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Issue Article

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GEOLOGICAL, INDUSTRY AND TECHNOLOGICAL BASES FOR THE DESIGN OF THE DEVELOPMENT OF MULTI-LAYER FIELDS BY THE METHOD OF DUAL COMPLETION OPERATION OF WELLS

Abstract*: In the article, in order to successfully implement the method of dual completion operation (here in after referred to as DC) of gas reservoirs simultaneously in one and in the other second elevators of oil reservoirs of one well, comparative laboratory analyses and field studies on the properties and composition of oil, gas and condensate, which play an important role in the development of wells DC, were carried out.*

The results of complex field studies of gas wells and reservoirs were carried out in order to establish the gas-dynamic parameters of the reservoir and well and study their gas-condensate characteristics of the Altyguyi deposit. The main attention in the study of the well and the formation was paid to a more accurate determination of the values of the component composition of the formation gas required for the compilation of differential condensation isotherms determined by sampling raw condensate.

Key words*: flow rate, condensate, asphalt, sulfur, paraffin, barometric, pressure gauge, bottomhole zone, molecular weight, isotherms, reservoir gas, filtration mode, hydroconductivity, separator.*

Language*: English*

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Introduction

The determination of the initial indicators of wells and formations at the Altyguyi deposit was achieved using the method of steady-state sampling, which, even under steady-state filtration regimes in the bottom-hole zone of the formation, were carried out in order to establish the gas-dynamic parameters of the formation and wells, to study their gas-condensate characteristics.

The filtration regime was changed by selecting the diameter of the fitting at the wellhead.

The duration of operation in oil and gas wells for at least 24 hours and for gas condensate wells in each mode was from 5 to 24 hours. The measurement on each mode began after the full stabilization of the wellhead pressures of P_{buf} and $P_{annul.}$

The measurement of reservoir and bottom-hole pressures and the recording of the pressure recovery curve were carried out with deep pressure gauges of the MGN2-800kgs/cm^2 type and MSU-1-100-160 and in some places with electronic geophysical devices "Granite" and "Sakmar".

The necessary indicators for calculating the determination of the daily gas flow rate were carried out using a separator of the PBS-350/64 type with a measuring diaphragm with a diameter of 50 mm.

Measurements of the daily gas flow rate were carried out using a complex field installation equipped with a separator of the "Demag" type and flow meters of the DSP-0.063 and DPS-1.6 types.

The parameters for determining the gas flow rate were calculated using 4- or 2-inch diaphragm meters of critical gas flow [13].

Wellhead pressures (P_{buf} and P_{annul}) were recorded with model pressure gauges of the MO type at 250, 400 and 600 kgf/cm^2, accuracy class ± 1, ±

0.6% and ± 0.4%.

Bottom-hole and reservoir temperatures are determined by thermometers with mercury columns of the TP-7 type.

In some facilities, it was not possible to close the well to the reservoir pressure value due to technical reasons. In these circumstances, the reservoir pressure was determined by the experimental method [14].

Application of the method under steady-state filtration conditions of products in the bottom-hole zone of the formation for trial operation (with a change in mode), complex hydrodynamic studies were carried out in 17 objects, 16 wells, in an amount of 22 times. Only on 6 wells (№12, 19, 107, 108, 111 and 112), measurements of the daily flow rate were carried out, and in 4 wells (№№. 7, 21, 105 and 107), a one-time measurement of reservoir and bottom-hole pressure was carried out. At oil well sites № 2 and №. 7, the study was carried out by the method of normalizing the fluid flow – pressure recovery curve (PRC). As a result of processing the obtained materials, the coefficient of hydraulic conductivity and permeability of the formation was calculated by the Horner method. The obtained results of the development, measurements and their definition are given in the table 1. Graphs of the pressure recovery curve are shown in Figures 1 and 2.

Table 1. The results of hydrodynamic studies at the wells of the Altyguyi field

Well number	Horizon	Perforation interval, (m)	Fitting diameter (m)	Coefficient			Note
				Capacity (kg/cm^2)	Hydraulic conductivity (sP)	Permeability (mD)	
Research in order							
1(I)	NK_9	3670-3680	5	-	-	-	
			6	-	-	-	
			8	-	-	-	
			-	0,1807	4,4	14,52	
			Repeated research				
			6	-	-	-	
			5	-	-	-	
			4,8	-	-	-	
			5,6	-	-	-	
			6,4	0,264	6,43	21,2	
2(I)	NK_9	3608-3618	4	-	-	-	
			5	-	-	-	
			6	0,9043	10.1 on PRC	34,34 on PRC	
3(I)	NK_9	3732-3738	4				
			5				
			6	0,171	4,2	23,1	
4	NK_9	3728-3740	4,8				
			5,6				
			6,4	1,1107	27,1	74,53	
7(II)	NK_9	3746-3750	4	-	-	-	
			4,8	-	-	-	
			3,1	0,8493	22,03 on PRC	93,4 on PRC	
10(I)	NK_9	3653-3662	6,3	-	-	-	
			8,0	-	-	-	
			4,8	0,4914	12,00	44,0	
106(I)	NK_9	3783-3792	4	-	-	-	
			5	-	-	-	
			6	1,3552	33,0	-	

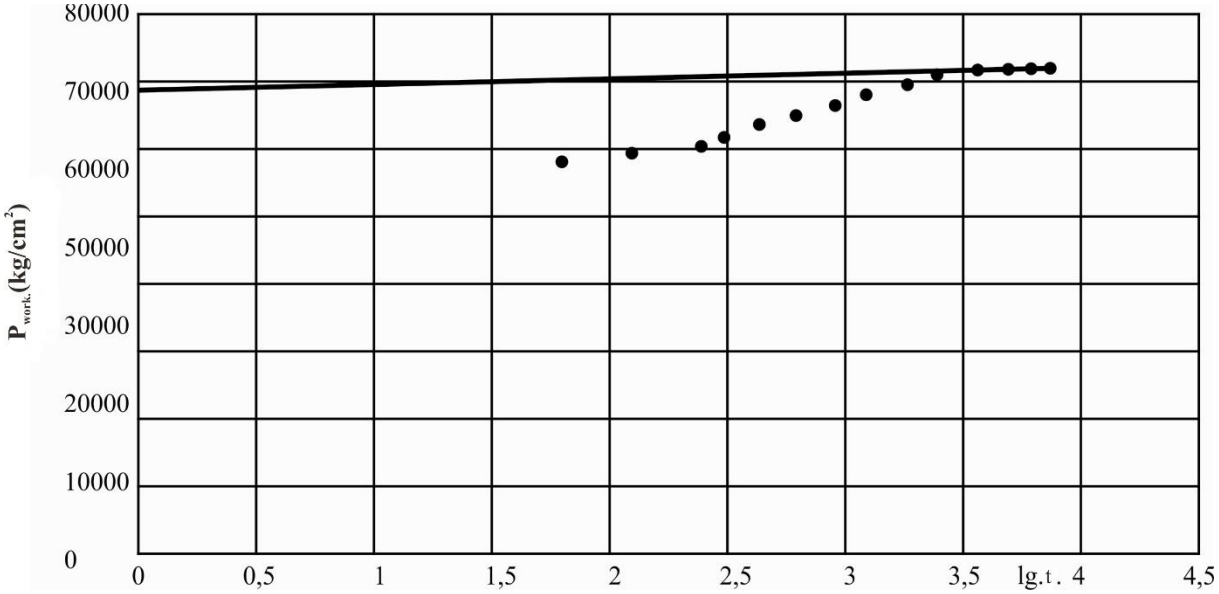

Figure 1. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure, during the study of production well № 2 of the Altyguyi field

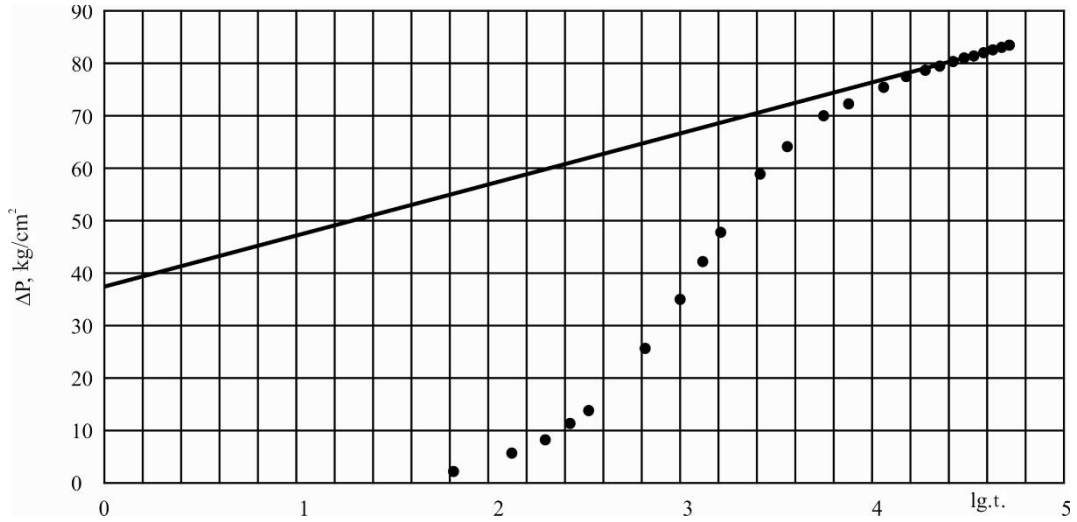

Figure 2. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure, during the study of the II-th object of the exploration well № 7 of the Altyguyi field

The specific gravity of Altyguyi oil in comparison with the oil of other fields in the Southwestern part of Turkmenistan is very heavy (0.910 g/cm^3) and has a lot of paraffin in its composition. In the process of oil extraction, the paraffin contained in the product freezes due to a decrease in temperature at a depth of 800-1000 meters. In this regard, the freezing of paraffin leads to a decrease in the inner diameter of the tubing, an increase in downhole pressure and a decrease in daily oil production [15]. This phenomenon has the opposite effect on determining the productivity coefficient of the well and the exact calculation of some reservoir indicators.

Before conducting hydro and gas dynamic studies, it is recommended to clean the inner walls of the tubing from the layers of paraffin.

Taking into account the above, the proposed values of the initial reservoir pressure and temperature of the NK_9 oil horizon are assumed to be the values of the accurately performed measurements of the II-th object of well № 7 - 643 kgf/cm^3 and 87 ^{0}C.

To study the indicators of a gas condensate field and to determine the amount of condensate released from 1 m^3 of gas, as well as conducting gas-hydrodynamic studies in productive wells and formations, were performed by methods and

instruments that were used in gas-hydrodynamic studies in oil horizons.

In some wells, for technical reasons, the reservoir and bottom - hole pressure was determined by the barometric formula on uncovered and not lowered depth gauges:

$$P_{b-h.} = P_{b(annul)} \cdot e^{s},$$

The separation of condensate and water from the products, as well as work on measuring the determination of the amount of separated condensate from 1 m3 of gas, was carried out at a complex field installation equipped with a mobile block separator of the PBS-350/64 type and a separator of the DEMAG type.

In general, during the period of exploratory drilling and testing of the productivity of drilled gas condensate wells, complex studies were carried out in 11 objects of 5 wells in the established modes of liquid or gas filtration (№ 2, 5, 102, 1, 20). In three wells (№1, 2 and 101), 4 comprehensive studies were carried out on unsteady filtration regimes (pressure recovery curve) [16].

The result of working off the PRC for production well № 101 is shown in Fig. 3.

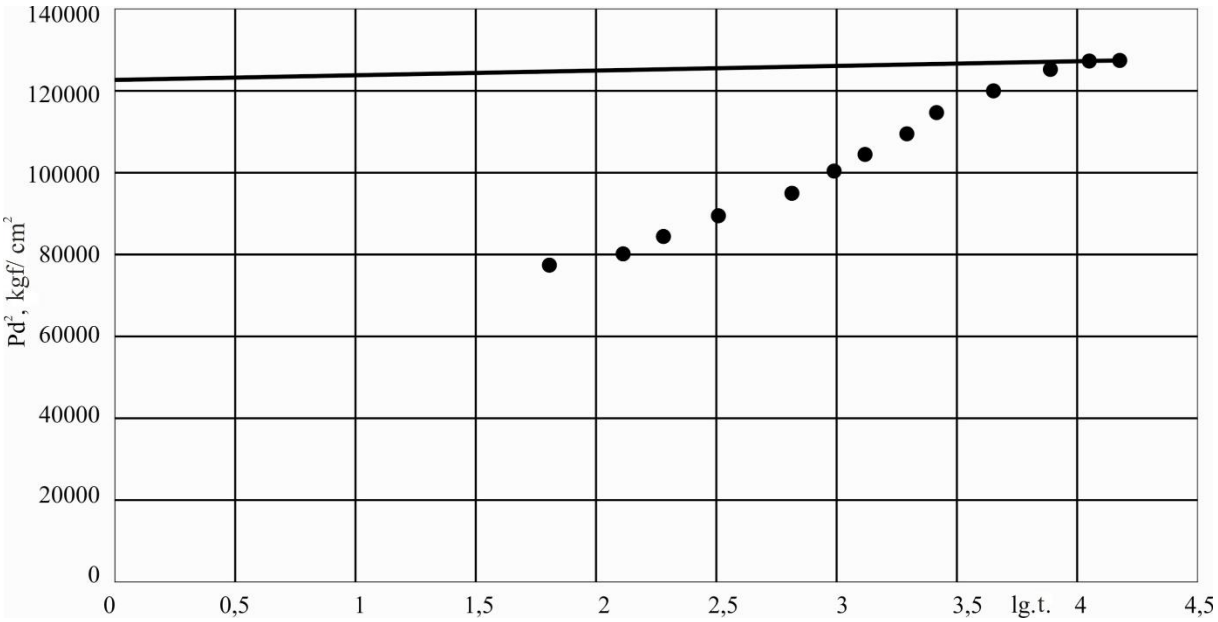

Figure 3. Graph of the curve of recovery of bottom-hole pressure to reservoir pressure for production well № 101 at the Altyguyi field

To determine the initial reservoir pressure and temperature of the NK_{7d} horizon, the average reservoir pressure values of 517 kgf/ cm^2 and 87 ºC are proposed, which were obtained during the study of the NK_{7d} horizon of the II object of well № 2 and the I object of well №.5.

Considering the close location of the NK_{7d} and NK_8 horizons (about 30 m.), the reservoir pressure and temperature were assumed to be P = 517 kgf/cm^2, T = 87 ºC.

Work on the determination of condensate indicators and the study of thermodynamic characteristics of wells and reservoirs for both horizons was carried out jointly.

Gas condensate wells and reservoirs were studied in three stationary filtration regimes [17].

The results of gas dynamic studies and determination of the amount of condensate released from 1 m^3 of reservoir gas (gas condensate factor - GCF) are shown in Table 2.

The results of hydro - gas dynamic studies of wells and formations of gas condensate deposits were processed using a two - term formula:

$$P^2_{res.} = P^2_{b\text{-}h} = aQ_2 + b \cdot Q^2_2,$$

where: $P_{res.}$ and $P_{b\text{-}h}$ - respectively, reservoir and bottom-hole pressure, kgf/cm^2;

Q_g is the flow rate of separation gas, thousand m^3/day;

a and b, respectively, are the coefficients of filtration resistance, depending on the parameters of the bottom-hole zone of the formation and the design of the well bottom.

