structural formula is



Triclosan (Tr) was developed in the 1960s as a broad-spectrum antibacterial agent. Its developer − Ciba-Geigy company − has become its main supplier to the world market. At first, Tr was believed to be a nonspecific antiseptic agent destroying any cells. Soon it has been established that Tr has a selective effect on microorganisms by primarily suppressing prokaryotes – bacteria that lack a membrane-bound nucleus and typical chromosomal apparatus. The majority of pathogenic bacteria are prokaryotes. 20 years of clinical tests and accumulation of facts have led to conclusion that Tr is effective in small doses, has a broad spectrum of action and no negative effects on human health and the environment which favorably distinguishes it from the majority of antimicrobial agents [27].

Tr has a wide range of action against gram-negative and gram positive bacteria. This compound, owing to the presence of the acaricide benzyl benzoate, also offers protection against mites and is used in acaricide (spray or powder) formulas, as well as in a solution (25% concentration) for the treatment of scabies. This compound is nontoxic. Benzyl benzoate is an acaricide that acts, chemically, directly on the mites. Due to its antibacterial properties, Triclosan has found widespread use in a variety of consumer products including toothpastes, deodorants, soaps, polymers and fibers [28].

According to the data provided by of F.F. Erisman Federal Scientific Center of Hygiene (Table 1) Tr is active against the majority of pathogenic microorganisms settling on the skin's surface [25].

Table 1

Microorganisms which growth is suppressed by Triclosan

Gram-positive bacteria	Gram-negative bacteria	Fungi and yeast microorganisms
Staphylococcus aureus	*Esherichia coli*	*Candida albicans*
Staphylococcus epidermidis	*Enterobacter cloacal*	*Epidermophyton flocssum*
Streptococcus pyogenes	*Enterobacter aerogenes*	*Trichophyton entagrophytes*
Propionibacterium acnes	*Klebsiella pneumonial*	*Tricophyton rumbum*
Clotridium tetani	*Proteus vulgaris*	
Corynebacterium species	*Proteus mirabilis*	
Salmonella paratyphi A, B		
Salmonella choeraesuis		
Shigella flexneri		
Shigella dysenterial		
Vibrio choleral		

Tr importance as a broad-spectrum antibacterial agent is confirmed by the practice of intrahospital

infections suppression with its help [29]. Besides, Tr has anti-inflammatory effect [30] by blocking synthesis of inflammatory mediators in fibroblasts (main cellular form of connective tissue) and suppressing the eukaryotic cells which initiate inflammation.

Thus, the safety criterion has become a primary argument in selecting Tr (given other conditions being equal) as the antimicrobial component for PET fibers. Tr biocompatibility is confirmed by the results of numerous laboratory, toxicological and long-term clinical trials.

The main problem of Triclosan introduction into the crazes of the fibers is considerable viscosity of its solutions and their poor wetting of PET fibers. Attempts to overcome this challenge by Tr dissolution in alcohols and other organic solvents result in occurrence of many other problems. It seemed like an optimum solution to substitute Tr true solutions with its aqueous suspensions. Water is much cheaper than solvents being irrecoverably lost in the production process, is compatible with PET fibers oiling agents and is environmentally safe. Actually, the development of stable surface-active Tr aqueous suspensions has determined competitiveness of antimicrobial PET fibers obtained by the mechanism of crazing.

Tr water emulsions were prepared using the surface-active components to stabilize the thermodynamically unstable suspension of Tr microdrops in water. It seemed feasible to use for this purpose the substances which are part of the process liquids ensuring the oiling effect at PET fibers processing.

Sintezin was the first investigated substance of this group. The main characteristics of sintezin 41-82 – commercial product purchased by chemical industry enterprises – are presented in Table 2.

Table 2

Sintezin 41-82 technical data

Parameter description	Value
Appearance	White color paste
Water content, % by mass, no more than	42–46
pH of an aqueous solution of 10% by mass	7.5–8.5

The modifying emulsion preparation process consists of three operations: 1) Tr dissolving in alcohol; 2) preparing the sintezin aqueous solution – mixing the sintezin in 1/3 of the total amount of water, heating the mix to 50 °C, adding the remaining water while stirring; 3) mixing the first and second solutions using a high-speed mixer. A suspension with the smallest particles (diameter ~ 1 mcm, determined by an optical microscope) is received when using the following ratio of components, % by mass: Tr – 1, sintezin – 1, ethyl alcohol – 30, distilled water – 68.

The emulsion thus obtained has a pronounced antimicrobial activity. At microbiological testing, a zone (7-8 mm wide) of suppression of growth of microorganisms being tested is formed around the emulsion drop specimen on an agar plate (Fig. 2).

In the course of bench tests, an essential drawback of such modifiers was revealed: stratification of the mix and settling out of crystals occur in approximately 5 h after preparation of the solution. It is conceivable that stratification is caused by physical and chemical bonding of alcohol and Sintezin molecules resulting in depletion of Tr solution with solvent.

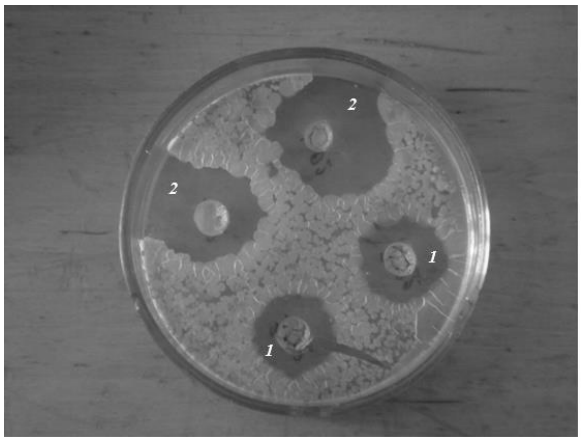


Figure 2 - Petri cup inhabited with *Staphylococcus*-type bacteria with antimicrobial emulsion samples: 1 – with sintezin, 2 – with sintanol.

Sintanol is SAS used in standard compositions of oiling agents for PET fibers (individually or in the mix with sintezin). Sintanol DC-10 manufactured by Hoechst (Germany) is a mix of polyethylene glycol monoalkyl ethers based on primary fatty alcohols $C_nH_{2n+1}O(C_2H_4O)_mH$, where n = 10÷18, m = 8÷10. Experiments on Tr water emulsions preparation using this substance were held by controlling IR spectra of the received products. They give evidence of physical and chemical interaction between emulsion components which, most likely, results in Tr microdrops stabilization by creating (on their surface) a structural and mechanical barrier against nonionic molecules of Sintanol [31]. Particles of such microemulsion are characterized by a very low surface tension at the boundary of water [26]. The following composition of Tr emulsion [32, 33], % by mass, has been developed to implement the crazing technology for obtaining antimicrobial PET fibers:

Triclosan − 0.8 ÷ 1.0,
Sintanol − 3.0 ÷ 4.0,
distilled water − 95.0 ÷ 96.2.

Neonol is another surface-active component of oiling agents for polyether fibers. It is a polyethylene glycol monoalkyl ether based on secondary fatty alcohols $(C_nH_{2n+1})(C_mH_{2m+1})CHO(C_2H_4O)_pH$, where $n + m$ = 10÷20, p = 12. A modifying compound for PET fibers was prepared using Neonol aqueous solution in which Tr is dissolved. Optimum compound composition, % by mass, is as follows: Tr 1.0÷1.5; Neonol 3.0; distilled water 95.5÷96.0. This compound is surface active and PET fibers drawing in it is accompanied with intensive crazes formation. Crazes are filled with the liquid phase which retains antimicrobial activity inherent to Tr [34].

In conclusion, it should be noted that the optimum area of Triclosan utilization in the crazing technologies for synthetic fibers modification is the creation of its emulsions in aqueous environments possessing surface activity.

2.3. Modifying compounds containing silver and bimetallic particles

Introduction of silver and compounds based thereof to the fibers' structure, results, along with clear benefits (bactericidal action, lack of skin irritant effects, long-term antimicrobial effect), in significant increase in the price of fibers (cost of precious metal additives is added to the fibers price). Expediency of, firstly, modifying the fibers' surface layer only to avoid "trapping" of silver particles in polymer matrix, and, secondly, using colloidal, preferably nanodimensional silver particles, in the modifying compounds to maximize area of their contact with the microbial environment is evident. These problems can be rather simply solved by introduction of silver to the fibers structure by the mechanism of crazing [10].

Antiseptic compounds for fibers processing should address the following issues. Firstly, acceptable balance between the basic level of the modifying fibers antibacterial activity and duration of their antiseptic action shall be ensured. Secondly, mandatory retention of antimicrobial effect when washing the modified-fibers-containing textile products shall be ensured. These requirements are inconsistent and therefore creation of antiseptic compositions demanded the structure optimization and development of non-standard methods for their preparation. It is obvious that fibers with high silver ions concentration on the surface will have the greatest antiseptic activity. However, in this case the duration of silver action is small as ions of metal will leave the fiber surface layer within a relatively short service life of a textile product.

Optimization of the structure and mechanism of action of a silver-containing modifier of fibers by the "activity/duration of action" criterion can be carried out observing several technological principles, the most significant of which are the following.

1) Use of silver particles in colloidal or nanodimensional range [35].

2) Use of slightly soluble antiseptic compounds [36].

3) Immobilization (fixation) of silver ions by the fibers polymer matrix containing functional groups which bind the ions [37].

When applying technologies envisaging the use of precious metals, the problem of reducing the consumption of the latter is always of crucial importance. A task was set to reduce silver concentration in the modifying compound by adding another, cheaper metal which creates antiseptic effect. It was solved by cultivation of colloidal copper particles on which surface the nanodimensional silver particles are settled.

The methodology of obtaining modifying compounds with bimetallic particles is as follows. When a colloidal copper solution is added to the silver nitrate solution, copper particles serve as a silver ions reducer by the exchange reaction mechanism

$$2Ag^+ + Cu = Ag + Cu^{2+}.$$

Bimetallic particles demonstrate complex antiseptic action: silver – against fungi, bacteria and viruses; copper – predominantly against fungi, especially mold ones. Exchange reaction of ions reduction prevents formation of silver dendrites as the growth of silver particles is localized at the centers of reduction and is limited by the size of colloidal copper particles.

The method of obtaining a modifying compound with bimetallic particles from the mix of silver nitrate and copper acetate $Cu(NO_3)_2 \cdot 3H_2O$ aqueous solutions was offered [38, 39].

By means of the instrument [40] it is established that all compounds mentioned in these paragraphs initiate crazes formation.

3. ANTIMICROBIAL ACTIVITY OF FIBERS

Efficiency of the developed compounds as the technological medium which imparts antiseptic properties to polyether fibers is assessed by processing the fibers by the mechanism of crazing. Experimental samples of antiseptic fibers were subjected to microbiological trials.

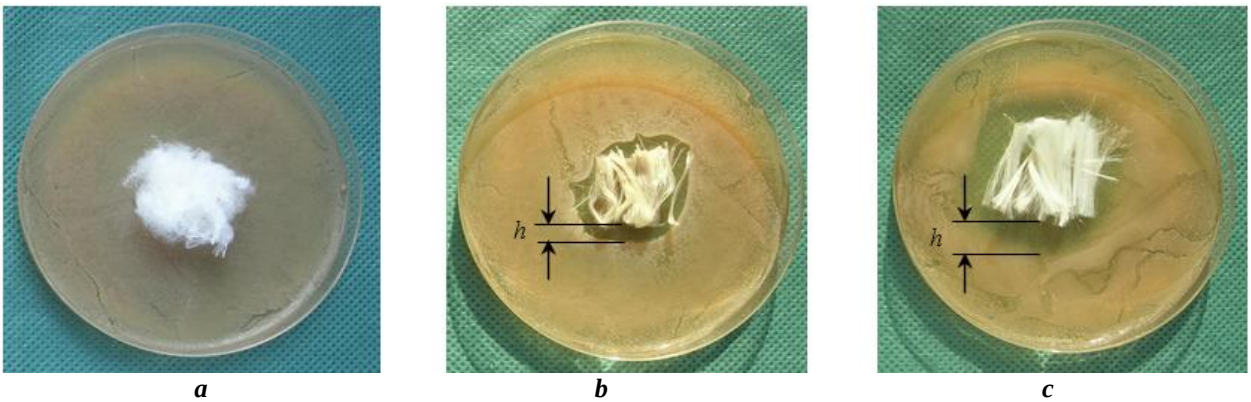
Bactericidal and bacteriostatic fibers were manufactured as a part of the pilot batch. Bactericidal fibers (from *bacterium* and the Latin *caedo*, meaning, "I kill") are fibers that are capable of killing bacteria, and bacteriostatic fibers (from *bacterium* and Greek *statis*) do not upset the balance of bacteria on the skin, but temporarily stop bacteria from reproducing.