Table 2. The results of field studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Fitting diameter (mm)	Operation in the regime (hour)	Condensate output (cm^3/m^3)		Molecular weight of condensate
1(II)	NK_8	3616-3625	12	24	241,9	181,4	-
			10	15	157,4	118,4	-
			-	-	-	-	151,5
			8	8	114,7	88,6	-
			9,5	24	11,7	9,6	-
			8	15	13,9	11,4	-
			6	15	15,5	12,7	-
1(I+II)	NK_8+ NK_9	3512-3522 3670-3680	-	-	-	-	150
			10	24	NKH productive		-
			8	18			-
			6	16			-
			-	-			-
			6	24	NKH productive		-
			8	22			-
			10	20			-
2(III)	NK_{7d}	3512-3522	8	24	64,6	56,2	-
			-	-	-	-	-
			12	24	-	60,5	159
			8	22	-	29,6	-
			10	18	-	46,3	-
2(III)	NK_{7d}	3512-3522	6,5	24	107,5	93,4	-
			8	18	97,2	81,6	-
			9	15	99,8	86,2	-
			-	-	-	-	159
			9,5	22	14,3	13,1	-
			8	17	12,9	12,0	-
			6	15	23,4	21,5	-
			-	-	-	-	-
5(I)	NK 7d	3618-3624	10	20	111,8	102,8	-
			8	21	118,6	104,4	-
			6	15	113,1	101,8	-
			-	-	-	-	144,5
			9,5	20	10,6	8,7	-
			8	21	12,8	10,5	-
			6	15	16,2	13,2	-
			-	-	-	-	153,5
			8	24	50,9	43,8	-
			-	-	-	-	149
			12	24	-	51,4	
			8	21	-	46,9	
			10	16	-	46,3	
101	NK 8	3564-3566	12	24	-	-	-
			10	24	-	-	-
			8	16	-	-	-
20 (III)	NK 8	3950-3958	-	-	-	-	-
			9,5	22	-	-	-
			8	17	-	-	-
			6	15	-	-	-
			-	-	-	-	-

The flow rate of the reservoir fluid $Q_{res.fl}$ is calculated using the following formula:

$$Q_{res.fl.} = Q_{s.g.} + \frac{Q_{c.}^{sat} + G_{eqv.}}{10^3},$$

$Q_{res.fl}$ - reservoir fluid, thousand m^3/day;

$Q_{s.g}$ -flow rate of separated gas, thousand m^3/day;

$Q_{c.}^{sat}$ -saturated condensate flow rate, m^3/day;

G_{eqv} is the calculated gas equivalent of the transfer of the liquid phase (condensate) to the gas phase.

The gas equivalent is determined by the formula

$$G_{eqv.} = 23342 \cdot \rho / M,$$

Here ρ and M are, respectively, the density and molecular weight of the C_{5+b} fraction.

The value of the molecular weight (μ) of the C_{5+b} fraction is calculated by the formula

$$M = \frac{44{,}29\left(\rho_{c.}^{st.} + 0{,}004\right)}{\left(1{,}034 - \rho_{c.}^{st.}\right)}.$$

where $Q_{c.}^{st.}$ is the density of stable condensate.

Tables 3, 4 and 5 show the values of reservoir and well parameters determined when processing the results of gas-dynamic studies and the output of stable condensate for the studied objects.

Table 3. The results of calculations of studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Type of research	Reservoir pressure (kgf/cm^2)	Reservoir temperature (^{0}C)	Stable condensate output (cm^3/m^3)
1(II)	NK_8	3616-3625	initial	496	84	119
			regular	452	89	11,4
1(I+II)	NK_8+NK_9	3512-3522 3670-3680	regular	452	91	-
			regular	308	88	-
2(III)	NK_{7d}	3512-3522	regular	510	81	86,2
			regular	490	87	12
			regular	471	82	56,2
			regular	270	81	60,5
5(I)	NK_{7d}	3618-3624	regular	524	84	103
			regular	487	90	8,7
			regular	426	82	43,8
			regular	274	84	51,4
20	NK_8	3950-3959	regular	400	96	4
			regular	336	87	96,1
101	NK_8	3564-3566	regular	358	78	85,6

Table 4. The results of calculations of studies to study the gas condensate properties of wells and formations at the Altyguyi field

№ well	Horizon	Perforation interval, (m)	Filtration resistance coefficient		Absolutely free gas flow rate (thousand m^3/day)	Coefficient of gas conductivity (m/sP)	Filtration coefficient (mD)
			a	b			
1(II)	NK_8	3616-3625	57,7	0,38	732,3	7,87	26,2
			137,6	0,243	677	3,4	11,2
1(I+II)	NK_8+ NK_9	3512-3522 3670-3680	86,1	0,411	713	5,37	8,1
			11,0	0,423	460,7	41,7	65,9
2(III)	NK_{7d}	3512-3522	92,5	0,1	1205,5	4,73	14,2
			37,9	0,112	1304,3	12,1	36,3
			-	-	-	-	-
			67,8	0,0123	921,2	6,6	20,0

5(I)	NK 7d	3618-3624	187,8	0,194	800,4	2,42	12,1
			80,5	0,111	1144,6	5,74	28,7
			-	-	-	-	-
			93,1	0,0144	725,1	4,9	24,4
20	NK 8	3950-3959	-	-	-	-	-
			134,4	0,784	303,2	3,4	12,8
101	NK 8	3564-3566	84,2	0,327	510,4	5,3	79,7

Table 5. The results of the study of the field determination of the properties of stable condensate

№ well	Horizon	Perforation interval, (m)	Fitting diameter (mm)	Condensate output from 1 m^3 of reservoir gas, (cm^3/m^3)		The rate of entry of the fluid into the barrel is tubing (m/sec)
				intense	stable	
1(II)	NK 8	3616-3625	10	157	118	4,95
			9,5	12	10	4,5
			10	A light hydrocarbon is oil. The specific gravity is 0.8455 g/cm^3. Due to the high gas factor, calculations were carried out on gas.		
			6			
2(III)	NK 7d	3512-3522	8	97	82	4,1
			8	13	12	4,3
			8	65	56	3,5
			10	-	60,5	4
5(I)	NK 7d	3618-3624	8	119	105	4,1
			8	13	11	4
			8	51	44	3,8
			10	-	46	4
20	NK 8	3950-3959	8	-	4	-
			12	-	55	4
101	NK 8	3564-3566	10	-	83	4

The proposed indicators of stable condensate yield are accepted along the horizon of NK 7g -95 cm^3/t^3; along the horizon of NK_8-118 cm^3/t^3.

According to the results of measurements, an accelerated drop in reservoir pressure was revealed at the beginning of the operation period [18].

Despite the short period of the start of operation of gas condensate reservoirs, the results of measurements revealed an accelerated drop in reservoir pressure.

For example, well №2 was put into operation in 2009 with an initial reservoir pressure of 510 kgf/cm^2. In 2010, the reservoir pressure was measured at 490 kgf/cm^2, and in 2014 it was 270 kgf/cm^2.

Well № 1 in the gas condensate facility of the NK_8 horizon was put into operation during development with an initial reservoir pressure of 496 kgf/cm^2 in 2009. In 2014, when measured, its readings amounted to a drop to 306 kgf/cm^2.

We believe that the reason for the low values obtained during the study is not the creation of an appropriate regime for the separation of products.

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MATHEMATICALLY CALCULATED REALITY, SUPPLEMENTING BIOCHEMISTRY OF SELF-PURIFICATION OF THE WATER OF RIVERS AND LAKES

Abstract: *For previously developed 5 Multiple-sense equations with known unknown semantic variables [1], a new equality was obtained: the sums of real senses of 2 types of measured real reactions BOD, COD are equal to the sum of 6 cognitive senses of their subtypes: sense(BOD)⊕sense(COD)=meaning(BOD1⊕meaning(BOD2)⊕ meaning(BOD3) ⊕meaning (BOD4)⊕ meaning(COD1) ⊕meaning(COD3). On the right side of the given semantic equality, it is equal to the sum of 6 calculated formula units [corresponding to subtypes of BOD,COD]:* $(z_{i1}*(0.4689+(z_{i4})*0.6972)[COD4]+z_{i1}*0.5506+z_{i2}*0.2589+(z_{i3}*(-0.3283)+z_{i4}*(-0.3545))[BOD3]+$ $z_{i1}*0.5506+z_{i2}*0.2589+z_{i5}*(-0.6296)[COD3]+(z_{i2}(-0.8827)+z_{i3}(-0.1386)+z_{i4}(-0.2542))[BOD2]+z_{i1}(0.4861)+$ $z_{i3}(0.1538)+z_{i4}(-0.4609)[BOD1]+ z_{i1}(0.4861)+z_{i3}(0.1538)+z_{i5}(0.6293)$ *[COD1]. Recording formulas of 6 calculated formula units is analogous to the form of semantic equality. Non-chemical formulas of real BOD, COD reactions depend on the formula units of their subtypes and conventionally look like this: COD formula* $z_{i3}(0.1538)+z_{i5}(0.6293)[COD1]+z_{i1}*0.5506+z_{i2}*0.2589+z_{i5}*(-0.6296)[COD3]+(z_{i1}*(0.4689+(z_{i4})*0.6972)$ *[COD4]. Formula BOD:* $z_{i1}*0.5506+z_{i2}*0.2589+(z_{i3}*(-0.3283)+z_{i4}*(-0.3545))[BOD3]+(z_{i2}(-0.8827)+z_{i3}(-0.1386)$ $+z_{i4}(-0.2542))[BOD2]+z_{i1}(0.4861)+z_{i3}(0.1538)+z_{i4}(-0.4609)[BOD1]$

Key words: *Formula units, semantic multidimensional equations, semantic variables, numerical parameters, measurements for real biochemical reactions.*

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МАТЕМАТИЧЕСКИ ВЫЧИСЛЕННАЯ РЕАЛЬНОСТЬ, ДОПОЛНЯЮЩАЯ БИОХИМИЮ САМООЧИЩЕНИЯ ВОДЫ РЕК И ОЗЕР

Аннотация: *Для ранее разработанных 5 многосмысловых уравнений с известными не известными смысловыми переменными [1] получено новое равенство: суммы реальных смыслов 2-х типов измеренных реальных биохимических реакций БПК, ХПК равны сумме 6 когнитивных смыслов их подтипов: смысл(БПК)⊕смысл(ХПК)=смысл(БПК1⊕смысл(БПК2)⊕смысл(БПК3)⊕смысл(БПК4)⊕смысл(ХПК1)⊕ смысл(ХПК3). Реальность 6 когнитивных смыслов подтипов смыслов 2-х реальных реакций БПК, ХПК фиксируется a priori. Получена формула для правой части приведенного смыслового равенства, она равна сумме 6-ти вычисленных формульных единиц [соответствующих подтипам БПК,ХПК]:* $(z_{i1}*(0.4689+(z_{i4})*0.6972)[ХПК4]+z_{i1}*0,5506+z_{i2}*0,2589+(z_{i3}*(-0,3283)+z_{i4}*(-0,3545))[БПК3]+$ $z_{i1}*0,5506+z_{i2}*0,2589+z_{i5}*(-0,6296)[ХПК3]+(z_{i2}(-0,8827)+z_{i3}(-0,1386)+z_{i4}(-0,2542))[БПК2]+z_{i1}(0.4861)+$

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$z_{i3}(0,1538)+z_{i4}(-0,4609)[БПК1]+z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i5}(0,6293)$ [ХПК1]. Запись формул 6-ти вычисленных формульных единиц алогична форме смыслового равенства. Нехимические формулы реальных реакций БПК, ХПК зависят от формульных единиц своих подтипов и условно выглядят так: Формула ХПК=$z_{i3}(0,1538)+z_{i5}(0,6293)[ХПК1]+z_{i1}*0,5506+ z_{i2}*0,2589+z_{i5}*(-0,6296)$ [ХПК3] $+(z_{i1}*(0.4689+(z_{i4})*0.6972)$ [ХПК4]. Формула БПК=$z_{i1}*0,5506+z_{i2}*0,2589+(z_{i3}*(-0,3283)+z_{i4}*(-0,3545))[БПК3]+(z_{i2}(-0,8827)+z_{i3}(-0,1386)+ z_{i4}(-0,2542))[БПК2]+z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)[БПК1]$.

***Ключевые слова:** Формульные единицы, смысловые многомерные уравнения, смысловые переменные, числовые параметры, измерения для реальных биохимических реакций.*

Введение

В разработанных 5 многосмысловых уравнениях с известными не известными смысловыми переменными [1] вычислены формулы 5 y–переменных, найдены их когнитивные смыслы, обобщающие смыслы «биологическое потребление кислородом» (БПК), «химиическое потребление кислородом» (ХПК) реальных биохимических реакций. Биохимикам удобно иметь дело с привычными терминами – БПК, ХПК, или с производными фразами, образующихся из приведенных выше смыслов. Рассматриваемые ниже смыслы многосмысловых уравнений с известными и неизвестными семантическими переменными соответствуют многомерным уравнениям с числовыми параметрами и z-переменными (z1,z2,z3,z4,z5), но для них нами сформированы другие «формульные единицы» в нехимических уравнениях y-реакций из [1]. В той или иной формуле y-реакции самоочищения воды присутствуют «формульные единицы», «изображающие» биологически активную или химически активную части растворенного кислорода. Под термином «многосмысловое» уравнение подразумевается многопеременное уравнение, в котором переменными являются не числовые переменные, не функции, не символы, а смысловые переменные, изобретаемые исследователем. В многомерном (n-мерном) смысловом пространстве (если разнородные смыслы изображать точкой аналогично многим числам) «многосмысловая» переменная ((смысл(z1),смысл(z2),смысл(z3),смысл(z4), смысл(z_5)) соответствует многопеременным z-переменным (z_1,z_2,z_3,z_4,z_5).

Мы интересуемся вопросами: какие формульные единицы, какие БПК-реакции, ХПК-реакции соответствуют многомерной переменной ((смысл(y1), смысл(y2), смысл(y3), смысл(y4), смысл(y_5)). Ответы на эти вопросы актуальны для нового научного направления «вычисляемые нехимические формулы химических реакций». Мы рассматриваем пока отдельные биохимические реакции (в рамках реакции абсорбции) самоочищения воды рек и озер.

Исходные данные

Исходные данные –система нехимических уравнений y-реакций из [1]. y4=0,4689*z1+0,6972*z4, $y_{i3}=z_{i1}*0,5506+ z_{i2}*0,2589+z_{i3}*(-0,3283)+z_{i4}*(-0,3545)+z_{i5}*(-0,6296)$, $y_{i2}=z_{i2}(-0,8827)+z_{i3}(-0,1386)+z_{i4}(-0,2542)$, $y_{i1}=z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)+z_{i5}(0,6293)$. Имена-смыслы 5 физико- химических веществ: ионы аммония (z_1), растворенный кислород (z_2), взвешенные вещества (z_3), БПК(z_4), ХПК (z_5). Матрица $\mathbf{C_{55}}$ (Таблица 2) соответствует как паре матриц (R_{55},Λ_{55}) таких, что: $R_{55}C_{55}=C_{55}\Lambda_{55}$, вычислена при решении ПСЗ**:** R_{55}=>($C_{55}\Lambda_{55}$), где $R_{55}=R^T_{55}$ - исходная матрица (z,z)-корреляций (Таблица 1) $R_{55}=\{r_{ij}=corr(z_i,z_j)\}$, i=1,...,5; j=1,...,5, диагональная матрица Λ_{55}=diag(2.8198,1.3987, 0.8343,0.465,0.2856,0.1965). Диагональные элементы матрицы Λ_{55}=diag(2.8198,1.3987,0.8343, 0.465,0.2856,0.1965) содержит дисперсии 5 y–изменчивостей: $\Lambda_{55}=(1/m)Y^T_{m5}Y_{m5}$, где $Y_{m5}=Z_{m5}C_{55}$ – матрица значений y–изменчивостей. Вычислительная схема Z_{m5}=>R_{55}=>($C_{55}\Lambda_{55}$) предшествует схеме вычисления многомерной выборки $Y_{m5}=Z_{m5}C_{55}$.

Таблица 1. Матрица $R_{55}=\{r_{ij}=corr(z_i,z_j)\}$ (z,z)-корреляций и матрица $C_{55}=C^{(s)}{}_{55}=\{c^{(s)}{}_{ij}=corr(z^{(s)}{}_i,y^{(s)}{}_j)\}$ ($z^{(s)}$,$y^{(s)}$)-корреляций

	z_2	z_3	z_4	z_5	c_1	c_2	c_3	c_4	c_5
1.0000	0.1096	0.3888	-0.6098	0.3026	**0.4861**	0.2650	**0.4480**	**0.6563**	-0.2491
0.1096	1.0000	0.3285	0.0539	-0.0285	0.1414	**-0.7165**	**0.5713**	-0.2937	-0.2325
0.3888	**0.3285**	1.0000	-0.2139	0.7258	**0.5292**	**-0.4054**	**-0.2630**	0.2043	0.6669
-0.6098	0.0539	-0.2139	1.0000	-0.3654	**-0.4432**	**-0.4979**	**-0.2961**	**0.6322**	-0.2614
0.3026	-0.0285	**0.7258**	**-0.3654**	1.0000	**0.5169**	-0.0651	**-0.5622**	-0.2039	-0.6090

Таблица 2. Матрица $R^{(20)}_{55}=\{r^{(s=20)}_{ij}=corr(z_i,z_j)\}$ (z,z)-корреляций

1	2	3	4	5	
1,0130	-0,0132	-0,0369	-0,0215	0,0375	1
-0,0132	0,9862	0,0074	-0,0088	0,0003	2
-0,0369	0,0092	0,9806	0,0185	-0,0246	3
-0,0215	-0,1560	0,0185	0,9788	-0,0026	4
0,0375	0,0702	-0,0246	-0,0026	1,0356	5

Таблица 3. Матрица $C_{66}=C^{(+)}_{55}=\{c^{(+)}_{ij}=corr(z^{(+)}_i,y^{(+)}_j)\}$ $(z^{(+)},y^{(+)})$-корреляций при $\Lambda^{(20)}_{55}=diag(\lambda^{(20)}_1,\ldots,\lambda^{(20)}_5$ = diag(1.0666,1.0091,0.9967, 0.9695,0 .9581)

	1	2	3	4	5
1	0,5868	0,0793	0,5506	0,4689	0,3555
2	0,1536	-0,8827	0,2589	0,3439	-0,1091
3	0,1538	-0,1386	-0,3283	-0,4096	0,8256
4	-0,4609	-0,2542	-0,3545	0,6972	0,3335
5	0,6293	0,3615	-0,6296	0,0896	-0,2625

Применяемые вычислительные модели

Применяемые вычислительные модели [1-11] соответствуют 5 шагам решаемых задач для одного из значений s=1,...,20:

а) вычисление «реальной» матрицы $R_{55}=(1/m)Z^T_{m5}$ Z_{m5} (матрица Z_{m5} стандартизованных реальных данных) и новая матрица (z_i,z_j)–корреляций $R^{(s)}_{55}=\{(1/s)r^{(1)}\}$;

б) вычисление матрицы собственных чисел $\Lambda^{(s)}_{55}$, s>1 такой, что выполняется условие неизменности (z,y)-корреляций для 2-х матриц R_{55} и $R^{(s)}_{55}$: $R_{55}C_{55}=C_{55}\Lambda_{55}$), $R^{(s)}_{55}C^{(s)}_{55}=C^{(s)}_{55}\Lambda^{(s)}_{55}$), $\Lambda^{(s=1)}_{55}$=diag(2.3329,1.1803,0.9349,0.3906,0.1613), значения элементов матрицы $\Lambda^{(s)}_{55}$ при s=2,3,…,20 приведены в Таблице 3. Вычисление каждой матрицы собственных чисел $\Lambda^{(s)}_{55}=diag(\lambda^{(s)}_1,\ldots,\lambda^{(s)}_5$ (матрица $C^{(s)}_{55}=C_{55}$) происходит по формуле $\Lambda^{(s)}_{55}=C^{(s)T}_{55}R^{(s)}_{55}C^{(s)}_{55}$ (после вычисления элементов матрицы $R^{(s)}_{55}$ по формуле $r^{(s)}_{ij}=(1/s)r_{ij}$);

в) поиск и нахождение связанной с матрицей $R^{(s)}_{55}$ матрицы $C^{(s=1654)}_{55}$ такой, что элементы матрицы $C^{(1654)}_{55}$ «близки» к элементам исходной матрицы C_{55} только по значениям 14 индикаторов (без изменения знака элемента) из прежней мозаики индикаторов;

г) разработка многосмысловых уравнений с известными и неизвестными семантическими переменными [2-3];

д) моделирование новых матриц $Y^{(t+)}_{m5}$, $Z^{(t,,s)}_{m5}$, соответствующих системе многосмысловым уравнениям с известными и неизвестными семантическими (смысловыми) переменными [4-9].

Моделирование новых матриц $Y^{(t,s)}_{m5}$, $Z^{(t,+)}_{m5}$ (Таблицы 4,5 [1]) для системы многосмысловых уравнений проведено в статье [1], Моделирование (не вычисление) матрицы $Y^{(t,s)}_{m5}=U^{(t)}_{m5}\Lambda^{(s)1/2}_{55}$, $s\in\{1,2,\ldots,1000\}$ такой, что: $(1/m)Y^{(t,s)T}_{m5}Y^{(t,s)}_{m5}=\Lambda^{(s)}$, происходит с применением ППП «Спектр» [10,11] и комплекса программ считывания\записи бинарных данных [11]. Модельную случайную матрицу $U^{(t)}_{m5}$ с номером $t=1,\ldots,\ k_t<\infty$ моделируем, применяя программы из ППП «Спектр» [10,11] и применяя вновь вычисленную матрицу собственных чисел $\Lambda^{(20)}$ (реализуется вычислительная схема $(\Lambda^{(20)}_{55},U^{(t)}_{m5})=>Y^{(t,20)}_{m5}$).

Модифицированные многосмысловые уравнения с известными и неизвестными семантическими переменными

Рассматриваемые ниже модифицированные многосмысловые уравнения с известными и неизвестными семантическими переменными отличаются другими формульными единицами, повливавшие на фразы их смыслов. Но модифицированные многосмысловые уравнения соответствуют многомерным уравнениям с числовыми параметрами и z-переменными (z_1,z_2,z_3,z_4,z_5), образующих уже иные «формульные единицы» в нехимических формулах (уравнениях) прежних у-реакций. Смысл формулы у-реакции состоит из других слагаемых смыслов других формульных единиц, входящих в формулу у-реакции. В той или иной формуле у-реакции самоочищения воды присутствуют «формульные единицы», изображающие биологически активную (БПК) или химически активную (ХПК) части

растворенного кислорода. Других химических реакций нет. Присутствие ионов аммония (в роли катализатора) служит фоновым «катализатором» протекания биохимических процессов разложения взвешенных веществ (взвешенных веществ (z_3) в виде белковых веществ, соединений азота).

Начнем изложение с простых формул у-реакций, имеющих легко анализируемые слагаемые смыслы формульных единиц. Простую нехимическую формулу имеет 4-ая реакция (y_4)**,** она имеет смысловую формулу с 2-мя заметными «весами» $c_{14}=(0{,}4689)>0$, $c_{44}=0{,}6972>0$: смысл(y_{i4})=смысл(z_{i1})*(0.4689)⊕смысл(z_{i4}) *0.6972.

Четвертая смысловая переменная (y_4**)** имеет когнитивный смысл **у**-реакции, выражаемый фразой смысл(y_4)**=**«химические процессы $c_{44}=0{,}6972$ (ХПК) разложения белковых веществ, соединений азота при присутствии иона аммония ($c_{14}=0{,}4689>0$, где смысл(z_1)=«ионы аммония»). Эта у-реакция проходит в среде поверхностных природных вод. Ниже покажем: смысл четвертой смысловой переменной y_4 (disp(λ_4)=0.9695, маловариабильная) является частью смысла первой переменной y_1 (ее дисперсия достаточно большая disp(y_1)= λ_1=2.3331).

Здесь в у-реакций «y_1» влияющими на формулу переменной y_1 являются 2 формульные единицы «z_{i1}*0.4689 и «z_{i4}*0.6972», имеющие постоянные положительные «веса» 0.4689, 0.6972 и знакопеременные изменчивости (z_{i1}), (z_{i4}), i=1,…,12. При положительных весах $c_{14}=0.4689$, $c_{44}=0.6972$ значения изменчивостей (z_{i1}), (z_{i4}) переменных (z_1), (z_4) имеют разные знаки, они обеспечивают свои тренды динамик (явно видны на Рисунке 1), влияющих на убывающий тренд динамики изменчивости переменной y_4. Для формульной единицы «z_{i1}*0.4689+z_{i4}*0.6972», объединяющей 2 формульные единицы «z_{i1}*0.4689 и «z_{i4}*0.6972», динамика значений ее изменчивости «суммирует» вклады формульной единицы «z_{i1}*0.4689+z_{i4}* 0.6972» в уменьшение изменчивости переменной y_4. Нужна более «короткая» формула для формульной единицы. Влияющими на убывающий тренд динамики изменчивости переменной y_4 яляются формульные единицы «z_{i1}*0.4689 и «z_{i4}*0.6972,», их «столбики» динамик, отображают вклады в уменьшение изменчивости переменной y_4 (к концу завершения реакции) приведены на Рисунке 1.

Следующей удобной реакцией для нашего анализа является реакция **у**$_3$ (Рисунок 2) со смысловом, равным когнитивной сумме (⊕) 5 смыслов: смысл(y_{i3})=смысл(z_{i1})*0,5506⊕ смысл(z_{i2})*0,2589⊕смысл(z_{i3})*(-0,3283)⊕ смысл(z_{i4})*(-0,3545)⊕смысл(z_{i5})*(-0,6296). Здесь выделим формульную единицу z_{i1}*0,5506+ z_{i2})*0,2589+(z_{i3}*(-0,3283)+z_{i4}*(-0,3545)). Ее когнитивный смысл (как смысл подтипа БПК\ХПК) передается фразой «биологически активное поглощение (смысл (z_{i4})=БПК, c_{43}=(-0,3545)) растворенного кислородом взвешен ных веществ (=смысл(z_{i3})), происходящее при присутствии ионов аммония». Формульная единица имеет разные сочетания знаков в суммах произведений вида ±c_j(±)z_j. «Вес» +c_j увеличивает в $z_j>0$ (уменьшает в $z_j<0$ раз) вклад «веса» c_j в уменьшающуюся изменчивость переменной y_3, а вес» (-c_j) уменьшает в $z_j>0$ (увеличивает в $z_j<0$ раз) вклад «веса» c_j в уменьшающуюся изменчивость (из-за свойства реальной реакции в воде рек и озер) переменной y_3. «Формульная единица» вида z_1*0,5506+z_5*(-0,6296) из переменной $y_{i3}=z_{i1}$*0.5506+z_{i2})*0.2589+z_{i3}*(-0.3283)+z_{i4}*(-0.3545)+z_{i5}*(-0.6296) «изображает» химически активную часть растворенного кислорода (смысл(z_5)=ХПК) при присутствии ионов аммония (смысл(z_1)=«ионы аммония»). «Формульная единица» вида (z_{i3}*(-0,3283)+z_{i4}*(-0,3545)) из переменной y_3 (из вещества «y_3») «изображает» биологическое поглощение кислорода (смысл(z_4)=БПК) разных взвешенных веществ (смысл(«z_3)=«взвешенные вещества»). Сформированная Таблица 4 формульных единиц (из формул реакций) имеют 6 своих смыслов-слагаемых, в смысловых нехимических уравнениях с смысловыми переменными. Присущие реакциям самоочищения формульные единицы выявляют, кроме нехимических формул, смыслы (в традиционных терминах БПК, ХПК) не только то, что (ресурс при присутствии катализатора, без присутствии катализатора) реагируют между собой, но и их неразделенные химическими формулами компоненты реагентов. «Формульная единица» реакции (Рисунок 2) $y_{i3}=z_{i1}$*0.5506+z_{i2}*0.2589+z_{i3}*(-0.3283)+z_{i4}*(-0.3545)+z_{i5}*(-0.6296) состоит из простых формульных единиц, описание которых легче начинать с последних компонент 3-го собственного вектора c_3=(0.5506,0.2589,(-0.3283), (-0.3545),(-0.6296))^T. Формульные единицы z_{i1}*0,5506+z_{i2})*0,2589+z_{i3}*(-0,3283) вычисляют расходные 3 вещества для БПК, ХПК. Интерпретация 5-ой компоненты (c_{53}=(-0.6296**,** смысл(z_5)=«ХПК») из формульной единицы z_{i5}*(-0,6296) позволяет «вычислить» нехимическим способом неизмеряемый факт: происходит химическое потребление кислорода взвешенными веществами (знак минус «веса» c_{53}=(-0.5622), смысл («z_3)=«взвешенные вещества», смысл(z_5) =«ХПК»)- окисление частиц (взвешенных веществ, c_{33}=(-0.3283), смысл («z_3)=«взвешенные вещества»). Две простые «формульные единицы» видов z_{i3}*c_{33}=z_{i3}*(-0.3283) показывает (соответствует) наличие взвешенных веществ при присутствии ионов аммония. А в «формульных

единицах» других видов $+z_{i4}*(-0,3545)$, $+z_{i5}*(-0,6296$ «работают» посредством индикаторов: если $c_{43}=(-0.3545)$, то формульная единица $z_{i4}*(-0,3545)$ вычисляет БПК, если $c_{53}=(-0,6296)$, то формульная единица $+z_{i5}*(-0,6296)$ вычисляет ХПК. Эти 2 компоненты c_{33}, c_{43} из матрицы индикаторов показывают:

а) наличие взвешенных веществ ($c_{33}=(-0.3283)$, знак минус показывает уменьшение взвешенных веществ);

б) наличие одного поглотителя кислорода знак минус при «весе» $c_{43}=(-0.3545)$ показывает уменьшение биохимического потребления кислорода (c43=(-0.3545), смысл(z5)=«БПК»). При этом учитываются:

- присутствие одного «катализатора» в виде ионов аммония (c13=0.5506, смысл(z1)=«ионы аммония»);

- наличие расходного вещества в виде растворенного кислорода ($c_{23}=0.2589$, смысл(z_2)=«растворенный кислород»).