Bactericidal fibers were obtained by using the modifying compound with Triclosan and sintanol. The composition was prepared as follows [32]: sintanol was diluted upon stirring in a small volume of water warmed up to 50 $^{\circ}C$, triclosan batches were being added and the solution was being diluted with the remaining water. Bactericidal fibers production was carried out at the bundle speed of 16.1 m/min and draw ratio of 210%, temperature of the modifying compound amounted to 28 $^{\circ}C$.

Bacteriostatic fibers were processed with the compound based on triclosan and sintanol in which the triclosan concentration was reduced twofold and a solution of colloidal silver (Adjetta trade mark) in the amount of 4 % by mass was additionally introduced. The composition was prepared similarly to the previous one, then the Adjetta solution was being added in batches to the mix. Fibers of the pilot batch were manufactured with speed of 13.6 m/min, draw ratio of 230%, modifier temperature of 26 $^{\circ}C$.

The standard methods for assessment of the textile fibers antimicrobial effect are developed in many countries. The fibers antiseptic properties were determined using the methodology which summarized the essential features of similar purpose standards – AATCC 100-1993 (USA), SN 195924-1983 (Switzerland), JIS 1902-1998 (Japan).

Cultures of microorganisms were sowed in Petri cups with the agarized nutritive medium. A sample of modified fibers (~ 0.03 g) was placed into the cup. The cups with samples were kept in a thermostat at temperature of 29±2 $^{\circ}C$ and relative humidity in air of 90 % during 14 days. Width *h* of a zone of suppression of bacterial growth around the sample was registered according to the Russian State Standard (GOST) 9.802−84. The basics of the method are explained in Fig.3 where it can be seen that the biofilm of testing bacteria *St. ep*. has grown to the edges of the sample from the initial PET fibers (*a*), but has not entered the zones of bacterial growth suppression which are forming round the fibers and which had been processed by the colloidal silver solution (*b*) and Triclosan (*c*).



a ***b*** ***c***

Figure 3 - Suppression of growth of testing bacteria *St. ep.* by PET fibers: *a* – initial fibers, *b* and *c* – modified by compounds containing silver [36] and Triclosan [33], *h* – width of suppression zone.

In the course of heat and wet processing, the fibers lose their ability to suppress vital functions of microorganisms. Stability of antiseptic characteristics of the modified fibers was estimated by subjecting them to repeated processing according to the method described in [41]. The fiber sample was placed into a beaker with a washing solution (5 g of detergent per 1 l of water) heated to T = 45 $^{\circ}C$., The sample was brought into rotation with frequency of 50±5 rpm during 5 minutes using a magnetic stirrer, then it was rinsed under running water (1 min.) and left at room temperature until dry. This processing corresponds to soft conditions (method 7B) of textiles washing in the activator-type machines [42]. Antimicrobial activity of fibers and fabric samples was controlled after each washing.

In the course of crazing modification, PET fibers and products thereof acquire a stable property

of suppressing growth of pathogenic microflora on the human body and its environment. In the textile technology, PET fibers are used in the mix with cotton, woolen, silk and other fibers. It allows to regulate antimicrobial activity of textiles by varying the share of antimicrobial fibers in the mix. At the same time, antimicrobial fibers retain the strength and anti-friction properties inherent to PET and make the textile fabrics crease-resistant. The results of assessment of these properties of PET fibers modified by the crazing mechanism and textile materials based on them are shown below.

Experimental samples of PET fibers processed with different antiseptic compounds demonstrate antimicrobial activity which indicators are shown in Table 3 [43].

Table 3

Antiseptic indicators of the modified PET fibers

Indicator / Modifier	*h* (mm) after heat and wet processing (cycles)						
	0	10	20	30	40	50	60
Althosan solution concentration (%):							
10	7 – 9	≥ 1	0	–	–	–	–
50	8 – 10	≥ 1	0	–	–	–	–
Kathamin solution concentration (%):							
10	5 – 7	≥ 1	0	–	–	–	–
50	9 – 10	≥ 1	0	–	–	–	–
Compound based on Triclosan [28]	9 – 13	8 – 12	7 – 11	6 – 9	4 – 8	3 – 6	2 – 5
Compound based on silver [35]	3 – 5	3 – 4	2 – 4	2 – 3	1 – 2	1 – 2	0

The following conclusions can be drawn based on comparison of these data. Kathamin and Althosan aqueous solutions are intensively removed from the crazes during heat and wet processing of fibers, while the removal rate has little dependence on the solution concentration. Colloidal silver particles trapped in the crazes "work" long enough. Triclosan is not washed away from the crazes even after 60 fiber processing cycles. It might be considered that the colloidal silver particles and Triclosan introduced into PET fibers by the crazing mechanism meet the requirements imposed by the textile industry on the new generation fibers for manufacturing products for personal use and special purposes [44]. Antimicrobial activity of the fibers containing colloidal bimetallic (Cu–Ag) particles is higher than that of fibers containing silver particles and is comparable with the indicators of activity of fibers modified by Triclosan. The mass of active components of antimicrobial compounds trapped by the crazes is within 0.9 ÷ 3.3% of the mass of initial fibers [45].

Technological effectiveness and assortment possibilities of the cotton yarns with introduction of 30÷50 % of antimicrobial PET fibers have been positively evaluated [46].

Microbiological testing of fabrics with different content of antimicrobial fibers was performed in the accredited laboratory "Scientific Research Institute of Epidemiology and Microbiology" of the Ministry of Health of Belarus. A conclusion on the expressed biological activity of fabrics of optimal composition with respect to *St. an.* and *Es. coli* was received. The antimicrobial effect remains after 5 dry cleanings of samples. The method of samples contamination (infection) with testing microbes has conclusively demonstrated antibacterial and antifungal activity of fabrics.

Experts of the Central Scientific Research Institute for Complex Automation of Light Industry (JSC TSNIILKA, Moscow) established that the optimal composition of fibrous textile with bioprotective capability is as follows (% by mass): natural and/or chemical fibers – 70 ÷ 95, biologically active fibers – 5 ÷ 30 [47].

4. FIBERS WITH ANTIMICROBIAL PROPERTIES

Products made of antimicrobial fibers have found their niche in the market of the new generation textiles. The demand for them continues to grow which has resulted in the change of priorities in textile products consumption. So, the demand for fibers with antimicrobial activity has respectively grown. The demand of Western European countries in these products in 2005 amounted to 17.6 thousand tons, in 2010 – 28 thousand tons. In Russia, this value is close to 15 thousand tons [48].

World's leading textile companies have been manufacturing antimicrobial chemical fibers for more than 20 years. Trevira (Germany) has developed polyether fiber of Trevira Bioactive brand. The antibacterial effect is achieved by volumetric chemical and physical modification of fibers that provides for long-term retention of the effect even after 100 washings. Trevira Bioactive creators claim

that the fiber protects the person against all forms and types of bacteria, thus ensuring purity and safety of the textile fabric. The fiber can be used in a range of applications, including production of workwear, overalls, aprons, trousers and shirts worn by medical personnel, food industry employees, etc. [49].

International company Nylstar (Italy) introduced bacteriostatic polyamide fibers – Meril®Skinlife. They impart long-term antiseptic effect to the textiles without causing adverse reactions to a person. Such fibers are used in production of cloths and fabrics, including medical and filter ones. The technology of antiseptic modification is based on introduction of a silver-based bactericidal agent into the surface layer [50].

Amicor®, the fiber developed by Schoeller Bregenz, is considered to be an achievement in the field of bactericidal materials. This is a polyacrylonitrile fiber with antimicrobial agent triclosan. The technology of its production constitutes the company's trade secret. Fibers are used as a part of fabrics for production of sportswear, hosiery, as well as for production of linen and special purpose fabrics, lining materials [51].

Polypropylene fibers Prolen® (manufactured by JSC Chemosvit Fibrochem) containing a silver-based bactericidal agent are intended for production of fabrics, knitted goods and non-woven fabrics. Textile products with the "Sanitized" logo have appeared in the European market. This marking means that antimicrobial Sanitized® fibers manufactured by Clariant Co. were used in manufacturing of the product [52].

Also of interest is Mirawave fiber introduced by Huvis Corporation (South Korea). These polyether staple fibers have the ability to emit infrared radiation and, due to this, display long-term antibacterial activity. ABF polyether fiber suppresses the development of microorganisms owing to the bactericidal agent being part of it [53].

DAK Americas Co has introduced the antimicrobial polyether staple fiber with the adjustable level of hygroscopicity under "Deleron Hydro Pur" brand [50]. The fiber comprises an antibacterial agent under the trade name "Alpha San" and ion exchange resin based on zirconium and silicon phosphates containing silver which inhibits the growth of microorganisms.

A range of products available on the Western European market of antimicrobial fibers is presented in Table 4.

Table 4

Range of synthetic bactericidal fibers [49, 50, 54]

Manufacturer	Trademark	Material fibers	Antibacterial additive
Accordis Kelheim GmbH, Germany	Danufil	Viscose	Triclosan
Lenzing AG, Austria	Lenzing Viscosa	Viscose	Silver
Montefibre SpA, Italy	Terital	PET	Silver
R. Stat SA, France	R. Stat P, R. Stat N	PET, PA	Silver
Accordis Acrylic Fibres UK Ltd.	Courtek M, Amicor	PAN PAN	Triclosan
Clariant, Switzerland	Sanitized	—	Triclosan
Noble Fiber Technologies	X-Static	PA/PET	Silver
Saniwear	Terital, Leacril	PET, PAN	Silver
Kanebo	Livefresh	PA	Silver
Rhovyl	Rhovyl	PVC	Triclosan

Research institutes of Russia and Eastern Europe are also engaged in development of antimicrobial materials. So, the Slovak Scientific-Research Institute of Chemical Fibers has obtained polypropylene-based fibers resistant

to the action of microorganisms and mold which are used in the productions of textiles and for medical purposes. The Institute of Chemical Fibers (Poland) conducts researches on the use of chitin/chitosan as additives to bactericidal fibers. Moscow State University of Design and Technology together with the All-Russian Center of Disaster Medicine "Zaschita" ("Protection") develop antimicrobial materials for medical use. Katamin AB, as well as a compound comprising potassium iodide and naphthalene sulphonate (in addition to katamin) are used as the antimicrobial agent [55].

A.N. Kosygin Moscow State Textile University together with the Institute of Synthetic Polymeric Materials (Tver, Russia) has developed a method to impart bactericidal properties to viscose fibrous material by impregnation Polyhexamethyleneguanidine hydrochloride (metacide) which has low toxicity, prolonged effect

and is a cationic surface-active substance is used as the bactericidal agent [56].

In certain cases, manufacturers of antimicrobial fibers report what active additives are introduced into the polymer base, but far more often they do not provide such information trying to protect their *know-how*;

however, in recent years they usually name a group of substances to which the additive belongs to show the consumer that fibers do not contain substances hazardous to health. Since suppression of the activity of microorganisms is not a sole requirement to the antimicrobial component of synthetic fibers, it is reasonable to consider the full range of such substances and to define criteria which they should meet.

5. ANTIMICROBIAL FIBERS' USE IN MEDICINE AND CLOTHING

Textile materials and products that have been engineered to meet particular needs are suitable for any medical and healthcare application in which a combination of strength, flexibility, and sometimes moisture-and air-permeability is required. Materials used include monofilament and multifilamenl yarns, woven, knitted, and non-woven fabrics, and composite structures. The applications are many and diverse, ranging from a single-thread suture to the complex composite structures used for bone replacement, and from the simple cleaning wipe to the advanced barrier fabrics used in operating rooms [57].

Over the last few years, the textile industry has developed different methods for obtaining fabrics and fibers with an antimicrobial action for use in hospital environments and for other purposes [16]. With the growing public health awareness of the pathogenic effects, malodors and stain formations caused by microorganisms, there is an increasing need for antibacterial materials in many application areas like medical devices, health care, hygienic application, water purification systems, hospital, dental surgery equipment, textiles, food packaging, and storage [58-60].

Various groups of antimicrobial substances belonging to the classes of organic and inorganic compounds are applied with the aim to create biologically active textile materials with wide-spectrum antimicrobial activity and resistance to different processing methods. The most common of them are metals and their salts, salts of quaternary ammonium bases, phenolic compounds, various heterocyclic compounds, including nitrofuran class compounds, antibiotics, antimicrobial dyes, etc.

The following antibiotics are also used to impart bactericidal properties to textile materials: cephalosporin, tetracycline, etc. Clinical studies of antibiotics have shown that the gram-positive and gram-negative microflora, including the colon group of bacteria, olms, blue pus bacillus, is sensitive to them [61].

The common carriers of antimicrobial materials are fabrics made of ***cellulose fibers*** manufactured by simple interlacing with smooth homogeneous surface. Among cellulose fabrics, the fabrics with chemically-bonded antimicrobial agents which are characterized by ability to retain the long-lasting bactericidal effect after repeated washings, sterilizations, autoclave treatment, etc. are of the greatest interest to medicine. For this purpose, cellulose is subjected to preliminary treatment in order to introduce (into the macromolecule) the reactive functional groups capable to interact with bactericidal or fungicidal preparations.

Antimicrobial fabrics made of cellulose fibers are used in production of medical bandages, tissues, sanitary products, underwear and bed-linen, hosiery, sock liners, as well as protective workwear for persons dealing with dangerous pathogens, plague, anthrax, brucellosis, etc. [58].

Wound dressings intended to accelerate healing of septic wounds and burns which application reduces the term of their treatment by half have been created on the basis of modified cellulose with reactionary active groups of medicinal substances [62].

Tissues made of low-grade ***cotton raw materials*** with surface density of 120–170 g/m and content of antimicrobial, antifungal or deodorizing additive of 10–70% of the mass of the material are related to sanitary products which are used for domestic and industrial purposes.

Medical bandages representing a sterile cotton gauze or similar textile material with a pharmaceutical carrier in the form of an ointment, paste, aerosol, etc. have found application in treatment of ulcers of the patients confined to bed. For example, a bandage on the base of a plain-woven cotton fabric and a layer of medicinal substances reduces microbial contamination of human skin and interrupts the mechanism of infectious diseases transmission [63].

The cotton-fabrics-based hosiery and sock liners have a distinctive mycocide effect resistant to repeated washings. They are applied for treatment and prevention of skin diseases.

Artificial and synthetic fibers and threads are effective carriers of antimicrobial preparations. So, fabrics made of polyvinylalcohol, polyethylenterephthalat, ftorlon, hydrocellulose and acetate fibers and threads are obtained by introducing various bactericidal agents into a spinning solution or polymer melt. However, they lack the antimicrobial effect resistance to repeated washings. Therefore, such fabrics can be used for the products designed for a limited number of washings or intended to be

used under conditions where they are not subjected to processing with water. However, as discussed in this chapter, the antimicrobial polyester fibers produced by the crazing technology can endure repeated wet processing with practically no decrease in antimicrobial activity.

Antimicrobial fabrics from polyvinyl alcohol, polyacrylonitrile, polyamide threads are used, for example, to produce sanitary products, hosiery, as well as rugs for hospitals.

Antimicrobial synthetic threads have a wide application in the form of ***suture materials*** – ***threads***. Such surgical suture represents a new pharmaceutical form of chemotherapeutic preparations to prevent side effects on the human body and tissues which frequently occur when traditional methods of medicines administration are used. According to data of the A.V. Vishnevsky Institute of Surgery (Russia), polypropylene and polycaproamide suture threads possess the highest and prolonged therapeutic action among all known antimicrobial suture materials. Synthetic threads with antimicrobial properties are also used as vascular implants.

Besides the fabrics, ***knitted cloths*** have found application as textile carriers for antimicrobial materials. The knitted cloth (unlike the fabrics) possesses good flexibility, elasticity and stretchability that allows to obtain products in the form of tubes of various diameters and shapes. The type of the knitted material weaving is one of the main characteristics which defines its properties: stretchability, unknitting, shape stability, etc. Knitted cloths with the main types of weaves (jersey structure, rib structure, tricot, etc.) are widely used in medicine.

Knitted fabrics based on polyester and polyamide threads, as well as spindleless spinning cotton yarn with surface density of 140-280 g/m are used to produce dressing materials [64-66]. They possess high capillary action, lightness and can be freely separated from the wound surface. High shape stability at washing and resistance to sterilization allow the reuse the products made of knitted synthetic materials (up to 10 times).

Knitted fabrics made of synthetic threads, for example, polyester ones, can be used in the bandaging products as an atraumatic layer [67].

Cotton knitted materials with a complex of therapeutic and antimicrobial substances are applied in medical bandages and tissues. They rapidly absorb wound secretions, possess the expressed antimicrobial properties, are characterized by the increased therapeutic effect, provide for dynamic clearing of infected wounds, prolonged medical action and less frequent change of bandages at practically complete atraumaticity.

For example, AKTIVTEKS antimicrobial bandages and tissues made of cotton knitted fabric are designed for treatment of trophic ulcers and ulcerous defects at diabetic foot infections. They contain medicinal agents of local anesthetic, antiseptic and wound-healing action along with a biocompatible polymer-polysaccharide which swells when moistened and forms a gel, thus ensuring a prolonged introduction of medicines into the wound. Application of AKTIVTEKS tissues increases the efficiency of trophic ulcers treatment because of the fact that, at the first stage, combination of antioxidant and antimicrobial action leads to the improved medical outcomes, while, at the second stage, the combination of antimicrobial and wound-healing action leads to reduction of the healing time [68].

Cotton-lavsan knitted fabrics with antimicrobial properties are used as medical swabs and surgical bandages. They are elastic, can be easily placed on contoured surfaces of wounds and introduced into slit-like wounds (as well as easily and relatively painlessly removed from them); they possess high hygroscopicity and capillarity and ensure drainage (the most important factor of treatment for wound) while their basic properties are as good as the ones of the medical gauze swabs and bandages. The design of products (knitted weaving, plain edge) simplifies operation of cotton-lavsan swabs and excludes the possibility to leave the tiniest threads of dressing material in the wound which is often the case when gauze swabs are used [69].

Flat knitted mesh cloths made of antimicrobial polypropylene threads have been successfully used in reconstructive surgery for many years, while mesh knitted fabrics made of polypropylene threads in combination with polyamide ones are used (instead of gauze tissues) as antimicrobial dressing for burn wounds [70].

Non-woven cloths are promising carriers of antimicrobial preparations. Non-woven fabrics obtained by needle-punching and canvas-sewing techniques, thermal bonding, adhesive bonding or their combinations are the most widespread ones.

Needle-punched non-woven fabrics made of polypropylene fibers with surface density of 100 g/m^2 and higher, as well as the ones based on polyvinylalcohol fibers with chemically bonded antimicrobial agents have found application as biologically active swabs [71]. Since polypropylene fibers have cation- and anion-exchange groups and medicinal agents have basic or acid groups of different ionic strengths, it is possible to control the bonding strength between the two which accordingly provides for the possibility to obtain biologically active non-woven fabrics with variable time of therapeutic action.

Medical non-woven material in the form of threadless canvas-sewn cloth made of the bleached modified viscose is used for bandages. It possesses high hygroscopicity, it rapidly absorbs and effectively withdraws the secretions from wounds. Air permeability of a bandage made of such non-

woven cloth is 4 times higher as compared to a cotton gauze bandage.

Thermally-bonded non-woven fabrics made of polyurethane threads are used to produce elastic bandages. Along with high elasticity, they possess good air permeability.

The problem of textile materials "dusting" prevention in surgery has been one of the most important challenges for a long time. Particles of fibers (when they get into an open wound) often lead to granulomas. The use of polypropylene non-woven materials with latex binders reduces the amount of large (more than 3 microns) particles in the wound by 90% as compared to cotton fabrics. They are used to produce tissues and sanitary products.

Thus, fabrics, knitted fabrics and non-woven cloths are the main textile carriers of antimicrobial materials used in medical practice.

Fabrics and knitted fabrics are used widely enough in production of ***clothes, linen, surgical dressings, sanitary and other products***. Non-woven cloths are not commonly used yet and have come into use mostly as surgical dressings. However, non-woven antimicrobial fabrics start to be used for production of workwear and bedding items, but most often such products are single-use ones.

Antimicrobial materials used to manufacture ***medical wear***, including special clothes for surgeons, occupy an important place. Such clothing not only provides for reduction in postoperative pathologies, but also protects the surgeon against infections which is particularly relevant with regard to the spread of such diseases as AIDS.

At present, products obtained from woven and knitted textile cloths prevail in the assortment of medical products based on textile antimicrobial materials. Non-woven cloths are used in production of antimicrobial materials on a limited basis. Antimicrobial materials on non-woven carriers are used mainly for production of single-use surgical dressings, bandages, tissues, sanitary products, personal hygiene products, medical workwear and linen (bed-linen, underwear, surgery clothes) [68].

Conclusion

The problem of preserving textile materials quality and consumer properties is of great practical importance and a task which solution lies at the intersection of sciences. Adverse changes in textile fabric properties during transportation, storage and operation are caused by the damages due to physical, chemical, mechanical and biological factors. Biological deterioration is the main cause of impairment in textile materials quality and in some cases of their complete destruction. Methods of textile protection from biodeterioration are used at different stages of usage and consumption of textile goods, as well as during their manufacturing. This review is devoted to polyester fibers with antimicrobial properties and describes the antiseptic components of fibers, testing methods and fiber's properties. The final part shows numerous examples of application of antimicrobial fibers (natural and synthetic ones) in medicine and clothing.