Словесная форма этого смыслового равенства: растворенный кислород химически поглощается при присутствии ионов аммония»=«ионы аммония»⊕«растворенный кислород»»⊕«химии чески поглощенный кислород». Суммарный смысл этих трех фраз создают итоговую фразу смысла смысловой переменной y_3 смысл(y_{i3})=«ХПК при присутствии ионов аммония». Мы видим: в 2-х формулах y_4, y_3 2-х реакций поглощают кислород химическим (в y_4) и биологическим (в y_3) способом при наличии «катализатора» «ионы аммония» и тем самым эти формулы «выявляют работу» химически активного кислорода (смысл(z_5)=ХПК) и «выявляют работу» биологически активного кислорода (смысл(z_4)=БПК). Удобной для ответа на вопрос: какие формульные единицы, какие БПК-реакции, ХПК-реакции соответствуют многомерной переменной ((смысл(y_1), смысл(y_2), смысл(y_3), смысл(y_4), смысл(y_5)), формульной единицей, является следующая: $z_{i1}*0.5506+z_{i2}*0.2589+z_{i5}*(-0.6296)+z_{i5}*(-0.6296)$. Она имеет смысл, передаваемый фразой «химиически активное поглощение (смысл (z_{i4})=ХПК, $c_{53}=(-0,6296)$ растворенным кислородом взвешен ных веществ (=смысл(z_{i3})), происходящее при присутствии ионов аммония».

Приведенное познание смыслов компонент 3-го собственного вектора позволяет перейти к познанию «формульной единицы» другой реакции, а именно *y*-реакции y_1, смысл которой и смысл содержащихся в ее формуле «формульных единиц» определяем из смыслового равенства вида: смысл(y_{i1})=смысл(z_{i1})*(0.5506)+смысл(z_{i2})*(0.2589)+смысл(z_{i3})*(-0.3283)+смысл(z_{i4})*(-0.3545)+смысл (z_{i5})*(-0.6296). Ниже покажем: смысл(y_1)= «окисление+ поглощение +(присутствие ионов аммония». Проценты участия *z*-веществ и поглотителя в *y*-реакции y_2(23,60%): растворенного кислорода (51,34%), взвешенных веществ(16,43%), био-поглощенного кислорода (24,79%). В формуле *y*-реакции y_1 три элемента $c_{31}=0.1538$,$c_{41}=(-0.4609)$,$c_{51}=0.6293$ из матрицы индикаторов показывают наличие 3-х поглотителей кислорода ($c_{31}=0.1538$,$c_{41}=-0.4609$, $c_{51}=0.6293$, знак (минус при $c_{41}=-0,4609$) убывающего ($c_{41}=-0.4609$) объема биологически активного кислорода ($c_{41}=-0.4609$, смысл(z_4)=«БПК») противоположен знаку потребляемого растущего объема взвешенных веществ ($c_{31}=+0.1538$, смысл(z_3)=«взвешенные вещества»). Наличие в поверхностных природных водах иона аммония связано с биохимическими процессами разложения белковых веществ, соединений азота. Поэтому $c_{11}=0.5868$ (смысл(z_1)= ионы аммония) служит фоновым катализатором протекания реакции y_1. Но объем взвешенных веществ («z3») возрастает («веса» $c_{31}=0,1538$, $c_{51}=0,6293$ имеют знаки (+)) вместе с объемом потребляемого химически активного кислорода ($c_{51}=0,6293$,смысл((z_5)=ХПК)). Формульные единицы «$z_{i1}*0.5868$, «$z_{i3}*(-0.4609)$», $z_{i5}*0.6293$ имеющие постоянные «веса» 0.5868, (-0.4609), 0.5868, и переменные изменчивости (z_{i1}), (z_{i3}), (z_{i5}). При положительных весах 0.5868, 0.6293 значения изменчивостей (z_{i1}), (z_{i5}) переменных (z_1), (z_5) имеют по 8 положительных знаков, их тренды динамик (явно видны на Рисунке 2), препятствуют убыванию тренда y_1. На убывание тренда динамики существенно влияют изменчивости переменной z_3. Пять заметных больших изменчивостей образуют слагаемые вида $z_3*(-0.4609)$, именно они влияют на убывающий тренд динамики изменчивости переменной y_1. Формульные единицы «$z_{i1}*0.4861$ и «$z_{i5}*0.6293$» препятствуют убыванию тренда y_1. Их кривые динамик приведены на Рисунках 4-6. Существенное влияние на убывание изменчивости $y_{i1}=z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)+z_{i5}(0,6293)$ переменной y_1 (на реакцию «y_1») оказывает переменная z_4 с отрицательным «весом» $c_{41}=(-0,4609)$, с изменчивостями z_{i4} i=1,…,12, (смысл(z_4)=БПК). Следовательно, смысл реакции «y_1» формируется при участии смысла смысл(z_1)=БПК. Далее покажем смысл(«$z_{i1}*0.4861$ + «$z_{i5}*0.6293$»)=«ионы аммония химически окисляются в среде растворенного кислорода», т.е. смысл (y_3)=БПК+ХПК. Мы проанализировали реакции y_4, y_3 с присутствием катализатора. Следующие 2 реакции y_1, y_2 протекают иначе. Они краткосрочны. Валидная переменная $y_{i1}=z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)+z_{i5}(0,6293)$, i=1, … ,m. Один индикатор ($c_{21}=0.1536\approx0$)–отсутствие растворенного кислорода (смысл(z_2)= «растворенный кислород»), обусловленное окончанием процесса общего самоочищения воды от взвешенных

веществ с расходом 3-х видов (z_3,z_4,z_5) поглотителей растворенного кислорода. Эта валидная переменная y_1 своими вычисленными значениями y–изменчивостей характеризует общее самоочищение вод водоемов от взвешенных веществ. Ниже показано: y_2–краткосрочное самоочищение биологическим способом (БПК) взвешенных веществ, а y_3-краткосрочное самоочищение вод водоемов от взвешенных веществ путем химического *потребления* кислорода (ХПК) – химическое окислением частиц взвешенных веществ, y_3-краткосрочное самоочищение при биологических процессах разложения белковых веществ, соединений азота при присутствии ионов аммония в поверхностных природных водах. Компоненты 1-го собственного вектора c_1 из матрицы собственных векторов (индикаторов) C_{55} определяют формулу 1-го модельного y–вещества в виде функции $y_{ij}=z_{i1}c_{1j}+z_{i3}c_{3j}+z_{i4}c_{4j}+z_{i5}c_{51}$, $y_{i1}=z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)+z_{i5}(0,6293)$, i=1, … ,m. Компоненты 2-го собственного вектора $\mathbf{c_2}$ из матрицы собственных векторов (индикаторов) C_{55} определяют формулу 2-го модельного y–вещества в виде функции $y_{i2}=z_{i2}(-0,8827)+z_{i3}(-0,1386)+z_{i4}(-0,2542)$, i=1,…,m. Компоненты 3-го собственного вектора c_3 из матрицы собственных векторов (индикаторов) $\mathbf{C_{55}}$ определяют формулу 3-го модельного *y*–вещества в виде функции $y_{i3}=z_{i1}c_{1j}+z_{i2}c_{2j}+z_{i5}c_{5j}$, $y_{i3}=z_{i1}*0.5506+z_{i2}*0.2589+z_{i3}*(-0.3283)+z_{i4}*(-0.3545)+z_{i5}*(-0.6296)$, i=1,… ,m. Все вычисленные нехимические формулы 3-го модельного y–вещества зависят от значений 3-х изменчивостей z_{i1},z_{i2}, z_{i5}, i=1,…,m. Смыслы изменчивостей z_1,z_2, z_5 смысл(z_1)=«ионы аммония», смысл(z_2)= «растворенный кислород», смысл(z_5)=ХПК формируют смысл другой y–переменной смысл($\boldsymbol{y_{i3}}$):

«ионы аммония химически окисляются в среде растворенного кислорода». Мы получили неизвестный смысл смысл($\boldsymbol{y_{i3}}$), «сложив» 3 известные смыслы, соответствующие формуле 3-го модельного y–вещества

$y_{i3}=z_{i1}*0.5506+z_{i2}*0.2589+z_{i3}*(-0.3283)+z_{i4}*(-0.3545)+z_{i5}*(-0.6296)$**:** смысл($y_{i3}$)=смысл($z_{i1}$)*(0.4480)⊕смысл($z_{i2}$)*(0.5713)⊕смысл($z_{i5}$)*(-0.5622). Словесная форма этого смыслового равенства: «ионы аммония химически окисляются в среде растворенного кислорода»= «ионы аммония»⊕«растворенный кислород»⊕ «химическое поглощение кислородом». Смыслы этих двух фраз «химически окисляются», «химическое поглощение кислородом» совпадают и создают итоговую фразу смысла смысловой переменной смысл($\mathbf{y_{i3}}$) **«химически окисляются».** Первый химический процесс, в отличие от 2-го биохимического процесса, длится краткосрочно по времени, протекает в среде растворенного в воде кислорода (в лаборатории, где испытуемые образцы находятся в темном помещении при постоянной температуре 20ºC). При 2-ом биологическом процессе происходит потребление взвешенными веществами растворенного кислорода биологическим способом (БПК). Растворенный кислород действует биологически активно. Другие 3 элемента c_{22} c_{23} из матрицы индикаторов показывают наличие кислорода (c_{22}=(-0.8827), знак минус показывает уменьшение), одного поглотителя кислорода (c_{32}=(-0.4054), знак минус показывает уменьшение) и одного окислителя вредных частиц (индикатор c_{42}=(-0.2542), знак минус показывает уменьшение), обусловленные наличием растворенного еще непоглощенного веществами кислорода. Третий процесс, также протекающий за краткосрочный период времени, протекает в воде (H_2O, в тех же лабораторных условиях) при наличии растворенного кислорода. Но происходит химическое потребление кислорода (ХПК) - окисление частиц (взвешенных веществ) в 1 л воды. Другие 2 индикатора $\mathbf{c_{33}}$, $\mathbf{c_{43}}$ из матрицы индикаторов показывают наличие взвешенных веществ (c_{33}=(-0.3283), знак минус показывает уменьшение взвешенных веществ), одного поглотителя кислорода (c_{43}=(-0.3545), знак минус показывает уменьшение) и уменьшение одного окислителя вредных частиц (индикатор c43=(-0.3545), знак минус показывает уменьшение биологического потребления кислорода (БПК)), обусловленные наличием растворенного и еще непоглощенного веществами кислорода. Вторая и третья валидные y-переменные посредством своих формульных единиц показывают отличие второго БПК-процесса от третьего ХПК-процесса Первый процесс наиболее информативен–1-ая y–переменная y_1 формульно показывает и биохимическое потребление растворенного кислорода (БПК) и химическое окисление кислородом (ХПК): дисперсия disp(y_1)=λ_1=2.3331 намного превосходит дисперсии 2-х других y–переменных: λ_2=1.1802, λ_3=0.9349. Первые 2 y–переменные соответствуют 2 ситуациям: ситуация 1 отсутствия растворенного кислорода для одних взвешенных веществ и ситуация 2 присутствия растворенного кислорода для других взвешенных веществ. Смысл первой переменной–окисление+поглощение (при отсутствии O_2), смысл второй переменной – окисление кислородом+небольшое поглощение взвешенными веществами кислорода (в присутствии растворенного кислорода). Четвертая реакция (ее дисперсия $\lambda^{(s)}_4$=0.9695 мала, едва дотягивает до 1) имеет формулу с 2-мя заметными «весами» c_{14}=0,4689, c_{44}=0,6972. смысл(y_{i4})=смысл(z_{i1})*0.4689+смысл(z_{i4})*0.6972, Четвертая смысловая переменная имеет когнитивный смысл смысл(y_{i4})=«биохимические

процессы с44=0,6972 (ХПК) разложения белковых веществ, соединений азота при наличии иона аммония (c_{14}=0,4689, смысл(z_1)=«ионы аммония») в поверхностных природных водах». Смысл четвертой смысловой переменной y_4 (disp(λ_4)=0.9695) является частью смысла первой переменной y_1 (disp(λ_1)=1.0666). Получается: смыслы 2-ой, 3-ей, 4-ой у-переменных (с дисперсиями 1.0091, 0.9967, 0.9695) входят в смысл у-переменной y_1, имеющей максимальную дисперсию 1.0666. Достигнутые постоянные «веса» соответствуют 3 вычисленным нами из реальных данных скрытым реакциям самоочищения воды 12 рек и озер. Доля извлеченной информации для у-реакции y_1 равна λ_1=1.0666/5=21.33%, доля извлеченной информации для y-реакции y_2 в 2 раза меньше - λ_2=1.0091/5=20.18%, немного меньше такой информации для y-реакции y_3: λ_3=0.9967=/5= 19.93%, для y-реакции y_4: λ_4=0.9695/5= 0.19.39%, Сумма информации, преобразованной в знания, равна 80.84%. Проценты участия z-веществ и поглотителей в y-реакции y_1(21.33%): ионов аммония(11,74%), растворенного кислорода (3,07%), взвешенных веществ(3.08%), био-поглощенного кислорода (9,22%), химически окисляющего кислорода (12,59%). При когнитивном моделировании к 5 показателям добавились 2 реакции поглощения, окисления, а также 2 биохимические процессы (c_{44}=0.6322, (ХПК) разложения неизмеренных белковых веществ, неизмеренных соединений азота, протекающих в присутствии ионов аммония. Наша модель так познает изучаемые данные. В рамках реакции абсорбции данное представление является формульным, и эмпирически осмысленным, является подтверждаемым на числовом материале, порождает многосмысловые уравнения (с известными не известными смысловыми переменными). Это иное смысловое представление символических систем, которыми реальные люди пользовались в реальной практике для придания формы своим мыслям. Исследование осуществляется на материале о смыловых, числовых данных. Записи формульных единиц в смысловых нехимических уравнениях с смысловыми переменными (присущих реакции абсорбции) выявляют не только то, что реагируют между собой отдельные частицы веществ, но и их неразделенные химическими формулами компоненты. В каждой из которых содержится огромное число химических частиц, не отраженных в химических формулах.