References:

1. (1992) Russian State Standard (GOST) 9.102–91. Unified system of corrosion and ageing protection. Influence of biological factors on technical objects. Terms and definitions. Moscow, 1992
2. (1985) Biotechnology: Principles and Applications (Studies in Microbiology, Vol. 3). Higgins, I.J.; Best, D.J.; Jones, J. (Editors). Oxford Uni., 1985
3. Pehtasheva EL, Neverov AN, Sinizin NM (2002) Die rolle und nutzung mikrobiologischer prozesse im lebenszyklus von materialien unter besonderer berucksichtigung von textilien. *Forum Ware*, 2002, Bd. 30, No 1-4, p. 73-76.
4. Sklyannikov VP (1982) Consumer properties of soft goods. Moscow: Ekonomika, 1982, 160 p.
5. Khasanov GI (2002) To the problem of wool destruction by microorganisms. *Textile industry*, 2002, No 2, p. 29-30.
6. Mesyachenko VT, Kokoshinskaya VI (1987) Merchandising of soft goods. Moscow: Ekonomika, 1987, 415 p.
7. Pekhtasheva El (2002) Biodeterioration and protection of nonfoods / Ed. A.N. Neverov. Moscow: Masterstvo, 2002, 224 p.
8. Afinogenov GE, Panarin EF (1993) Antimicrobial polymers. S.-Petersburg: Gippokrat, 1993, 264 p.
9. (1980) Fibers with special characteristics / Ed. L.A. Wolf. Moscow: Khimiya, 1980, 240 p.
10. Goldade VA, Pinchuk LS, Vinidiktova NS (2010) Modification of polyester fibers by bactericides using crazing mechanism. *Intern.*

Polymer Processing, 2010, Vol. 25, No 3, p. 199-204.
11. Krasil'nikov AP (1995) Handbook on antiseptics. Minsk: Vysheishaya shkola, 1995, 366 p.
12. (1987) Antimicrobial materials in medicine. Ed. by L.A. Il'in. Moscow: Medicine, 1987, 190 p.
13. Pyatkin KD, Krivoshein YS (1981) Microbiology. Moscow: Medicine, 1981, 512 p.
14. Cho KH, Park JE, Osaka T, Park SG (2005) The study of antimicrobial activity and preservative effects of nanosilver ingredient. *Electrochimica acta*, 2005, V. 51, No 5, p. 956-960.
15. Miyanaga S, Hiwara A, Yasuda H (2002) Preparation and high bacteriostatic action of the activated carbons possessing ultrafine silver particles. *Science and Technology of Advanced Materials*, 2002, Vol. 3, No 2, p. 103-109.
16. Mariscal A, Lopez-Gigosos RM, Carnero-Varo M, Fernandez-Crehuet J (2011) Antimicrobial effect of medical textiles containing bioactive fibers. *Eur J Clin Microbiol Infect Dis.*, 2011, Vol. 30(2), p. 227-232. DOI: 10.1007/s10096-010-1073-1. Epub 2010 Oct 17
17. Nomiya K, Onoue KI, Kondoh Y, et al. (1995) Synthesis and characterization of oligomeric, anionic thiomalato-silver(I) complexes with biological activities. *Polyhedron*, 1995, Vol. 14, No 10, p. 1359-1367.
18. Zaporojtchenko V, Podschun R, Schürmann U, et al. (2006) Physico-chemical and antimicrobial properties of co-sputtered Ag–Au/PTFE nanocomposite coatings. *Nanotechnology*, 2006, Vol. 17, No 19, p. 4904-4908.
19. Chen CY, Li Chiang C (2008) Preparation of cotton fibers with antibacterial silver nanoparticles. *Materials Letters*, 2008, Vol. 62, p. 3607–3609
20. (2017) Nexera Medical. Strategic Alliances. Available: http://www.nexeramed.com/cfiles/about_partners.php#agion (Accessed: 10.03.2017).
21. Kazakyavichute GA, Korchyagin IV, Kul'kova ON, Sedov AV, Il'in VV (1983) Imparting antimicrobial properties to cellulose textile materials. *Textile Industry*, 1983. No 9, p. 53-55.
22. Borisevich IV, Sytsko VE, Pinchuk LS (2005) Active components of bactericidal polymer fibers. *Plasticheskie massy* (Plastics Magazine), 2005, No 8, p. 35-40.
23. Borisevich IV, Sytsko VE, Pinchuk LS, Ignatovskaya LV (2005) Antimicrobial components of polymer fibers. *Materials. Technologies. Tools*, 2005, Vol. 10, No 3, p. 63-68.
24. Pletnev YN (1990) Cosmetics-hygienic cleaning agents. Moscow: Khimiya, 1990, 272 p.
25. Ernandes E (2000) Triclosan: modern conceptions. *Cosmetics and Medicine*, 2000, No 1, p. 5-17.
26. Efimov KM, Gembitskiy PA, Snezhko AG (2000) *P*oliguanidins – class of low-toxicity disinfectant agents with prolonged action. *Disinfectant art*, 2000, No 4, p. 22-30.
27. Regos J, Zak O, Solf R (1979) Antimicrobial spectrum of triclosan, a broad-spectrum antimicrobial agent for topical application. *Dermatologica*, 1979, Vol. 158, No 1, p. 72-79.
28. Allmyr M, Adolfsson-Erici M, McLachlan MS, Englund GS (2006) Triclosan in plasma and milk from Swedish nursing mothers and their exposure via personal care products, *Science of the Total Environment*, 2006, Vol. 372, p. 87-93
29. Zafar AB, Butler RC, Reese DJ (1995) Use of 0.3 triclosan (Bacti-Stat) to eradicate an outbreak of methicillin-resistant *Staphylococcus aureus* in a neonatal nursery. *American J. Infect. Control*, 1995, Vol. 23, No 3, p. 200-208.
30. Kiaerheim V, Barkvoll P, Waaler SM, Rolla G (1995) Triclosan inhibits histamine-induced inflammation in human skin. *J. Clin. Periodontol*, 1995. Vol. 22, N 6, p. 423-426.
31. (1977) Micellization**,** Solubilization and Microemulsions. Ed. K.L. Mittal. New York: Plenum Press, 1977, 489 p.
32. (2011) Russia patent 2,421,555. D01D 5/247. Process of antimicrobial PET fibers manufacturing. L.S. Pinchuk, N.S. Vinidiktova, V.A. Goldade, et al., 2011.
33. (2011) Belarus patent 15,252. D01D 5/247. Process of antimicrobial PET fibers manufacturing. L.S. Pinchuk, N.S. Vinidiktova, V.A. Goldade, et al., 2011.
34. (2009) Belarus patent 12,186. D01F 6/92, D06M 13/00. Process of antimicrobial PET fibers manufacturing. L.S. Pinchuk, V.A. Goldade, N.S. Vinidiktova, et al., 2009.
35. (2008) Belarus patent 11,260. D01F 6/92, D06M 11/00. Process of manufacturing antimicrobial fibers from polyethylene terephthalate. L.S. Pinchuk, V.A. Goldade, N.S. Vinidiktova, et al., 2008.
36. (2008) Belarus patent 10,803. D01F 6/92, D06M 13/00. Process of manufacturing polyethylene terephthalate antimicrobial fibers. L.S. Pinchuk, V.P. Novikov, N.S. Vinidiktova, et al., 2008.
37. (2011) Belarus patent 13,983. D01F 6/92, D06M 11/00. Process of manufacturing bactericidal fibers from polyethylene terephthalate. L.S. Pinchuk, V.P. Novikov, N.S. Vinidiktova, et al., 2011.

38. (2011) Belarus patent 14,166. D01F 6/92, D06M 11/00. Process of attachment antimicrobial activity to PET fibers. L.S. Pinchuk, V.P. Novikov, N.S. Vinidiktova, et al., 2011.
39. (2010) Russian patent 2,400,576. D01F 6/92, D06M 11/00, D01D 5/247. Process of attachment antimicrobial activity to PET fibers. L.S. Pinchuk, V.P. Novikov, N.S. Vinidiktova, et al., 2010.
40. (2010) Belarus patent 6,040 (utility model). G01N 3/00. Device for crazing investigation in chemical fibers. L.S. Pinchuk, N.S. Vinidiktova, V.A. Goldade, et al., 2010.
41. Vinidiktova NS, Borisevich IV, Pinchuk LS, et al. (2006) Modification of PET fibers with bactericides by craising mechanism. *Fiber Chemistry*, 2006, No 5, p. 34-37.
42. (2009) STB ISO 6330-2009 Textile materials. Washing and drying methods, applied for testing textiles. Minsk: BelarusLows, 2009, 24 p.
43. Vinidiktova NS, Pinchuk LS, Goldade VA, Novikov VP (2009) Craising use for antimicrobial fibers manufacturing. *Doklady NAN Belarusi* (Reports of NAS of Belarus), 2009, Vol. 53, No 5, p. 108-112.
44. (2003) Technology creation and production organization of fire-, bio- and electro-protective chemical fibers using crazing technology. *Textile*, 2003, Vol. 6, No 4, p. 32-33.
45. Vinidiktova NS, Pinchuk LS, Goldade VA, et al. (2009) Production of antimicrobial chemical fibers using crazing technology. *Materialovedenie* (Material science). 2009, Vol. 151, No 10, p. 57-63.
46. Gorodnicheva NA (2003) Investigation of specific properties of textile carriers with antimicrobial fibers. Proc. of Intern. Conf. "Polycomtrib". Gomel, 2003, p. 62-64.
47. (2012) Russian patent 2,439,221. D03D 25/00. Textile fibrous material with bioprotective properties. T.N. Kudryavtseva, V.A. Grischenkova, L.S. Pinchuk, V.A. Goldade, 2012.
48. (2003) Kudryavtseva T.N. Priorities in development of the complex on manufacture and processing of polyether fibers in Russia. *LegPromBiznes-Direktor*, 2003, Vol. 55, No 5, p. 29-31
49. Papkov CP (1990) Theoretical grounds of chemical fibers manufacturing. Moscow: Khimiya, 1990, 272 p.
50. Koluntayev S, Ulanov K (2003) Thank you, Meril. The bacteria are stepping back. *Rynok legkoi promyshlennosni* (The market of light industry), 2003, No 28, p. 14-15.
51. Il'ina I (2003) Today knitted wear is not only comfort but also protection! *Technical textile*, 2003, No 5, p. 27-28
52. Bossard M (2002) Hygienic protection of textile materials as an argument for goods sailing. An example of high marketing. *Russian Chemical Journal*, 2002. Vol. XLVI, No 2, p. 62-65.
53. Perepelkin KE (2001) Physical-chemical nature and structural conditionality of unique properties of polyether fibers. *Chemical fibers*, 2001, No 5, p. 8-19.
54. Aizenshtein EM (2003) Russian market of imported polyether fibers. *Textile Industry*, 2003, No 9, p. 60-63.
55. Makarova NA, Buzov BA, Mishakov VY (2003) Textile against microbes. Nomenclature and quality of carriers of antimicrobial preparations. *Textile Industry*, 2003, No 6, p. 20-21.
56. Yudanova TN, Skokova IF, Bochkareva ON, Gal'braikh LS (2001) Pharma-kinetical properties of fibrous materials modified by biological active matters of different type. *Chemical Fibers*, 2001, No 4, p. 35-39.
57. Rigby AJ, Anand SC, Horrocks AR (1997) Textile Materials for medical and healthcare applications. *J. Text. Inst.*, 1997, Vol. 88, Part 3, p. 83-93.
58. Shahidi S, Ghoranneviss M, Moazzenchi B, Rashidi A, Mirjalili M (2007) Investigation of antibacterial activity on cotton fabrics with cold plasma in the presence of a magnetic field. *Plasma Process and Polymers*, 2007, Vol. 4, p.1098–1103;
59. Anand SC, Kennedy JF, Miraftab M, Rajendran S (2010) Editors. Medical and Healthcare Textiles. Elsevier, Cambridge, 2010, 529 p. ISBN: 978-1-84569-224-7, Available: http://www.bolton.ac.uk/IMRI/Staff/StaffPages/ProfSubbiyanRajendran.aspx#sthash.YoLVKIgX.dpuf. (Accessed: 10.03.2017).
60. Anand SC, Kennedy JF, Miraftab M, Rajendran S (2006) Editors, Medical Textiles and Biomaterials for Healthcare, 1-508, Cambridge, Woodhead Publishing Limited, ISBN 1 85573 683 7, Washington DC, CRC Press, ISBN 0-8493 1780 0, 2006.
61. Chao Dong, Li-Ying Qian, Guang-Lei Zhao, Bei-Hai He, Hui-Ning Xiao (2014) Preparation of antimicrobial cellulose fibers by grafting β-cyclodextrin and inclusion with antibiotics. *Materials Letters*, 2014, Vol. 124, p. 181–183.
62. (2000) Russian patent 2157244. A61L 15/44. Method of manufacturing material with antimicrobial properties. Ponedel'kina I.Yu., Sibagatullin N.G., Gataullin N.G., et al., 2000.
63. (1998) Russian patent 1,473,147. A61L 17/00. Method of manufacturing suture filament with antimicrobial properties. Plechev V.V., 1998.

64. (2002) Russian patent 2,189,210. A61F 13/15, A61F 13/40, A61L 15/44, A61P 17/02. Multilayer medical bandage. Boldyrev S.N., 2002.
65. (1996) Russian patent 2,101,033. A61L 15/22. Dressing material with prolonged medical action. Boldyrev S.N., 1996.
66. (2002) Russian patent 2,178,310. A61K 45/06, A61L 15/20, A61L 15/28, A61P 17/02. Method of treatment ulcerous defects at syndrome of diabetic foot. Dreval A.V., Bakharev I.V., Krivikhin V.T., Vasil'eva T.S., 2002.
67. (2002) Russian patent 2,178,311. A61L 15/20, A61L 15/28. Method of treatment trophic ulcer of venous genesis. Batkaev E.A., Svetukhin A.M., Askerov N.G., et al., 2002.
68. Vainburg VM, Shtyagina LM, Illarionova EL, Chufarovskaya TI (2003) Biological active materials. *Technical Textile*, 2003, No 6, p. 24-26.
69. (1995) Russian patent 2,044,549. A61L 15/16. Bandage for treatment infected wounds and rendering first aid. Adamyan A.A., Zakharov V.V., Malinin S.E., et al., 1995.
70. (2000) Russian patent 2,143,281. A61L 15/16, A61L 15/44. Bandage for treatment wounds, burns, wounds, bedsores and rendering first aid. Shklyar S.A., Mokrushin I.N., 2000.
71. (1988) US patent 4,748,076 A. A61F 13/18, A61L 15/00. Water absorbent fibrous product and a method of producing the same. Kazuo Saotome, 1988.

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SECTION 3. Nanotechnology. Physics.

RESEARCH OF CURRENT- VOLTAGE CHARACTERISTIC OF PHOTOCONDUCTOR

Abstract: *The paper is devoted to research of current- voltage characteristic photoconductor in darkness at lighting.*

Key words: *semiconductors, current-voltage characteristic, photoconductor, resistance in darkness, photoconductivity.*

Language: *Russian*

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ИССЛЕДОВАНИЕ ВОЛЬТ-АМПЕРНОЙ ХАРАКТЕРИСТИКИ ФОТОРЕЗИСТОРА

Аннотация: *Статья посвящена исследованию вольт-амперной характеристики фоторезистора в темноте и при освещении его интегральным светом в собственной области поглощения.*

Ключевые слова: *полупроводник, вольтамперная характеристика фоторезистор, сопротивление при темноте, сопротивление при освещении.*

Introduction

Статья посвящена исследованию вольт-амперной характеристики фоторезистора в темноте и при освещении его интегральным светом в собственной области поглощения.

Общеизвестно, что при обучении курса физики на основе углубленной её программы для соответствующих учебных заведений или классов, в силу развития современной физики, техники и новых применяемых методов исследований предполагает углубить теоретических знаний и практических умений учащихся в обучении физике. Один из таких направлений является изучение свойств полупроводниковых элементов и их физических свойств. Данная статья посвящена одному из таких вопросов организации лабораторной работы – изучению вольт – амперной характеристики фоторезисторов в углубленных классах.

Фоторезисторы - это полупроводниковые элементы, которые под действием света меняют электрическое сопротивление. Принцип работы фоторезисторов основан на внутреннем фотоэлектрическом эффекте. При поглощении энергии кванта излучения в собственной области поглощения за счет отрыва ковалентной связи атомов полупроводника в них генерируются свободные электронно-дырочные пары, что приводит к резкому увеличению концентрации носителей тока и повышению электропроводности. В отличие от электронно-дырочных переходов или различных других диодных структур типа барьеров Шоттки (переход металл-полупроводник, имеющий внутренний разделяющий барьер) в фоторезисторах отсутствует внутренний электрический барьер, разделяющий носителей тока. Направленное движение электронов и дырок осуществляется под действием внешнего электрического поля, создаваемого потенциалами металлических электродов, припаянных на различных концах фоторезистора (металлические контакты являются не только электродами, задающий потенциал, но и участвуют в сборе носителей тока).

Фоторезисторы широко используются в самых различных областях науки, техники и производства. Они применяются для регистрации и измерения слабых световых потоков как в

видимой, так и в невидимой инфракрасной области излучения. В связи с этим изучение фоторезисторов включено в программу учебных заведении среднего специального образования с углублённым обучением физике в академических лицеях [1].

Materials and Methods

В настоящей работе приводятся некоторые результаты исследования электрофизических свойств фоторезисторов, которые имеются в кабинетах физики академических лицеев, представленных ПО «Эл-Холдинг» (Узбекистан). Экспериментальные результаты были получены на измерительной установке, электрическая схема которой представлена на рис. 1

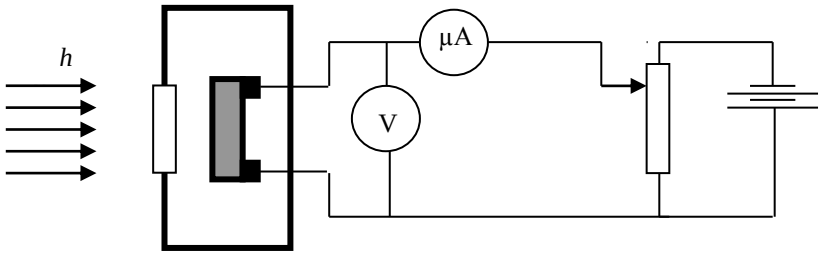

Рисунок 1 - Электрическая схема измерительной установки для снятия вольт-амперной характеристики фоторезистора.

На эксперименте были изучены вольт-амперные характеристики фоторезистора в темноте и при облучении его интегральным светом от ртутной лампы в широком интервале внешнего электрического напряжения как в положительном, так и в отрицательном направлениях. Вся измерительная часть установки была помещена в экранированном от внешнего освещения специальном ящике. На основе экспериментально полученных вольт-амперных характеристик фоторезистора в темноте было вычислено его темновое электрическое сопротивление, которое имело значение равное 9,9 МΩ (рис. 2). Из этого графика видно, что зависимость тока от приложенного напряжения в обоих направлениях имеет чисто линейный характер – $I \sim U$, это означает, что перенос тока через фоторезистор подчиняется закону Ома. Эти результаты также подтверждают, что металлические контакты являются чисто омическими, структура не имеет выпрямляющего свойства, следовательно, на контактах отсутствуют внутренние барьеры.

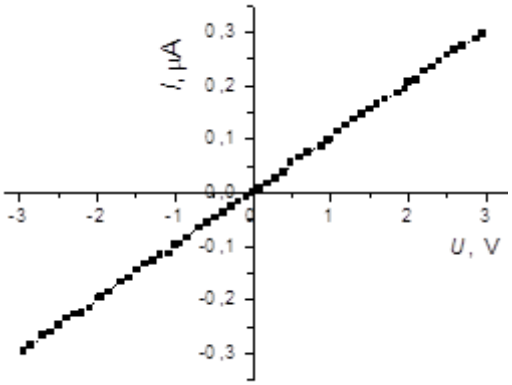

Рисунок 2 - Вольт-амперная характеристика фоторезистора при темноте. $R_{тем}$ = 9,9 МΩ.

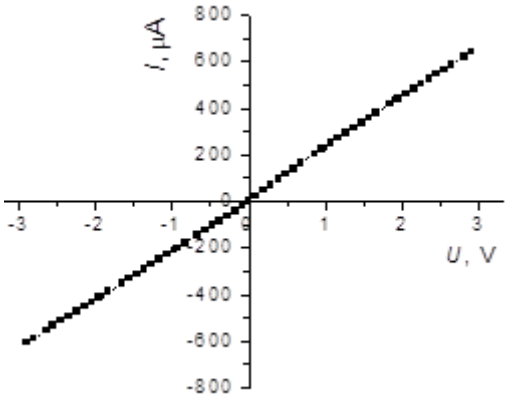

Рисунок 3 - Вольт-амперная характеристика фоторезистора при освещении. $R_{фото}$ = 4,58 кΩ.

На рис.3 показана вольт-амперная характеристика фоторезистора при освещении его интегральным светом от ртутной лампы в области собственного поглощения. Видно, что как в темноте, так и при освещении фоторезистора сохраняется линейная зависимость между током и напряжения – $I \sim U$. Однако, при освещении наблюдается резкий рост силы тока примерно в 2000 раза, что означает уменьшение сопротивления фоторезистора примерно в столько же раз. На основе этих данных было определено величина сопротивления фоторезистора при освещении, которое имело значение ~ 4,58 кΩ. Эти результаты показывают также, что освещение не приводит к появлению внутренних барьеров, т.е. выпрямляющие свойства структуры и в этом случае не проявляются.

Строго линейный характер зависимости $I \sim U$ как в темноте, так и при освещении говорит еще о том, что на контактах металл-полупроводник также отсутствуют разделяющие барьеры, т.е. они являются омическими.

Высокая фоточувствительность фоторезистора свидетельствует о том, что фоторезистор является слаболегированным полупроводником, и в нем концентрация свободных электронов близка к концентрации свободных дырок. Ток через фоторезистор определяется суммарным током, образованным свободными электронами (I_n) и свободными дырками (I_p), т.е.:

$$I = I_n + I_p . \qquad (1)$$

Когда образец однородный и отсутствуют внутренние барьеры, влияющие на движение носителей тока, электрический ток через образец определяется только упорядоченными движениями электронов под действием разности потенциалов, приложенных к концам образца, и плотность тока через образец можно выразить следующим образом:

$$J = q \cdot n \cdot \upsilon , \qquad (2)$$

где q– элементарный заряд, n – концентрация свободных электронов, υ – скорость упорядоченного движения электронов. На основе (1) и (2) для плотности тока исследованного фоторезистора можно написать следующее выражение:

$$J = J_n + J_p = q \cdot n \cdot \upsilon_n + q \cdot p \cdot \upsilon_p , \qquad (3)$$

где J_n, J_p – плотности тока, образованные свободными электронами и дырками, соответственно, υ_n, υ_p, - средние скорости упорядоченного движения электронов и дырок, соответственно, p – концентрация свободных дырок.

Как показывают результаты эксперимента при малых значениях напряжения и силы тока, (рис. 2, рис. 3), концентрация свободных электронов и дырок, а также скорости υ_n, υ_p не зависят от приложенного напряжения, и соответственно, от напряженности электрического поля (E). При постоянной силе тока I_n, I_p, согласно выражению (2), также постоянны. Но при этом на электроны и дырки действует со стороны поля постоянная сила $F = q \cdot E$. Если электрическое поле перестаёт действовать на заряженные частицы, то под действием сопротивления среды ток быстро прекращается, т.е. прекращается упорядоченное движение носителей тока. Время, за которое практически прекращается упорядоченное движение зарядов, называется временем релаксации.

При малых токах скорости I_n и I_p плотности тока имеют также малые значения (3), следовательно, силы сопротивления среды, действующие на электроны ($F_{c,n}$) и на дырок ($F_{c,p}$), можно считать прямо пропорциональными скоростям υ_n и υ_p, т.е. [2]:

$$F_{c,n} = k_n \cdot \upsilon_n , \quad F_{c,p} = k_p \cdot \upsilon_p \qquad (4)$$

где k_n, k_p – коэффициенты для электронов и дырок соответственно, считаем независящими от скорости и, соответственно, от приложенного электрического поля в образце. По второму закону Ньютона уравнения движения электронов и дырок описываются следующими выражениями:

$$m_n \frac{d\upsilon_n}{dt} = q \cdot E - k_n \upsilon_n ,$$

$$m_p \frac{d\upsilon_p}{dt} = q \cdot E - k_p \upsilon_p \qquad (5)$$

где m_n, m_p – массы свободных электронов и дырок в полупроводнике, соответственно. Считаем, что при малых электрических полях m_n, m_p постоянны. Если в момент времени $t = 0$ сила оказалась равной нулю $F = q \cdot E = 0$, а скорости в этот момент $\upsilon_n(0) = \upsilon_{no}$, $\upsilon_p(0) = \upsilon_{po}$, то уравнения (5) упрощаются:

$$m_n \frac{d\upsilon_n}{dt} = -k_n \upsilon_n , \quad m_p \frac{d\upsilon_p}{dt} = -k_p \upsilon_p . \qquad (6)$$

Из уравнений (6) следует, что быстрота убывания скоростей υ_{no} и υ_{po} до нуля прямо пропорциональна отношению $\frac{k}{m}$. Отметим, что величина $\frac{m}{k}$ имеет размерность времени. Введем обозначения

$$\tau_n = \frac{m_n}{k_n} , \ \tau_p = \frac{m_p}{k_p} . \qquad (7)$$

Тогда из уравнения (6) получим

$$\frac{d\upsilon_n}{dt} = -\frac{1}{\tau_n}\upsilon_n , \ \frac{d\upsilon_p}{dt} = -\frac{1}{\tau_p}\upsilon_p . \qquad (8)$$

Величины τ_n и τ_p определяют времена уменьшения скорости упорядоченного движения электронов и дырок до нуля. Чем больше τ_n и τ_p, тем медленнее происходит убывание скорости, следовательно, можно предположить, что τ_n и τ_p определяют времена релаксации упорядоченного движения электронов и дырок, соответственно. Решения уравнений (8) относительно скоростей имеют экспоненциальные виды:

$$\upsilon_n = \upsilon_{no} e^{-\frac{t}{\tau_n}} , \ \upsilon_p = \upsilon_{po} e^{-\frac{t}{\tau_p}} \qquad (9)$$

Из уравнения (9) следует, что смысл величины времени τ_n и τ_p – это время, за которых скорости упорядоченного движения электронов и дырок уменьшаются в e раз, соответственно.