Таблица 4. Полсмысл вычисляемых формульных единиц

у-реакция	Формульная единица	Смысл вычисляемой формульной единицы	Тип у-реакции (БПК/ХПК)
у 4	z_{i1}*(0.4689+(z_{i4}) *0.6972) y4=**0,4689*z1+z4*0,6972**	биологическое поглощение (с44=0,6972 (БПК) кислородом белковых веществ, соединений азота при присутствии ионов аммония (биологически активная часть растворенного кислорода)	БПК4
у3	z_{i1}*0,5506+z_{i2}*0,2589+(z_{i3}* (-0,3283)+z_{i4}* (-0,3545)) z_{i1}*0,5506+ z_{i2}*0,2589+ z_{i5}*(-0,6296) + z_{i5}*(-0,6296) y_{i3}=z_{i1}*0,5506+z_{i2}*0,2589+ z_{i3}*(-0,3283)+z_{i4}*(-0,3545)+z_{i5}*(-0,6296)	Биологически активное поглощение (смысл (z_{i4}) =БПК, с43=(-0,3545)) растворенного кислородом взвешенных веществ (=смысл(z_{i3})), происходящее при присутствии ионов аммония. Химически активное поглощение смысл (z_{i4}) = ХПК, с53=(-0,6296) растворенным кислородом взвешенных веществ (=смысл(z_{i3})), происходящее при присутствии ионов аммония.	БПК3,ХПК3
у2	(z_{i2}(-0,8827)+z_{i3}(-0,1386) +z_{i4}(-0,2542)) y_{i2}=z_{i2}(-0,8827)+z_{i3}(-0,1386)+z_{i4}(-0,2542)	Биологически активное поглощение (БПК) (смысл (z_{i4}) = БПК, с53=((-0,6296) растворенным кислородом взвешенных веществ (=смысл(z_{i3})), происходящее при наличии расходуемого растворенного кислорода.	БПК2

y1	$z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)$ $z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i5}(0,6293)$ $y_{i1}=z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0,4609)+z_{i5}(0,6293)$	Биологически активное потребление кислородом (БПК)) ионов аммония Химически активное окисление ионов аммония кислородом (ХПК)). Эти БПК иХПК обусловлены наличием растворенного и непоглощенного веществами кислорода.	БПК1, ХПК1

Эта таблица содержит новое равенство: суммы реальных смыслов 2-х типов измеренных реальных реакций БПК, ХПК равны сумме 6 когнитивных смыслов их подтипов: смысл(БПК)⊕ смысл(ХПК)=смысл(БПК1⊕смысл(БПК2)⊕ смысл(БПК3)⊕смысл(БПК4)⊕смысл(ХПК1)⊕ смысл(ХПК3). Они получены для ранее разработанных 5 многосмысловых уравнений с известными не известными смысловыми переменными [1]. Реальность 6 когнитивных смыслов подтипов смыслов 2-х реальных реакций БПК, ХПК фиксируется a priori. Получена формула для правой части приведенного смыслового равенства, она равна сумме 6-ти вычисленных формульных единиц [соответствующих подвидам БПК,ХПК]: $(z_{i1}*0.4689+(z_{i4})*0.6972)$[ХПК4]+$z_{i1}*0.5506+z_{i2}*0.2589+(z_{i3}*(-0.3283)+z_{i4}*(-0.3545))$[БПК3]+ $z_{i1}*0.5506+z_{i2}*0.2589+z_{i5}*(-0.6296)$[ХПК3]+ $(z_{i2}(-0.8827)+z_{i3}(-0.1386)+z_{i4}(-0.2542))$[БПК2]+ $z_{i1}(0.4861)+z_{i3}(0.1538)+z_{i4}(-0.4609)$[БПК1]+ $z_{i1}(0.4861)\ z_{i3}(0.1538)+z_{i5}(0.6293)$ [ХПК1]. Запись формул 6-ти вычисленнх формульных единиц приведены (для облегчения восприятия) в форме, аналогичной форме смыслового равенства. Нехимические формулы реальных реакций БПК, ХПК зависят от формульных единиц своих подтипов и условно выглядят так: Формула ХПК=$z_{i3}(0.1538)+z_{i5}(0.6293)$[ХПК1]+$z_{i1}*0.5506+z_{i2}*0.2589+z_{i5}*(-0.6296)$[ХПК3]+$(z_{i1}*(0.4689+(z_{i4})*0.6972)$[ХПК4]. Формула БПК=$z_{i1}*0,5506+z_{i2}*0.2589+(z_{i3}*(-0.3283)+z_{i4}*(-0.3545))$[БПК3]+ $(z_{i2}(-0.8827)+z_{i3}(-0.1386)+z_{i4}(-0.2542))$[БПК2]+ $z_{i1}(0.4861)+z_{i3}(0,1538)+z_{i4}(-0.4609)$[БПК1] . Визуализации этих формул приведены на Рисунках 5,6,7,8,9.

Измеренным расходным веществам и реакциям БПК, ХПК соответствуют 6 вычисленных формульных единиц из 4-х у реакций. Этим 6 формульным единицам можно придать смысл БПК или ХПК. Следовательно в результате разбиения формул 4-х у-реакций на 6 формульных единиц мы дополнили их – реальные 2 реакции самоочищения: БПХ, ХПК, математически вычисленными БПХ, ХПК, но в количестве 6 штук (Таблица 5). Мы обнаружили математически вычисляемую «реальность», дополняющую биохимию самоочищения воды рек и озер. Четыре смысла 4-х формул у-реакций дают 4 обобщенных смысла 4 валидным переменным. Для большей ясности и полезности нашей модели мы выделили для них 6 разновидностей БПК, ХПК, понятных специалистам по биохимии самоочищения воды рек и озер. Когнитивные суммы смыслов измеренных реакций БПК, ХПК равны сумме смыслов формульных единиц смысл(БПК)+смысл(ХПК)=смысл(БПК1)⊕ смысл(БПК2)⊕смысл(БПК3)⊕смысл(БПК4)⊕ смысл(ХПК1)⊕ смысл(ХПК3). Из этого равенства видно: в дополнение к 2 реальным природным реакциям вычислены 6 подтипов биохимических реакций. Они - математически вычисленная «реальность», дополняющая биохимию самоочищения воды рек и озер Восточного Казахстана.

Формульные единицы, сильно влияющие и способствующие уменьшению динамик изменчивостей 4-х вычисляемых у-реакций слагаемые смыслы формульных единиц имеют заметные дисперсии можно обозначить отдельно:

$Z^{+}_1=\mathbf{z_{i1}*0,4689}+z_{i1}*0,5506+z_{i1}(0.4861)$

$Z^{+}_2=z_{i2}(-0,8827)+z_{i2})*0,2589$

$Z^{+}_3=z_{i3}(-0,1386)+z_{i3}*(-0,3283)$

$Z^{+}_4=z_{i4}*(-0,3545)+z_{i4}(-0,2542)+z_{i4}*(-0,4609)+z_{i4}*0,6972$

$Z^{+}_5=z_{i5}*(-0,6296)+z_{i5}(0,6293)$

Перечень формульных единиц, соответствующих формулам у–реакций $(z_{i1}*0.4689+(z_{i4})*0.6972)$[y4], $(z_1*0,5506+z_{i4}*(-0,3545))$[y3], $(z_{i3}*(-0,3283)+z_{i4}*(-0,3545))$[y3], $(z_1*0,5506+z_5*(-0,6296))$[y3], [y3], $(z_{i2}(-0,8827)+z_{i3}(-0,1386)+z_{i4}(-0,2542))$ [y2], [y1], [y1] (Рисунки 5,6,7,8,9).

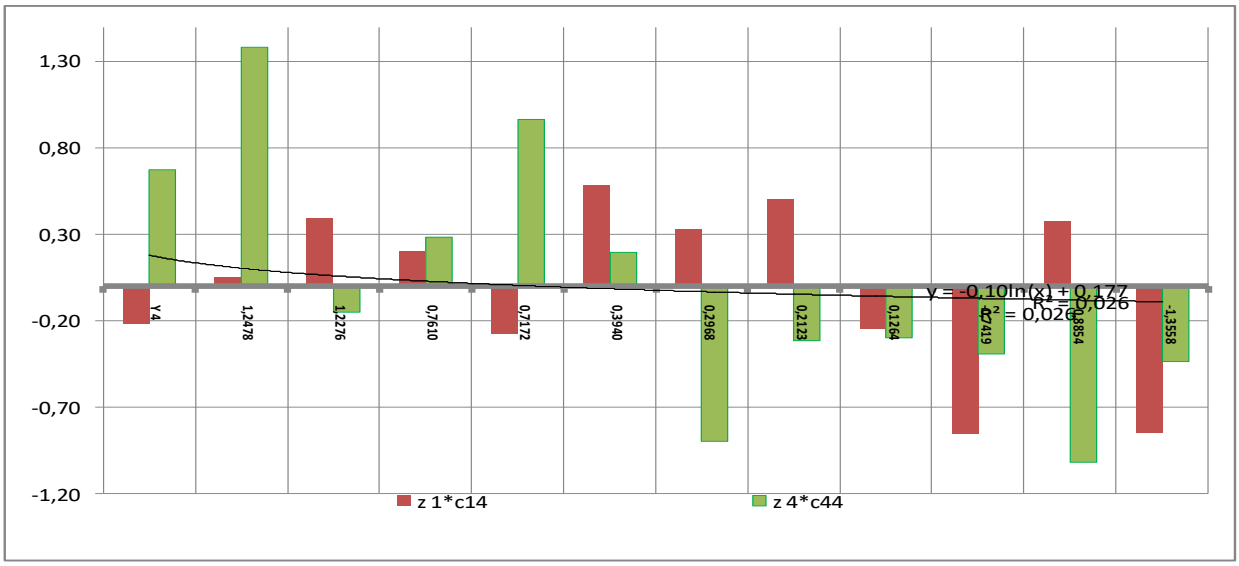

Рисунок 1.

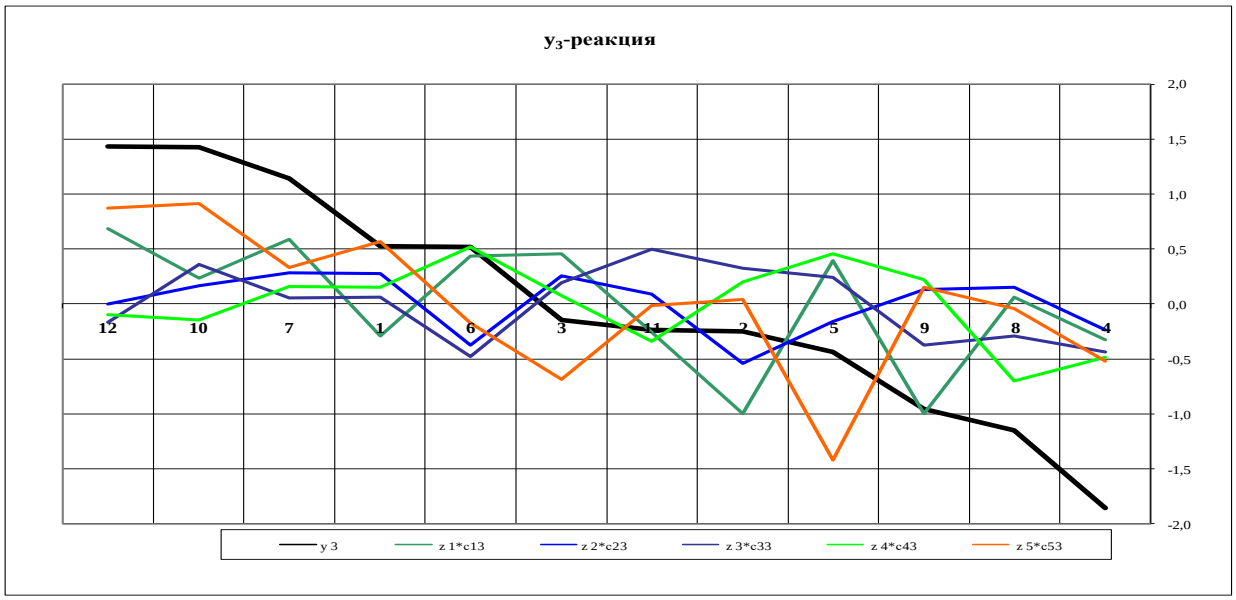

Рисунок 2.

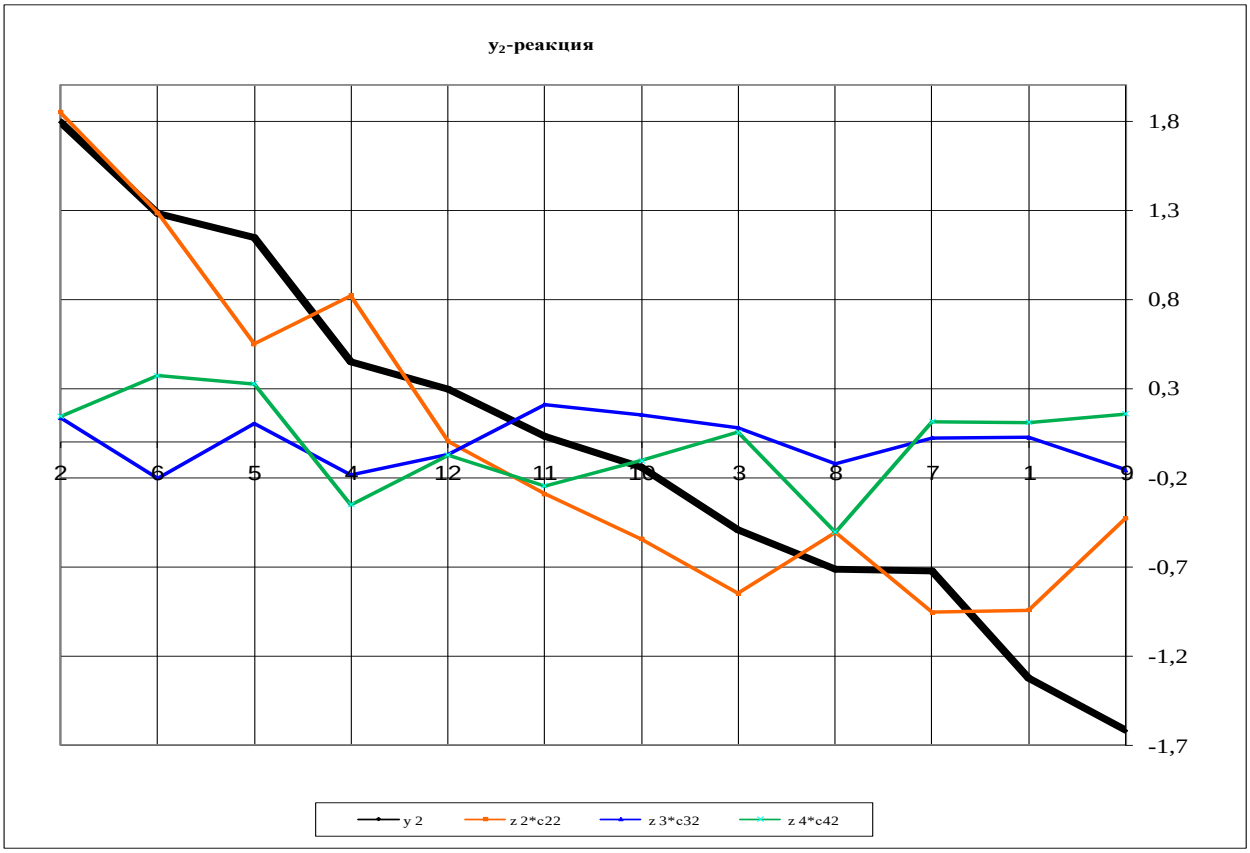

Рисунок 3.