Поскольку мы определили времена τ_n и τ_p, теперь на их основе можем определить скорости υ_n и υ_p. При постоянном токе, когда υ_n = const и υ_p = const, т.е. когда $\frac{d\upsilon_n}{dt} = 0$ и $\frac{d\upsilon_p}{dt} = 0$ из уравнений (5) и (7) следует

$$\upsilon_n = \frac{q \cdot \tau_n}{m_n} E , \quad \upsilon_p = \frac{q \cdot \tau_p}{m_p} E . \qquad (10)$$

Учитывая (10) и на основе уравнения (3) получим выражение для плотности тока в однородном полупроводнике, когда в нем отсутствуют внутренние барьеры

$$J = \left(\frac{q^2 n \cdot \tau_n}{m_n} + \frac{q^2 p \cdot \tau_p}{m_p} \right) \cdot E . \qquad (11)$$

Когда $n \approx p$ для нелегированного полупроводника, или полупроводника с малым количеством примесей выражение для плотности тока имеет следующий вид:

$$J = q^2 n \cdot \left(\frac{\tau_n}{m_n} + \frac{\tau_p}{m_p} \right) \cdot E . \qquad (12)$$

Экспериментальная зависимость $I = f(U)$ (рис. 2 и рис. 3) для исследованного фоторезистора имеет чисто линейный характер – $I \sim U$, т.е. выполняется закон Ома:

$$J = \sigma \cdot E , \qquad (13)$$

где σ - удельная проводимость, которая в нашем случае имеет вид

$$\sigma = q^2 n \cdot \left(\frac{\tau_n}{m_n} + \frac{\tau_p}{m_p} \right) . \qquad (14)$$

Линейная зависимость $I \sim U$ экспериментальных кривых (рис. 2 и рис. 3) подтверждает выполнение закона Ома и независимость удельной проводимости фоторезисторов от напряженности электрического поля в исследованном диапазоне напряжения.

Следовательно, концентрация и времена релаксации τ_n и τ_p также не зависят от напряженности электрического поля. Увеличения тока в ~ 2000 раза при освещении (рис. 3), по-видимому, обусловлено увеличением концентрации носителей тока за счет фотогенерации электронно-дырочных пар. Поскольку интенсивность освещения была невысокая, то не проявляются нелинейные эффекты, τ_n и τ_p, а также m_n и m_p не зависят от интенсивности освещения. Тогда можно заключить, что рост удельной проводимости фоторезистора обусловлен только зависимостью концентрации носителей тока от интенсивности освещения.

Conclusion

После проведения эксперимента полезно обратить внимание учащихся на тот факт, что широкое применение фоторезисторов в автоматике объясняется именно высокой чувствительностью их электрического сопротивления к внешним воздействиям. Отсюда следует также, при резкое изменение электрического сопротивления при внешнем воздействии приводит к изменению силы тока в цепи, что позволяет использовать фоторезистор для автоматического контроля объекта при включении или выключении различных устройств.

Таким образом, исследования вольт-амперных характеристик фоторезистора в темноте и при освещении его интегральным светом в области собственного поглощения поможет учащимся глубже понять сущность прохождения тока через структуру фоторезистора с омическими контактами и способствует формированию у них необходимых знаний и умений в изучении зависимости тока от напряжения в полупроводниковых структурах, в частности о свойствах фоторезисторов, которые подчиняются закону Ома.

References:

1. (2005) Otraslevoj standart. Gosudarstvennaja sistema standartov nepreryvnogo obrazovanija Uzbekistana. Tashkent -2005. p. 66-94.
2. Mjakishev GJ (2002) Fizika. Jelektrodinamika. 10-11kl.Uchebnik dlja uglublennogo izuchenija fiziki. Moskva: - Drofa 2002g. p.260-263, p. 327-329.
3. Zamjatin VJ, Kondrat'ev BV (1980) Tiristory. M.: Sov. radio, 1980. p. 64.
4. Gerlah V (1985) Tiristory [per. s nem]. M.: Jenergoatomiz dat, 1985. p. 328.
5. Mironov JM (1997) Teoreticheskaja jelektrotehnika jelektricheskih jelektrodnyh pechej. Cheboksary: Izd-vo Chuvash. un-ta, 1997. 232 p.
6. Mironov JM, Mihadarov DG (2008) Issledovanie harakteristik dugi postojannogo toka // Jelektro- mehanika, jelektrotehnologii, jelektrotehnicheskie materialy i komponenty: XII Mezhdunar. konf. Alush- ta, 29 sent.-4 okt., 2008 g. Alushta, 2008. p. 312.
7. Mironov JM, Mihadarov DG (2009) Issledovanie staticheskih i regulirovochnyh harakteristik dugi postojannogo toka // Trudy Akademii jelektrotehnicheskih nauk Chuvashskoj Respubliki. 2009. № 2. p. 41-43.
8. Sisojan GA (1974) Jelektricheskaja duga v jelektricheskoj pechi. 3-e izd. M.: Metallurgija, 1974. 304 p.
9. Semjonov AA, Usanov DA (2009) Aktivnyj dvuhpoljusnik s S i N obraznoj vol't ampernoj harakteristikoj // Izv. vuzov. Jelektronika. 2009. № 2. p. 17–21.
10. Chua L, Yu Juebang, Yu Youying (1985) Bipolar JFET MOSFET negative resistance devices // IEEE Transactions on Circuits and Systems. 1985. Vol. 32. p. 46–61.
11. Tejlor P (1990) Raschet i proektirovanie tiristorov / per. s angl. M.: Jenergoatomizdat, 1990. p. 208.

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SECTION 30. Philosophy.

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THE CREATIVITY PHENOMENON IN THE FOCUS OF SOCIAL-PHILOSOPHIC RESEARCH FOR POSTMODERN INTELLECTUAL PROPERTY

Abstract: *The article gives a brief analysis of the creativity phenomenon in its understanding as a process, and also as originative mechanism playing a key role in the artworks' genesis, meaning that creative results later become the objects of intellectual property. Contemporary creative process' specificity is analyzed considering current information realities, and taking into account the postmodern situation. The general conclusion that can be drawn from the stated material follows here: in some areas the culture of our time demonstrates a tendency of movement from the individual creativity to the collective creativity, and nowadays' communication technologies make it possible to co-author for people who may even don't know by sight each other actually. Everything mentioned doesn't mean that the end of Intellectual Property institution is coming. But it indicates quite definitely: the contents of researched social institution have significant expansive and updating potential, and obviously should be reconsidered by Philosophy and Jurisprudence in a proper way.*

Key words: *creativity, art, "the open work", intellectual property, information technologies, postmodernity.*

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ФЕНОМЕН ТВОРЧЕСТВА В ФОКУСЕ СОЦИАЛЬНО-ФИЛОСОФСКОГО ИССЛЕДОВАНИЯ ПОСТМОДЕРНОЙ ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ

Аннотация: *В статье осуществлён краткий анализ феномена творчества в понимании его как процесса, и как созидательного инструмента, играющего ключевую роль в возникновении произведений искусства – результатов творчества, которые и становятся впоследствии объектами интеллектуальной собственности. Специфика современного творческого процесса анализируется с учётом нынешних информационных реалий, и с поправкой на ситуацию постмодерна. Общий вывод, который можно извлечь из представленного в статье материала, таков: современная культура в некоторых сферах демонстрирует тенденцию к переходу от творчества индивидуального к творчеству коллективному, а нынешние коммуникационные технологии делают возможным соавторство людей, которые даже могут быть незнакомы между собой непосредственно. Всё это не означает, что грядёт конец института интеллектуальной собственности, но вполне определённо свидетельствует о том, что содержание упомянутого социального института имеет значительные перспективы к расширению, обновлению и, конечно же, нуждается в надлежащем переосмыслении – и в философском, и в юридическом.*

Ключевые слова: *творчество, искусство, «открытое произведение», интеллектуальная собственность, информационные технологии, постмодерн.*

Introduction

В контексте исследуемого с философских позиций социального института интеллектуальной собственности нам представляется важным рассмотреть *феномен творчества*. Ведь именно оно является тем ключевым источником, в процессе проявления созидательной сущности которого и возникают

известные нам объекты интеллектуальной собственности разных видов – произведения изобразительного искусства, кино, музыки, литературы и др. Не менее важно и то, что творческие процессы реализуются сегодня в особом социокультурном пространстве, существование которого обусловлено развитием информационного общества и формированием постмодерных культурных тенденций в жизни постиндустриальной цивилизации.

Materials and Methods

В данной статье мы предлагаем рассматривать искусство (как *сферу*, порождаемую творческой *деятельностью*) не только как эстетический опыт, но и как чрезвычайно важный социальный проект, т.е. как общественный институт. Как отмечают некоторые исследователи [1], нынешнее искусство – это массовое технически воспроизводимое искусство технологизированной современности. Возникло оно после изобретения фотографии, когда появилась возможность репродуцировать уникальные произведения искусства в виде иллюстраций, плакатов, открыток и т.д. То же можно сказать и о музыке: эпоха массовой звуко- и видеозаписи положила конец неповторимости концертного исполнения. Возможность многократного воспроизведения оригинального произведения искусства оказала в целом разрушительное воздействие на концепцию «единичности, уникальности, подлинности» [2]. Возможность почти неограниченного механического репродуцирования превратила «искусство для немногих» в «искусство для всех». Ещё одним шагом на пути эволюции в воспроизводимости объектов искусства можно считать цифровые технологии, которые доводят воспроизводимость до невиданных доселе масштабов: подлинник зачастую неотличим от копии, от репродукции, в силу их цифровой тождественности.

После возникновения в Интернет-пространстве таких явлений, как «движение за свободный / открытый контент» (free / open source), Вики-сообществ, блогов, пиринговых (файлообменных) сетей, практик совместной категоризации информации (ссылок, фото, видео и т.п.) посредством тегов, Всемирная сеть вовлекается в сферу искусства и занимает своё место в творческих процессах. Художники начинают использовать технологические возможности Сети для «творческого производства» и дистрибуции [3]. Это изменяет привычные художественные практики и каналы распространения произведений. В одночасье такие юридические категории, как «авторство», «происхождение», «авторское право» в данной среде начинают осознаваться как ограничивающие свободу действия художника.

Конвергенция искусства, науки и технологии, медленно протекающая практически от эпохи Возрождения, с появлением Всемирной сети позволяет поставить под вопрос само представление о том, как искусство создаётся и каковы его предмет и функции в обществе [4]. В какой-то степени даже можно сказать, что в условиях технологизированной современности произошла своего рода трансмутация творчества: существенно (и внезапно) увеличившееся количество потенциальных (и очень разных) участников изменило модус участия в творческом процессе. М. Дертузос [5] выделяет четыре характеристики искусства информационной эпохи:

1. Сенсорная вовлечённость в процесс восприятия с помощью визуального и слухового погружения, тактильных ощущений, изменений температуры и даже запахов (по мере совершенствования технологий художники будут создавать произведения, несущие всё более реальные, полные и глубокие переживания).

2. Интерактивность (несмотря на то, что интерактивные произведения – книги, фильмы, компьютерные игры, даже пьесы с альтернативными сценариями уже существуют, ожидается, что информационные технологии выведут степень взаимодействия в рамках аудиовизуальных искусств на более высокий уровень).

3. Коллективная игра (в процесс творения какого-либо произведения может быть вовлечено большое количество человек, объединённых с помощью информационно-коммуникативных технологий; это свойство и было обозначено У. Эко как «открытое произведение»).

4. Демократизация (проявляется, прежде всего, в том, что мировое искусство стало доступным миллионам людей удалённо, т.е. в режиме онлайн. Онлайновые порталы, посвящённые искусству, предлагают колоссальное количество аудио-, видео-, графических и текстовых материалов, цифровых копий классических и новых произведений искусства).

Как отмечает А. Соловьёв, произведения современного искусства, соответствующие перечисленным характеристикам, присутствовали на выставке «Арт-Кёльн» в 2009 году (Кёльнская ярмарка современного искусства). Более 200 галерей наполнили пространство ярмарки под общим названием «Тёмная комната» (Dark room). Сама же ярмарка проходила под лозунгом «Искусство – плод спонтанной игры разума и воображения, тёмная зона сознания». Куратор проекта The Dark Room отмечала, что время «искусства-фетиша»,

искусства – «вещи в себе», искусства как сообщества немногих избранных кануло в лету, а современное искусство – это *процесс*, а не результат; это «сияние извечной красоты природы перед вратами небытия» [6, с. 177]. Это «сияние» на упомянутой ярмарке выражалось аудиовизуальными композициями, видео-инсталляциями, световыми и прочими эффектами. Мотивы природы и современные технологии слились в информационном симбиозе. Программная фраза «современное искусство – это процесс, а не результат» отсылает нас к пониманию искусства как базы данных, которая постоянно пополняется, но никогда не завершается [6, с. 178].

В т.н. кибер-искусстве XXI века главным художником, субъектом искусства, будет «инженер миров». По мнению П. Леви, инженеры миров – это создатели виртуальностей, конструкторы новых коммуникативных пространств, разработчики коллективных инфраструктур распознавания и накопления информации (баз данных), а также всевозможных интеракций с цифровой вселенной [7, с. 125]. В такой пространственно-временной среде искусство как произведение, как предмет, многократно воспроизведенный, теряет своё присутствие во времени и пространстве, своё уникальное существование в месте, где ему случилось быть. Присутствие и субъекта, и объекта искусства заменяется «телеприсутствием», при котором произведение теряет свою привязанность к локальности. Телеприсутствие представляет собой эстетический парадокс: оно обеспечивает доступ к виртуальному пространству на глобальном уровне, который ощущается одновременно как пребывание и как перемещение в совершенно различные места [1, с. 20].

Иногда для характеристики нового искусства, кибер-искусства, используется словосочетание «сетевое искусство», которое не фиксировано как материальный объект (на холсте, в камне, гипсе или мраморе, на бумаге или в дереве, или хотя бы на фото-, киноплёнке), а «…разбросано по электрическим сетям, движется, трансформируется, и каждый из пользователей Сети может внести в него свою долю творчества» [8, с. 230]. В столь изменчивой и высокодинамичной информационной среде произведения кибер-искусства отвечают критериям «открытого произведения», определённым У. Эко. Для описания этих характеристик он использует в качестве примера главу / эпизод «Блуждающие скалы» из романа «Улисс» (Ulysses) Дж. Джойса [9, эпизод 10]. Упомянутая глава, по мнению У. Эко, «…образует малый универсум, который можно рассматривать с разных точек зрения, и где от поэтики Аристотеля, а вместе с ней – и от представления об однонаправленном течении времени в однородном пространстве – не остаётся и следа. Чтение такого произведения позволяет читателю самому прокладывать себе пути, а его перечитывание можно начинать с любого места точно так же, как можно войти в город с любой стороны и составить о нём другое представление. В такой ситуации читатель становится сотрудником автора в деле создания произведения» [10, с. 80]. Анализируя другой роман Дж. Джойса, «Поминки по Финнегану» (Finnegans Wake) [11], У. Эко добавляет ещё несколько характеристик открытого произведения, применяя к тексту метафору «…космоса, искривлённого, замкнутого на себе самом, где начальное слово совпадает с конечным, но как раз поэтому произведение становится беспредельным… Эта беспредельность также выражается через целостную многозначность, в которой несколько различных корней сочетаются таким образом, что одно слово становится вместилищем значений, каждое из которых сталкивается и соотносится с другими средоточиями аллюзий, в свою очередь открытыми для новых вариантов и возможностей прочтения» [10, с. 81].

Но в случае с Дж. Джойсом в части восприятия, понимания, дел*а* обстоят довольно непросто: хотя его произведения, вероятно, и являются иллюстративными примерами «открытых произведений», но вдумчивое их прочтение едва ли возможно без параллельного чтения подстрочных комментариев людей, которые специально занимались исследованием творчества и биографии самого автора. Нам же кажется куда более простым, легкодоступным для восприятия и достаточно популярным сегодня, пример другого «открытого произведения», которое обрело по-настоящему глобальный масштаб и является незавершённым в силу того, что жизнь и мышление человечества не останавливаются ни на мгновение. Речь идёт о проекте Wikipedia.

По сути, Википедия – это один из наиболее глобальных проектов в Сети, реализованных в соответствии с концептом «открытого произведения». Кроме того, Википедия, несомненно – явление постмодерное, и для неё характерны такие признаки: сопричастность, соавторство, вовлечённость людей в создание и редактирование статей; в целом бескорыстное содействие массовизации знания; иллюстративность; всеобщая доступность, «деэлитаризация» знания; интерактивность, динамичность в развитии и обновлении.

Как бы ни критиковали Википедию, кто бы ни обвинял её в «ненаучности», отсутствии глубины, дилетантстве, тем не менее, на сегодня

это один из наиболее выдающихся научно-просветительских проектов, когда-либо существовавших в культурной истории человечества. Идея Википедии легла на благодатную почву информационно-коммуникационных технологий, которые и позволили ей реализоваться в том всемирном формате, который наблюдается сегодня. Д. Дидро, Ж. д'Аламбер и другие великие просветители, наверняка, мечтали о чём-то подобном, но и представить себе не могли, что такие масштабы массовизации знаний достижимы в реальности уже через 250 лет с того момента, как вышли в свет тома их Энциклопедии.

Конечно, Википедия не идеальна и, стало быть, не лишена недостатков, таких как неточности, неподтверждённые источники цитирования, в отдельных случаях – ненаучный стиль рассуждений, субъективизм, экспрессивная окраска некоторых статей, и прочих. Однако большинство материалов, составляющих контент Свободной Энциклопедии, всё-таки соответствуют объективной действительности, имеют научное обоснование, и всегда могут быть перепроверены, оспорены, пересмотрены, исправлены по инициативе небезразличных пользователей. Здесь важно подчеркнуть, что Википедия соответствует общему духу эпохи *постмодерна*, в частности, таким аспектам *его* идеологии, как постматериализм, эклектичность, гибридность, общедоступность. Ведь упомянутая энциклопедия является бесплатной и политически нейтральной (незаангажированной), не претендует на какую-либо окончательность и категоричность суждений, является редактируемой и регулярно обновляемой, и не исключает возможности обращаться к альтернативным источникам (более того, ссылается на них и требует от соавторов соответствующей верификации в виде ссылок на первоисточники или иные авторитетные источники).

Завершая свои размышления в рамках данной статьи, хочется отметить, что, конечно, творчество не ограничивается рассмотренными здесь некоторыми его сферами, и большинство невероятно ёмких областей творчества (как изобразительное искусство, кинематограф, музыка, архитектура) вообще не попали в фокус настоящего исследования. Тем не менее, рассмотренные в статье общие аспекты феномена творчества (в частности, взгляд на современное искусство не как на результат, а как на творческий процесс), а также концепт «открытого произведения» (главным образом, применительно к литературе) позволяют сделать некоторые обобщения.

Conclusions

В свете вышеизложенного, мы видим, что ***подходы*** *к творчеству* (как к процессу) и *к результатам творчества* (например, к произведениям искусства, к продуктам массовой культуры), а также *к пониманию творчества* и его производной – искусства (в различных его формах) в эпоху информации и постмодерна ***меняются***. Соответственно, и интеллектуальная собственность, будучи лишь организационно-правовой оболочкой для всевозможных результатов творчества и мышления, должна претерпеть соответствующие изменения. По мере общественной эволюции отношения в интеллектуально-правовой сфере обретают черты социального института. Логично предположить, что с изменением его сущностной основы – самой интеллектуальной собственности (как концепта) – подвергнется значительной трансформации и данный социальный институт. Это, в свою очередь, означает, что возможно ожидать изменений в его структуре, функциях, принципах охраны и защиты, и в иных аспектах, связывающих нынешнюю концептуальную модель интеллектуальной собственности с реальностью.

References:

1. Benjamin W (2006) The Work of Art in the Age of Mechanical Reproduction / Durham, M.G., Kellner, D.M. (Ed.) // Media and Cultural Studies. – Maiden: Blackwell Publishing, 2006. – p. 18-40.
2. Appin'janezi P, Gjerrett K (2004) Znakom'tes': postmodernizm. – Sankt-Peterburg: Akademicheskij proekt, 2004. – p. 18.
3. Andersen S (2006) Mapping Intervention and the Network Interface // Art/Net/Work. – Aarhus, 2006.
4. Grau O (2003) Virtual Art. – Cambridge: MIT Press, 2003. – p. 8.
5. Dertouzos M (1997) What Will Be: How the New World of Information Will Change Our Lives. – New York: Harper Edge, 1997. – p. 151-154.

6. Solov'jov AV (2009) Kul'turnaja dinamika informacionnogo obshhestva: ot post- k protokul'ture / A. V. Solov'jov // dissertacija ... doktora filosofskih nauk: 24.00.01. – S.-Pb.: Sankt-Peterburgskij gosudarstvennyj universitet, 2009. – 358 p.
7. Levy P (2000) Cyberculture. – Minneapolis: University of Minnesota Press, 2001. – P. 125.
8. Dianova, V. M. Postmodernistskaja filosofija iskusstva: istoki i sovremennost'. – S.-Pb., 2000. – p. 230.
9. Joyce J (2002) Ulysses / James Joyce // edited by Hans Walter Gabler with Wolfhard Steppe and Claus Melchior; afterword by Michael Groden. – London: Bodley Head, 2002. – 657 p.
10. Jeko U (2004) Otkrytoe proizvedenie / Umberto Jeko // per. s ital. A. Shurbeleva. – M.: Akademicheskij proekt, 2004. – 384 p.
11. Joyce J (1978) Finnegans Wake / James Joyce // prefaced by David Hayman, arranged by Danis Rose with the assistance of John O'Hanlon; 4 books. – New York: Garland, 1978.

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SECTION 31. Economic research, finance, innovation, risk management.