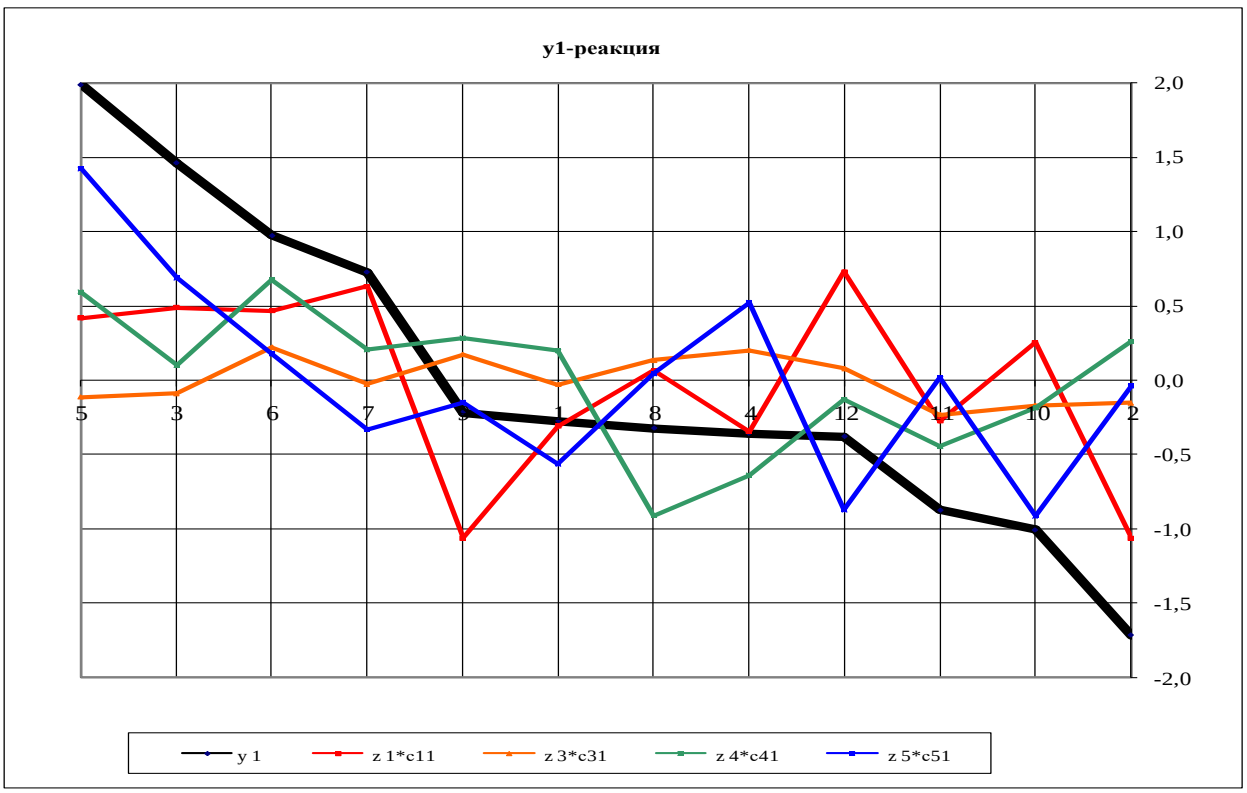

Рисунок 4.

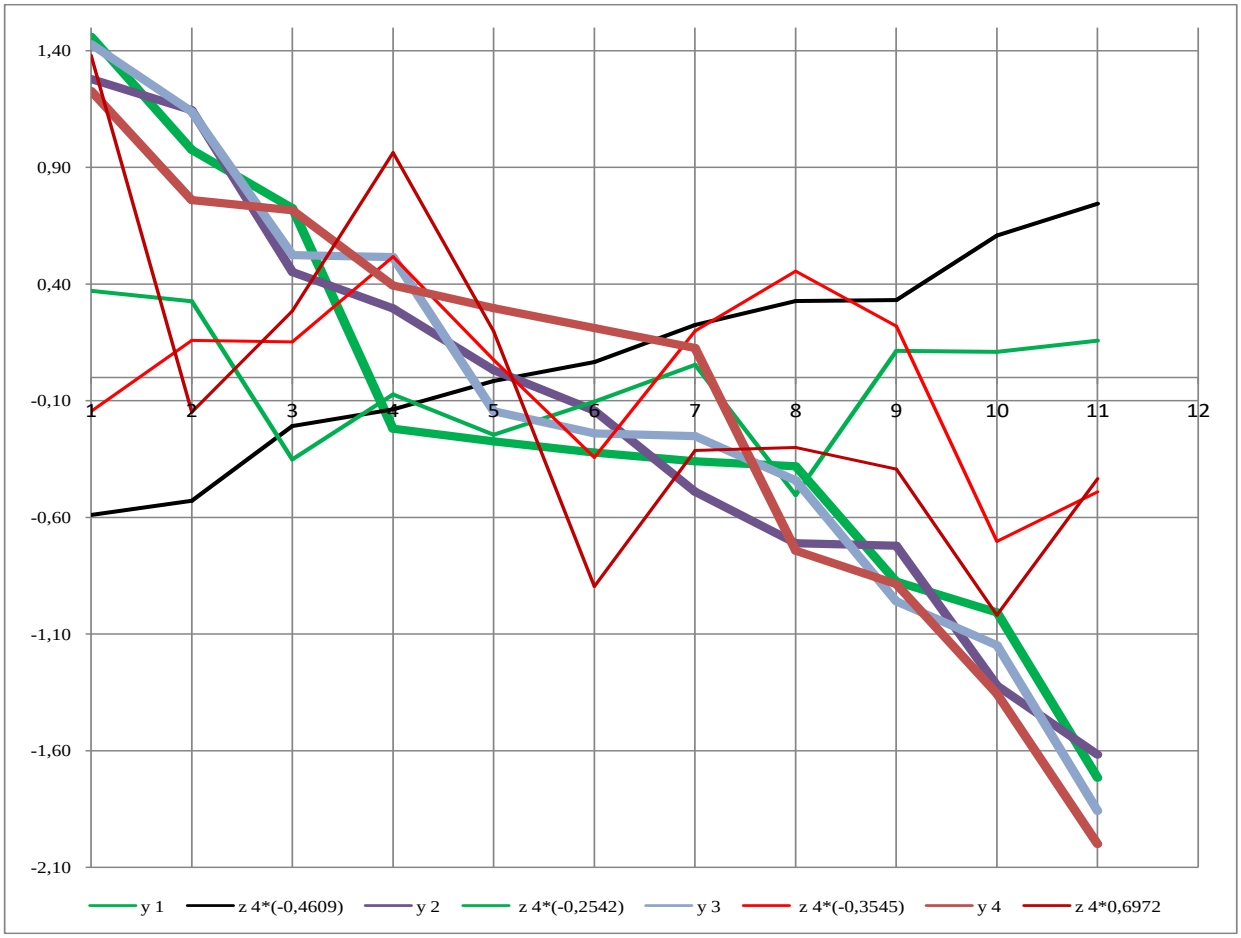

Рисунок 5.

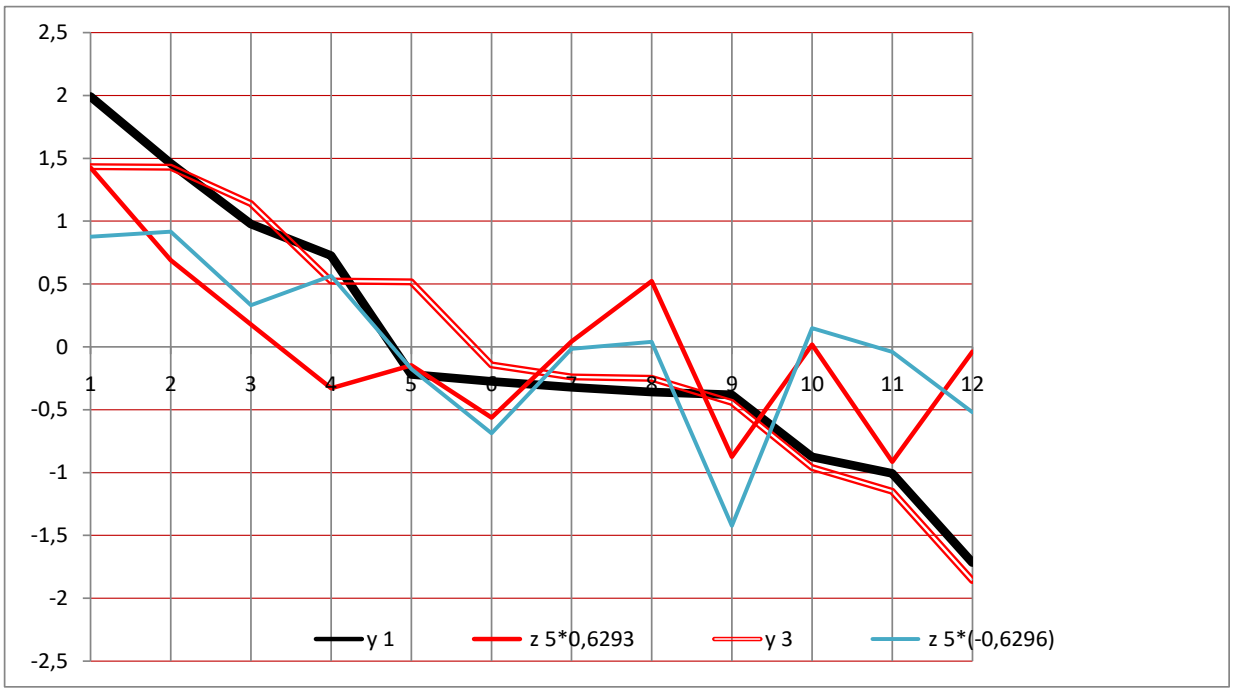

Рисунок 6.

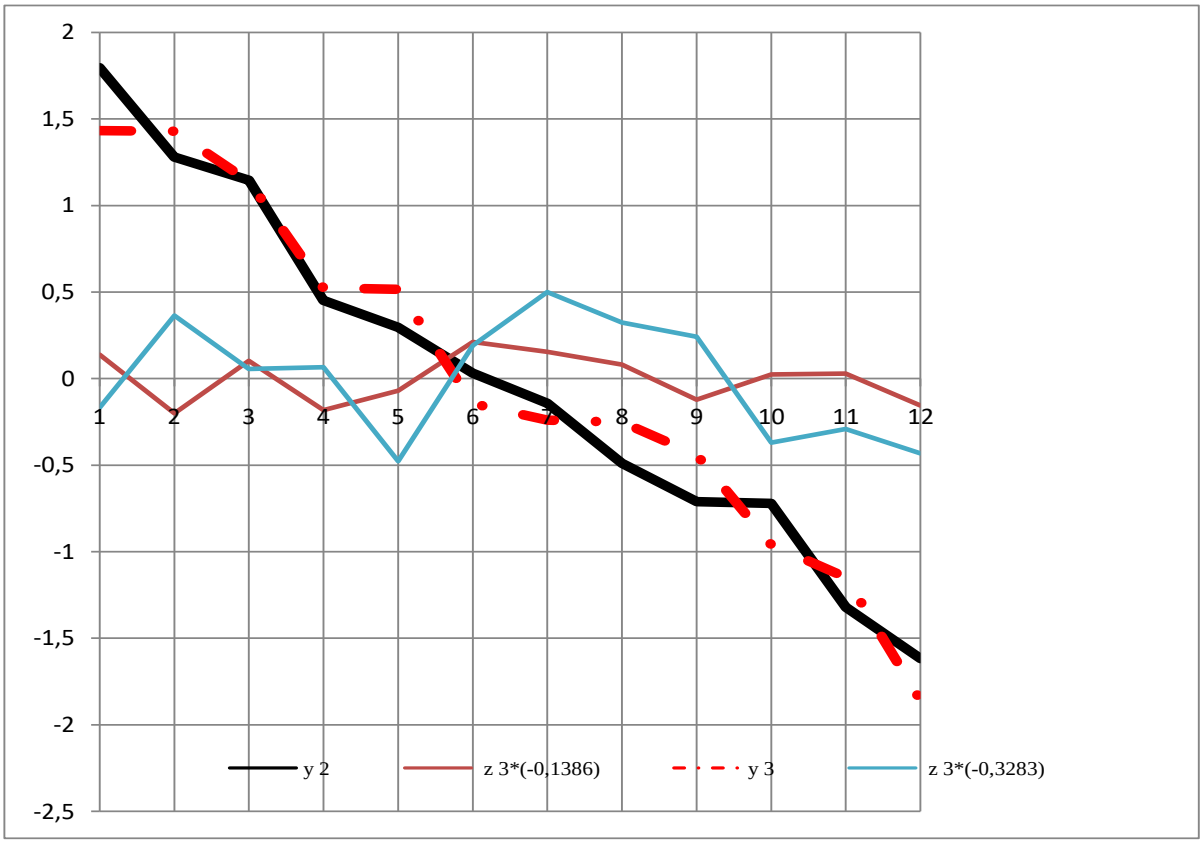

Рисунок 7.

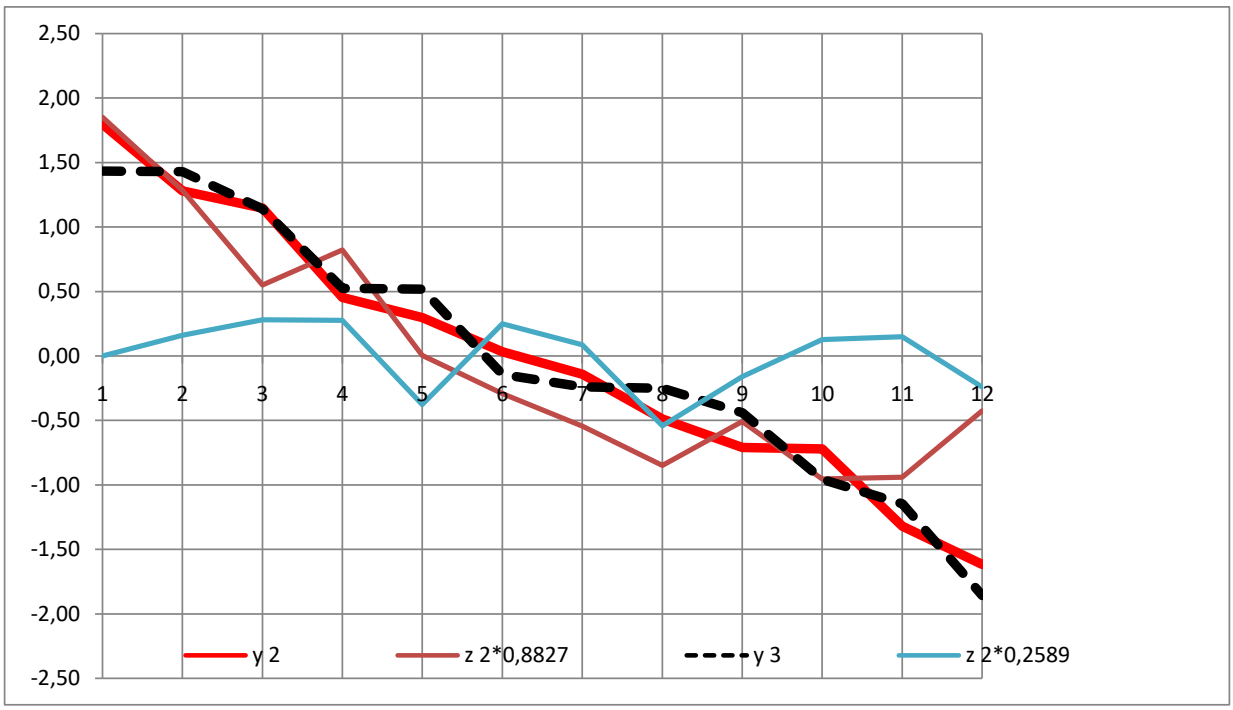

Рисунок 8.

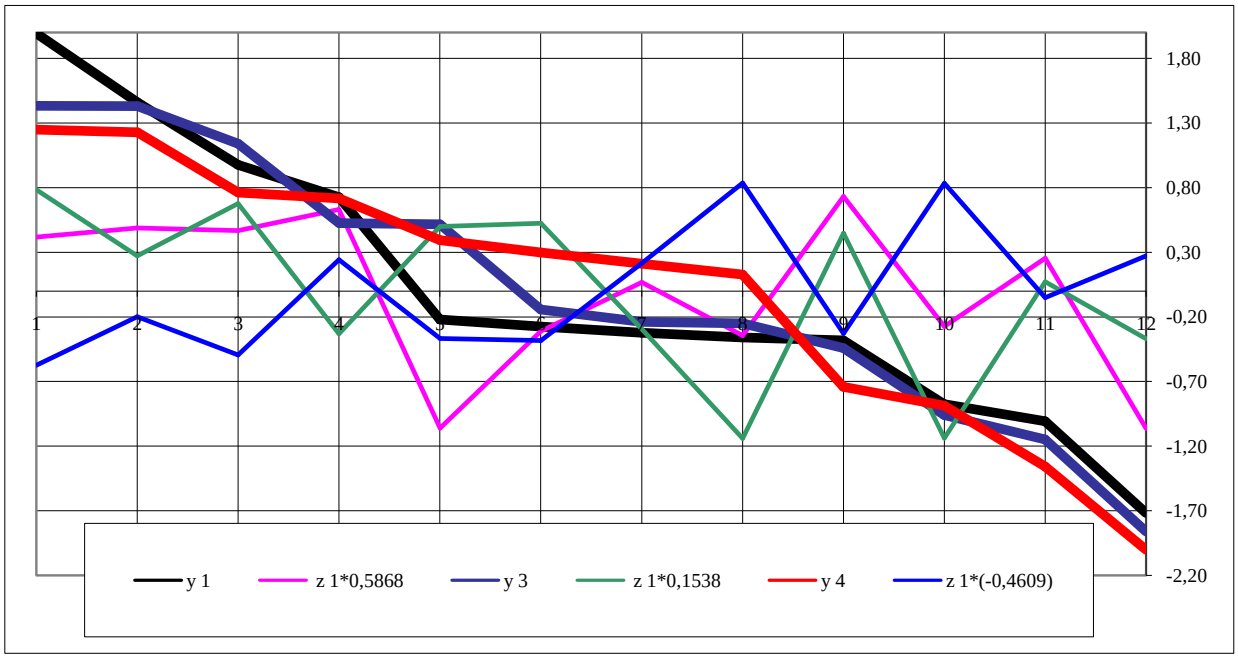

Рисунок 9.

Таблица 5. Матрица $Y^{(20)}_{m6}$ y–изменчивостей

№					
1	-0.2741	-1.3205	0.5244	-0.7419	-0.5685
2	-1.7156	1.7954	-0.2510	-0.8854	-1.1079
3	1.4603	-0.4892	-0.1442	0.7610	-0.7389
4	-0.3587	0.4525	-1.8582	0.3940	1.1940
5	1.9911	1.1460	-0.4410	0.2123	-1.1389
6	0.9762	1.2794	0.5165	-1.3558	1.3260
7	0.7251	-0.7211	1.1389	0.1264	0.0550
8	-0.3222	-0.7105	-1.1484	1.2276	1.1667
9	-0.2195	-1.6169	-0.9589	-1.9999	-0.2374
10	-1.0071	-0.1425	1.4288	0.7172	-0.2548
11	-0.8746	0.0316	-0.2397	1.2478	-1.1491
12	-0.3809	0.2958	1.4328	0.2968	1.4538
13	0.0000	0.0000	0.0000	0.0001	0.0000
14	1.0666	1.0091	0.9967	0.9695	0.9581

Таблица 6. Матрица $Z^{(+)}_{m5}$ z–изменчивостей

№					
1	-0.526802	1.066155	-0.196767	-0.430743	-0.897257
2	-1.811562	-2.09726	-0.982321	-0.563477	-0.061068
3	0.832868	0.063753	-0.582003	-0.213433	1.095056
4	-0.588513	-1.101008	1.316547	1.381927	0.829649

5	0.711109	-0.928485	-0.735058	-1.284484	2.262915
6	0.794334	-1.606531	1.453329	-1.461296	0.282083
7	1.074205	0.968845	-0.168801	-0.448166	-0.524536
8	0.112665	0.624722	0.886343	1.981196	0.067161
9	-1.807142	0.517113	1.128312	-0.62139	-0.235791
10	0.430144	0.770145	-1.108345	0.408942	-1.453708
11	-0.4661	0.464534	-1.519996	0.966785	0.025394
12	1.24484	0.053309	0.508719	0.284208	-1.389889
13	0.0000	0.0000	0.0000	0.0001	0.0000
14	2.0499	-0.4038	0.0909	-0.1060	1.0231
	0.0000	0.0000	0.0000	0.0000	0.0000
	1.0000	1.0000	1.0000	1.0000	1.0000

Заключение

В рамках реакции абсорбции данное представление является формульным, и эмпирически осмысленным, является подтверждаемым на числовом материале, порождает многосмысловые уравнения (с известными не известными смысловыми переменными). Это иное смысловое представление символических систем, которыми реальные люди пользовались в реальной практике для придания формы своим мыслям. Исследование осуществлялось на материале о смысловых, числовых данных. Записи формульных единиц в смысловых нехимических уравнениях с смысловыми переменными (присущих реакции абсорбции) выявляют не только то, что реагируют между собой отдельные частицы веществ, но и их неразделенные химическими формулами компоненты. В каждой из которых содержится огромное число химических частиц, не отраженных в химических формулах. В количественных моделях вычислений для когнитивного моделирования мы перешли от (z,r)-значений к от (y,c)-значениям , от значений (z,r)–изменчивостей измеряемых показателей (z1,…,z5) к значениям (y,c)–изменчивостей вычисляемых показателей (y1,…,y5). Матрица $R=(1/m)Z^TZ$ (z,r)-значений изменчивостей к зависят от матрицы Y=ZC (y,c)-значений изменчивостей. Матрица $C=(1/m)Z^TY$ (z,y)-корреляций является преобразователем любой матрицы изменчивостей в матрицу других изменчивостей. Она может моделироваться в паре матриц (R,C), (Λ,C), она может моделироваться независимо, обладающей свойством ортонормированности $C^TC=CC^T=I=$ diag(1,…,1). Матрица $C=(1/m)Z^TY$, обладая выделенными элементами, может порождтъ (моделировать) матрицы изменчивостей Y, Z: $C=(1/m)Z^TY$.

Мы рассмотрели случаи разбиения матриц по столбцам, руководствуясь химическими доводами, смыслами z-, y– изменчивостей. Формула строки матрицы Y=ZC (формула y-реакции) разделяется на несколько формульных единиц, имеющих свои подсмыслы вычисляемой химической y-реакции, относящейся к одному из подтипов БПК/ХПК. Для ранее разработанных 5 многосмысловых уравнений с известными не известными смысловыми переменными [1] получено новое равенство: суммы реальных смыслов 2-х типов измеренных реальных реакций БПК, ХПК равны сумме 6 когнитивных смыслов их подтипов: смысл(БПК)⊕смысл(ХПК)= смысл(БПК1⊕смысл(БПК2)⊕смысл(БПК3)⊕ смысл(БПК4)⊕смысл(ХПК1)⊕смысл(ХПК3).

Реальность 6 когнитивных смыслов подтипов смыслов 2-х реальных реакций БПК, ХПК фиксируется a priori. Получена формула для правой части приведенного смыслового равенства, она равна сумме 6-ти вычисленных формульных единиц [соответствующих подвидам БПК,ХПК]: $(z_{i1}*0.4689+(z_{i4})*0.6972)$[ХПК4]+ $z_{i1}*0{,}5506+z_{i2})*0{,}2589+(z_{i3}*(-0{,}3283)+z_{i4}*(-0{,}3545))$ [БПК3]+$z_{i1}*0{,}5506+z_{i2}*0{,}2589+z_{i5}*(-0{,}6296)$ [ХПК3]+$(z_{i2}(-0{,}8827)+z_{i3}(-0{,}1386)+z_{i4}(-0{,}2542))$ [БПК2]+$z_{i1}(0.4861)+z_{i3}(0{,}1538)+z_{i4}(-0{,}4609)$ [БПК1]+$z_{i1}(0.4861)+z_{i3}(0{,}1538)+z_{i5}(0{,}6293)$ [ХПК1]. Запись формул 6-ти вычисленных формульных единиц приведены (для облегчения восприятия) в форме, аналогичном форме смыслового равенства. Нехимические формулы реальных реакций БПК, ХПК зависят от формульных единиц своих подтипов и условно выглядят так: формула ХПК=$z_{i3}(0{,}1538)+ z_{i5}(0{,}6293)$[ХПК1]+$z_{i1}*0{,}5506+z_{i2}*0{,}2589+z_{i5}*(-0{,}6296)$[ХПК3]+$(z_{i1}*0.4689+(z_{i4})*0.6972)$ [ХПК4]. Формула БПК=$z_{i1}*0{,}5506+z_{i2}*0{,}2589+(z_{i3}*(-0{,}3283)+z_{i4}*(-0{,}3545))$[БПК3]+$(z_{i2}(-0{,}8827)+z_{i3}(-0{,}1386)+z_{i4}(-0{,}2542))$[БПК2]+$z_{i1}(0.4861)+ z_{i3}(0{,}1538)+z_{i4}(-0{,}4609)$[БПК1].

Мы привели очередную ситуацию моделирования и извлечения когнитивных знаний [4-8] из многомерных данных типа «объект-свойства». Извлеченные значимые знания в начальный момент из данных типа «объект-свойства» делает возможным извлечение знаний и в конечный момент завершения процесса самоочищения воды.

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Issue Article

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REFERENCE DATA OF PRESSURE DISTRIBUTION ON THE SURFACES OF AIRFOILS HAVING THE NAMES BEGINNING WITH THE LETTER O

Abstract: *The results of the computer calculation of air flow around the airfoils having the names beginning with the letter O are presented in the article. The contours of pressure distribution on the surfaces of the airfoils at angles of attack of 0, 15 and -15 degrees in conditions of the subsonic airplane flight speed were obtained.*

Key words: *airfoil, angle of attack, pressure, surface.*
Language: *English*
Citation: Chemezov, D., et al. (2023). Reference data of pressure distribution on the surfaces of airfoils having the names beginning with the letter O. *ISJ Theoretical & Applied Science, 01 (117)*, 624-635.
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Introduction

Creating reference materials that determine the most accurate pressure distribution on the airfoil surfaces is an actual task of the airplane aerodynamics.

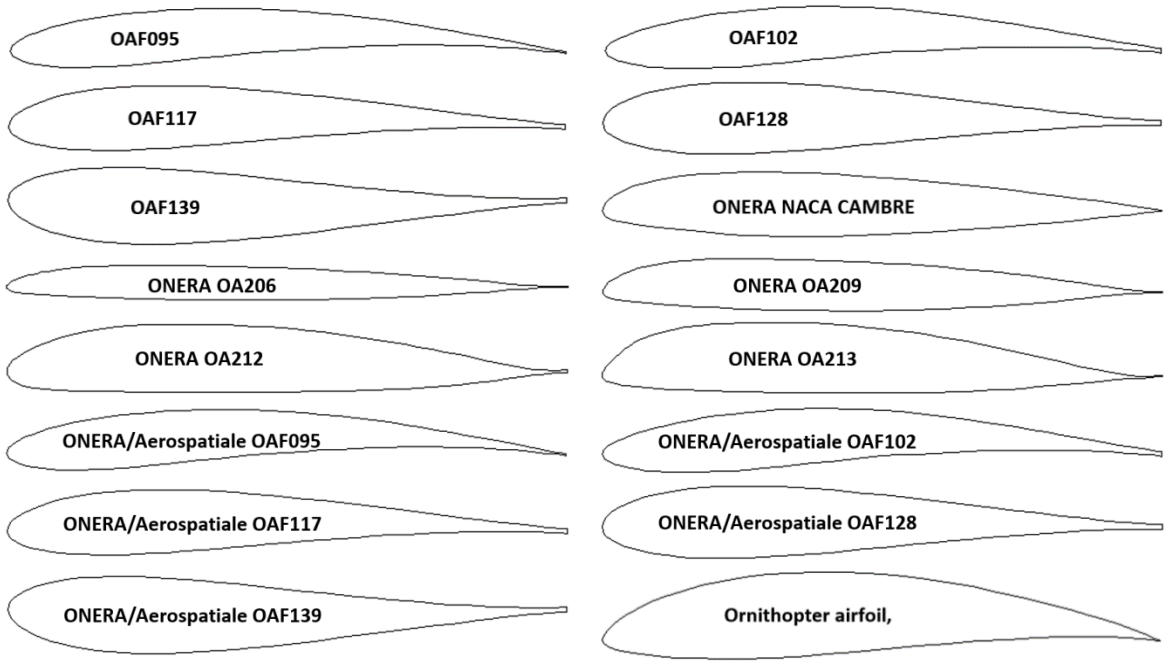
Materials and methods

The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-31]. In this work, the airfoils having the names beginning with the letter *O* were adopted. Air flow around the airfoils was carried out at angles of attack (α) of 0, 15 and -15 degrees. Flight speed of the airplane in each case was subsonic. The airplane flight in the atmosphere was carried out under normal weather conditions. The geometric characteristics of the studied airfoils are presented in the Table 1. The geometric shapes of the airfoils in the cross section are presented in the Table 2.

Table 1. The geometric characteristics of the airfoils.

Airfoil name	Max. thickness	Max. camber	Leading edge radius	Trailing edge thickness
OAF095	9.48% at 23.2% of the chord	3.79% at 53.1% of the chord	1.1073%	0.5153%
OAF102	10.17% at 28.7% of the chord	3.63% at 53.1% of the chord	0.9518%	1.0018%
OAF117	11.47% at 23.2% of the chord	2.03% at 46.9% of the chord	1.6813%	0.9973%
OAF128	12.79% at 23.2% of the chord	0.99% at 43.7% of the chord	2.2047%	1.0653%
OAF139	13.67% at 23.2% of the chord	0.03% at 0.1% of the chord	2.1665%	0.9757%
ONERA NACA CAMBRE	11.52% at 31.0% of the chord	1.38% at 15.7% of the chord	1.3411%	0.24%
ONERA OA206	6.01% at 31.8% of the chord	0.84% at 19.6% of the chord	0.4632%	0.3348%
ONERA OA209	9.01% at 29.3% of the chord	1.56% at 17.1% of the chord	1.154%	0.5023%
ONERA OA212	12.01% at 31.8% of the chord	2.29% at 31.8% of the chord	2.0675%	0.67%
ONERA OA213	12.57% at 32.5% of the chord	3.32% at 25.0% of the chord	1.2962%	0.4216%
ONERA/Aerospatiale OAF095	9.48% at 23.2% of the chord	3.79% at 53.1% of the chord	1.1063%	0.515%
ONERA/Aerospatiale OAF102	10.17% at 28.7% of the chord	3.63% at 53.1% of the chord	0.9514%	1.002%
ONERA/Aerospatiale OAF117	11.47% at 23.2% of the chord	2.03% at 46.9% of the chord	1.6805%	0.997%
ONERA/Aerospatiale OAF128	12.79% at 23.2% of the chord	0.99% at 43.7% of the chord	2.2024%	1.065%
ONERA/Aerospatiale OAF139	13.67% at 23.2% of the chord	0.03% at 0.1% of the chord	2.1638%	0.976%
Ornithopter airfoil,	15.08% at 35.0% of the chord	5.04% at 50.9% of the chord	1.1514%	0.0%
Note: *ONERA/Aerospatiale OAF095, ONERA/Aerospatiale OAF102, ONERA/Aerospatiale OAF117, ONERA/Aerospatiale OAF128, ONERA/Aerospatiale OAF139* (Fenestron airfoil).				

Table 2. The geometric shapes of the airfoils in the cross section.



Results and discussion

The calculated pressure contours on the surfaces of the airfoils at different angles of attack are presented in the Figs. 1-16. The calculated values on the scale can be represented as the basic values when comparing the pressure drop under conditions of changing the angle of attack of the airfoils.