TRENDS OF CHANGING VOLUMES OF DEPOSITS IN FOREIGN CURRENCY AND PRECIOUS METALS IN RUSSIAN BANKS

Abstract: *In conditions of instability in the banking sector to make predictions for the long term not sufficiently effective, as the internal and external factors that influence the formation of the deposit market in Russia can wipe out all analyses and calculations of Russian and international experts. Despite this, the market of deposits reveals certain trends, and can trace what happens to them in the near future. The article discusses the trends in the volume of deposits in foreign currency and precious metals in the Russian credit organizations.*

Key words: *Contribution, deposit, bank, cash, foreign currency, precious metals.*

Language: *Russian*

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ТЕНДЕНЦИИ ИЗМЕНЕНИЯ ОБЪЕМОВ ДЕПОЗИТОВ В ИНОСТРАННОЙ ВАЛЮТЕ И ДРАГОЦЕННЫХ МЕТАЛЛАХ В РОССИЙСКИХ БАНКАХ

Аннотация: *В условиях нестабильности в банковском секторе делать прогнозы на далекую перспективу не достаточно эффективно, так как внутренние и внешние факторы, оказывающие влияние на формирование депозитного рынка в РФ, могут перечеркнуть все аналитические выводы и расчеты российских и международных экспертов. Несмотря на это, на рынке депозитных вкладов прослеживаются определенные тенденции, и можно проследить к чему они приведут в ближайшем будущем. В статье рассмотрены тенденции изменения объемов депозитов в иностранной валюте и драгоценных металлах в Российских кредитных организациях.*

Ключевые слова: *Вклад, депозит, банк, денежные средства, иностранная валюта, драгоценные металлы.*

Introduction

В целом над российской экономикой в данный момент времени преобладает нестабильная геополитическая обстановка, поэтому актуально проведение исследования с целью прослеживания изменения ситуации на российском рынке депозитных продуктов.

Большое влияние на формирование депозитного рынка в Российской Федерации оказывают многочисленные внешние и внутренние факторы:

- присоединение нового региона и развитие банковской системы в Крыму;
- санкции запада по отношению к ряду государственных финансовых институтов и их возможное ужесточение;
- чистка банковского сектора Банком России и ее продолжение;
- резервы Агентства по страхованию вкладов и их возможное исчерпание;
- волатильность рубля и попытки ЦБ РФ удержать его курс.[1, с. 220]

Materials and Methods

С учетом влияния на рынок депозитных продуктов и услуг, рассмотрим изменения происходящие на рынке вкладов(депозитов) физических лиц, представленные на рисунке 1.

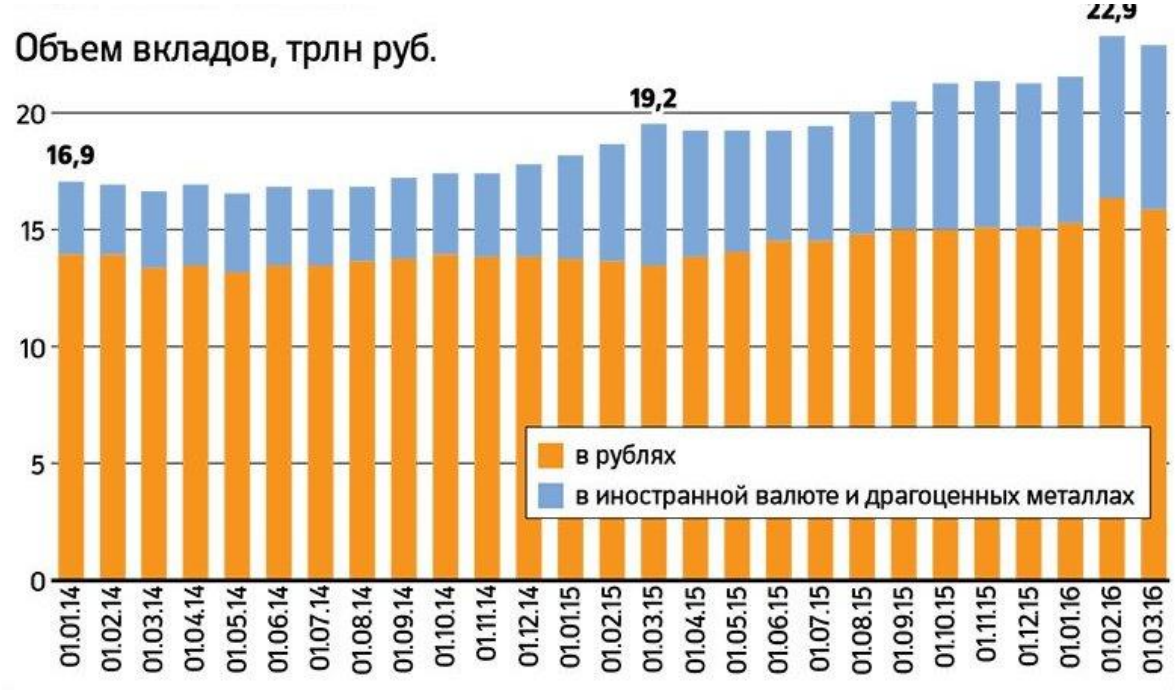

Рисунок 1 - Тенденция объемов средств населения на банковских счетах

Исходя из данных отображенных на рис. 1, можно сделать вывод, что по объему средств на счетах в кредитных институтах, наиболее предпочтительным вариантом для населения является вложения средств в рублях. На начало 2014 года вклады(депозиты) в рублях составляли 14,8 трлн. руб., а доля средств в иностранной валюте составила 2,1 трлн. руб., что в общем объеме средств равнялось 16,9 трлн. руб. На март 2015 года депозитная база в рублях составила 14,5 трлн. руб., но прирост в иностранной валюте был выше чем на начало 2014 года, и составил 4,7 трлн. руб., в общем объеме 19,2 трлн. руб. [4, с. 45]

Тенденция роста вкладов в рублях и иностранной валюте, сохранилась и в 2016 году, когда в феврале была достигнута максимальная отметка общего объема в 22,9 трлн. руб., при этом вклады в рублях составили 16 трлн. руб., а в иностранной валюте и драгоценных металлах 6,9 трлн. руб. Это свидетельствует об интересе и доверии населения банкам в хранении своих сбережений. Стоит отметить, что на протяжении исследуемого периода времени в целом, прирост вкладов (депозитов) в иностранной валюте и драгоценных металлах увеличивался значительно, в то время как объемы средств в рублях оставались на стабильном уровне. [5, с. 35]

Рассмотрим структуру средств вкладов (депозитов) физических лиц в кредитных институтах, в РФ, открываемых в иностранной валюте и драгоценных металлах, представленной на рисунке 2.

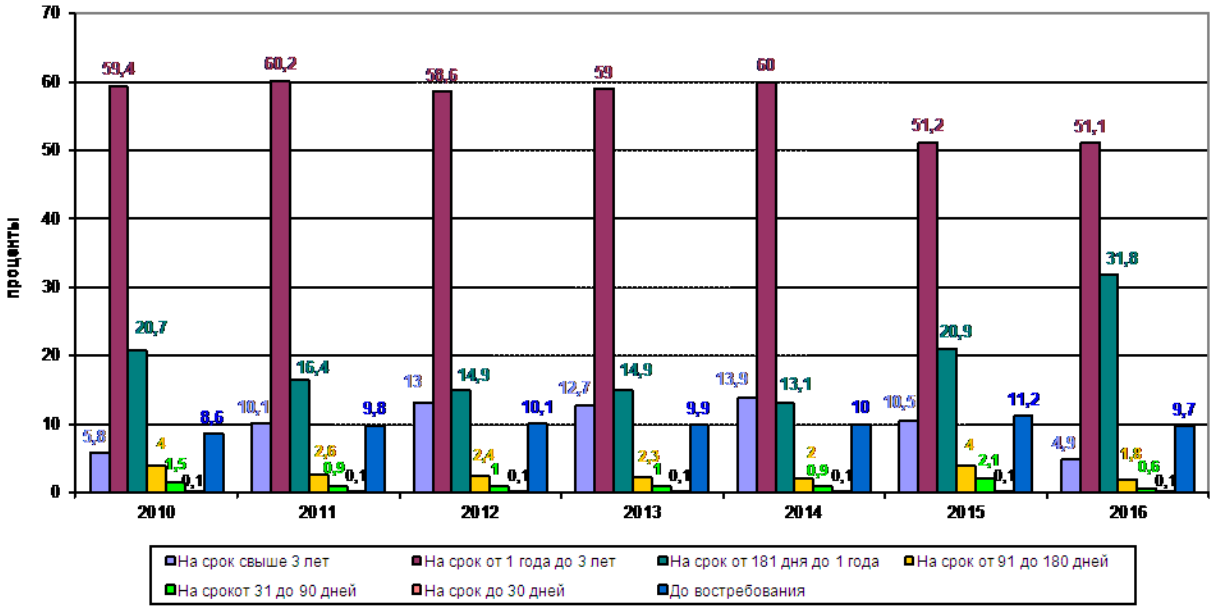

Рисунок 2 – Структура вкладов (депозитов) населения в Российских банках открываемых в иностранной валюте и драгоценных металлах.

По представленным данным на рис. 2, можно отметить, что на период с 2010 года по 0216 год, более 50% вкладов (депозитов) в иностранной валюте открывается на срок от 1 года до 3-х лет. Причем в 2014 году этот показатель достиг отметки в 60%. Период с 2015 по 2016 гг. характеризуется снижением объема средств на депозитных счетах почти на 9%. Второе место по величине вкладов (депозитов) на счетах в банках, занимает вложения средств физическими лицами на срок от 181 дня до 1 года. В 2010 году этот показатель составлял 20,7% от общего объема вкладов, последующие 4 года снижался до 13%.однако в 2015 году он достиг показателей 2010 года, а в 2016 году и вовсе вырос почти на 11% по сравнению с 2015 годом. [6, с. 200]

Также, можно отметить, что физические лица проявляли интерес к открытию вклада (депозита) на срок свыше 3-х лет. Данный показатель, начиная с 2011 по 2013 гг. стабильно составлял примерно 13% в общей совокупности открытия вкладов. Но начиная с 2014 года и по 2016 год, открытие вклада на такой срок резко сократилось, с 13,9% до 4,9%, что свидетельствует о нецелесообразности вложения средств на такой большой период. Самым невостребованным среди физических лиц условием открытия вклада (депозита) в иностранной валюте является срок до 30 дней.

Conclusion

Таким образом, несмотря на нестабильность развития банковского сектора, вклады (депозиты) в иностранной валюте и драгоценных металлах пользуются у населения достаточно большим спросом в Российских финансово-кредитных организациях, особенно преобладает вложение средств физическими лицами на срок от 1 года до 3 лет. Стоит отметить, что прирост к общему объему вкладов в рублях увеличивался с 2014 по 2016 гг. с 16,9 трлн. руб., до 22,9 трлн. руб., что свидетельствуется о положительной тенденции развития таких вкладов (депозитов) в России.

References:

1. (2012) Bank management [Text] : the textbook / under the editorship of E. F. Zhukov, N. D. Eriashvili. - 4-e Izd., Rev. and extra - M. : YUNITI-DANA, 2012. - 319 p.
2. Bahodurov MN (2011) Items Deposit policy of the commercial Bank [text]/ M. N. Bahodurov// journal of National University of Tajikistan. - Dushanbe, 2011. - №10 (74). – p. 47-56.

3. Vasilev AV, Gerasimova EB, Silence LC (2014) Monitoring of quality of banking services: the Monography. - Tambov: Publishing house Tamb. GOS. tehn. University press, 2014. - 112 p.
4. Vasileva AS (2015) peculiarities of the Deposit policy of commercial Bank in modern conditions // Finance and credit. - 2015. - No. 40. - p. 42-52.
5. Zinovieva NM (2016) Types of Bank deposits and their characteristics / N. M. Zinovieva // Territory of science. – 2016. – No. 5. – p. 133-137
6. Zinovieva NM (2016) A study of the advantages and disadvantages of modern banking deposits / N.M. Zinovieva // Finance of Russia in conditions of globalization: materials of all-Russian round table with international participation, dedicated to the "Day of the financier - 2016". – Voronezh: VAPI, 2016. – p. 198-202
7. Maslova DB (2012) Deposit policy of commercial banks in attracting funds to deposits//Siberian trade and economic journal.- No. 8.- 2012.
8. Matovnikov MY (2010) lowering the interest rate – risks and opportunities // Banking. – 2010. – No. 10. – p.49-55.
9. Olkhova RG (2009) Banking. Management in the modern Bank: a Training manual. - M.: KnoRus, 2009. - 231 p.
10. Sviridov OY (2015) Features of formation customer-oriented development models of Russian banks // Economic Bulletin of Rostov state University. 2015, volume 6, No. 3, part 3.

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