16 airfoils of the airplane wings of OAF and ONERA types were considered. All the studied airfoils were asymmetrical, since they had some camber at different chord lengths. The geometries of the OAF095, OAF102, OAF117, OAF128 and OAF139 airfoils are similar to the geometries of the ONERA/Aerospatiale OAF095, …, ONERA/Aerospatiale OAF139 airfoils, respectively, except for the values of the leading edge radius and the trailing edge thickness, which vary in the ranges 0.001-0.0027% and 0.0002-0.0003%, respectively.

Let us compare the aerodynamic characteristics of the airfoils of the airplane wings by type based on the given calculated pressure values.

Airfoils of the OAF type have almost the same ratio of positive and negative pressures on the leading edge, upper and lower surfaces at zero angle of attack. A slight increase in negative pressure is observed on the surfaces of the OAF139 airfoil. During the climb, the highest ratio of positive and negative pressures (approximately 10 times) was determined for the OAF102 airfoil on the lower and upper surfaces from the leading edge, respectively. This leads to an increase in the drag of the airfoil when the airplane moves in the airspace. For the OAF139 airfoil, the climb in the air is more favorable, since the negative pressure near the leading edge is halved compared to the OAF102 airfoil. During the airplane descent, the minimum and maximum values of negative pressure near the leading edge are similarly determined for the OAF095 and OAF128 airfoils, respectively.

Since airfoils of the ONERA/Aerospatiale type had the slightly smaller leading edge radius, with a positive angle of attack, the negative pressure value increased, and with a negative angle of attack, the negative pressure value for the most airfoils decreased.

Analyzing the airfoils of the ONERA OA type, it was determined that the ONERA OA206 and ONERA OA209 airfoils are subjected to the greatest drag during horizontal flight and climb of the airplane, respectively. The ONERA OA213 airfoil is subjected to minimal drag under the considered flight conditions of the airplane. Minimum and maximum pressures occur in magnitude on the leading edge of the ONERA OA206 and ONERA OA212 airfoils at a negative angle of attack, respectively.

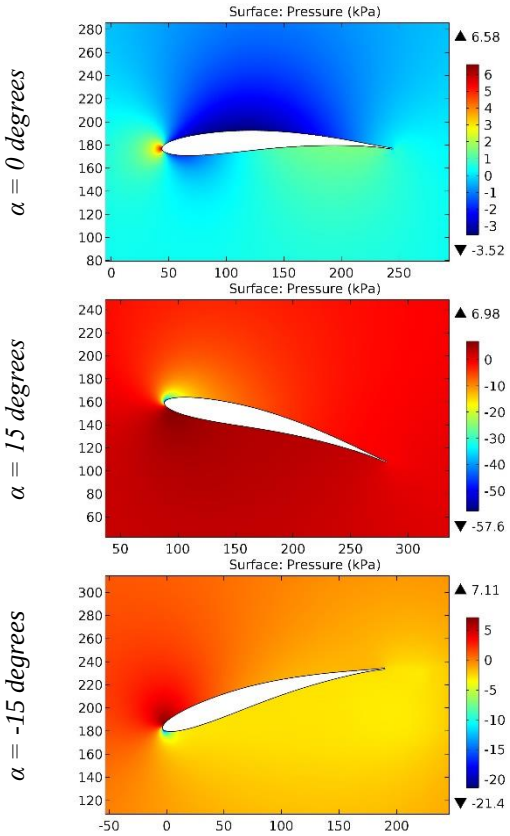


Figure 1. The pressure contours on the surfaces of the OAF095 airfoil.

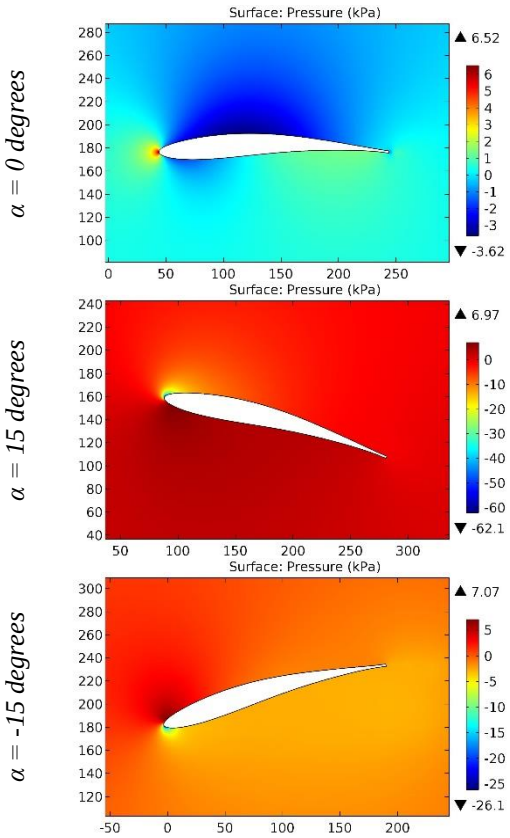


Figure 2. The pressure contours on the surfaces of the OAF102 airfoil.

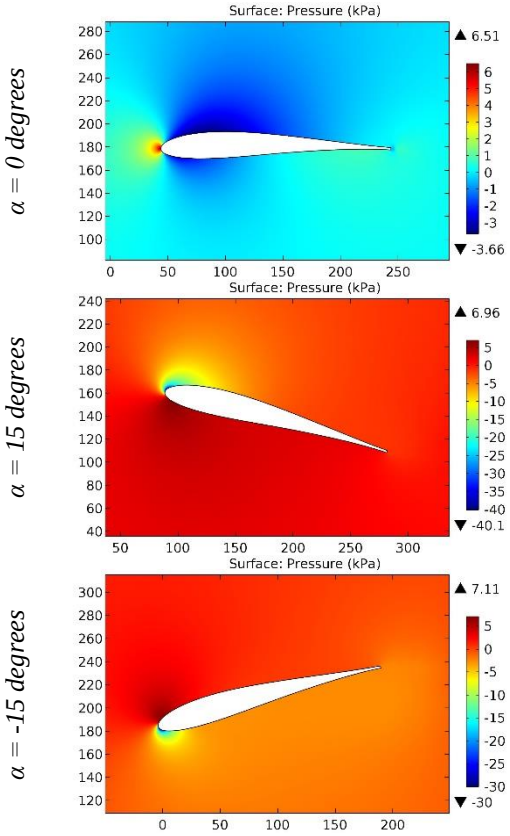


Figure 3. The pressure contours on the surfaces of the OAF117 airfoil.

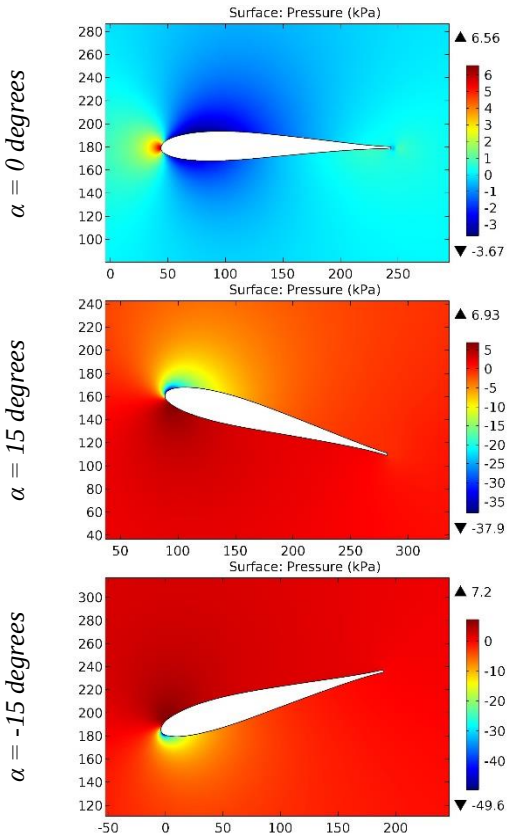


Figure 4. The pressure contours on the surfaces of the OAF128 airfoil.

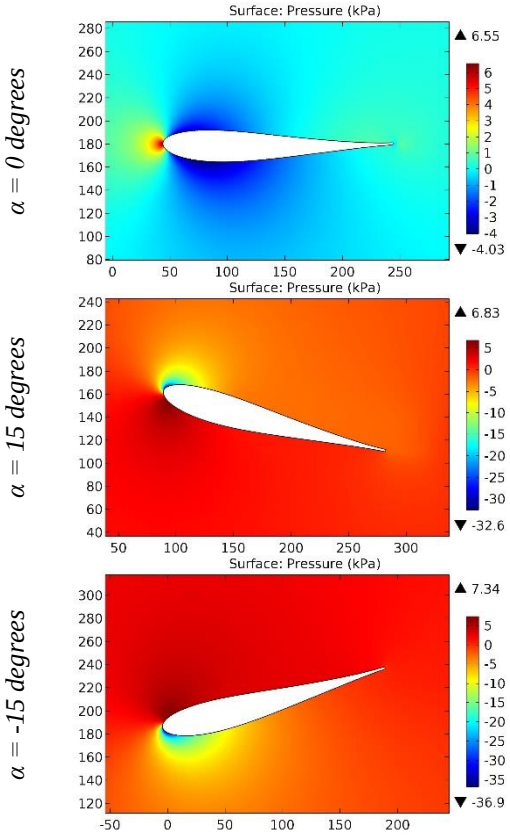


Figure 5. The pressure contours on the surfaces of the OAF139 airfoil.

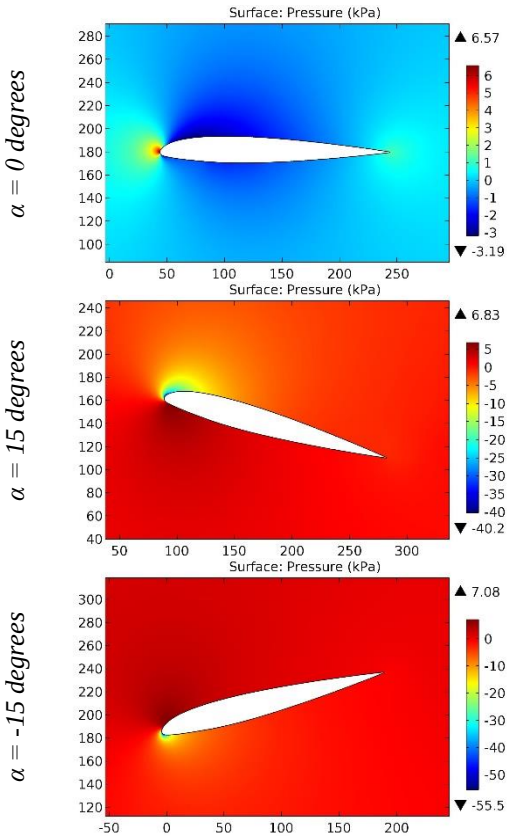


Figure 6. The pressure contours on the surfaces of the ONERA NACA CAMBRE airfoil.

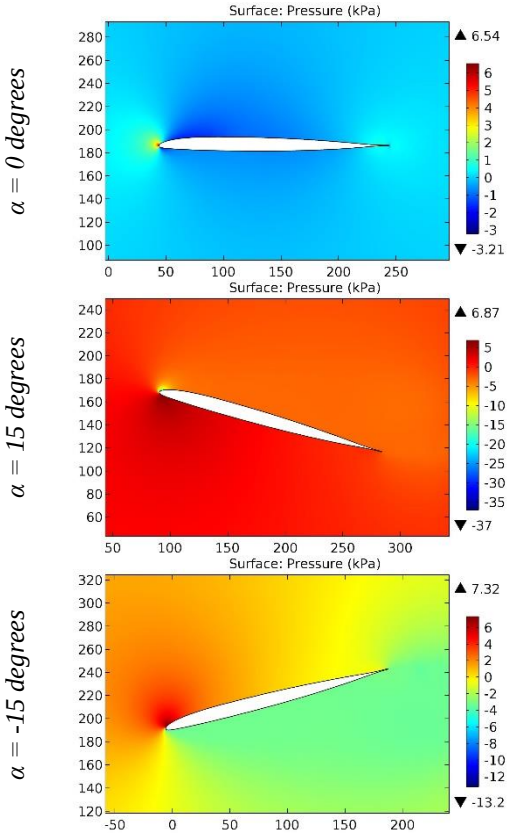


Figure 7. The pressure contours on the surfaces of the ONERA OA206 airfoil.

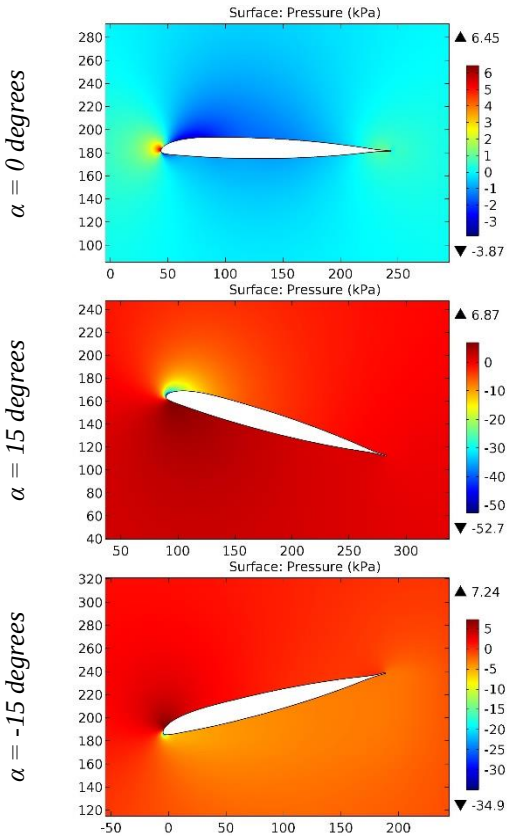


Figure 8. The pressure contours on the surfaces of the ONERA OA209 airfoil.

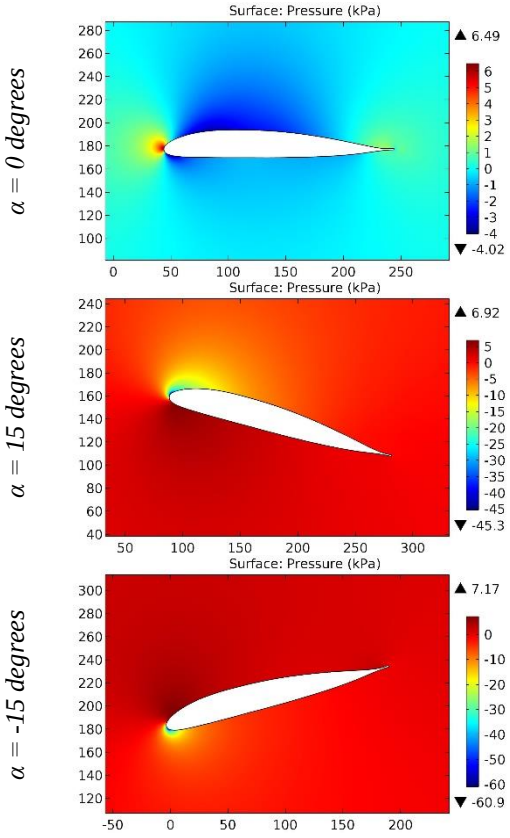


Figure 9. The pressure contours on the surfaces of the ONERA OA212 airfoil.

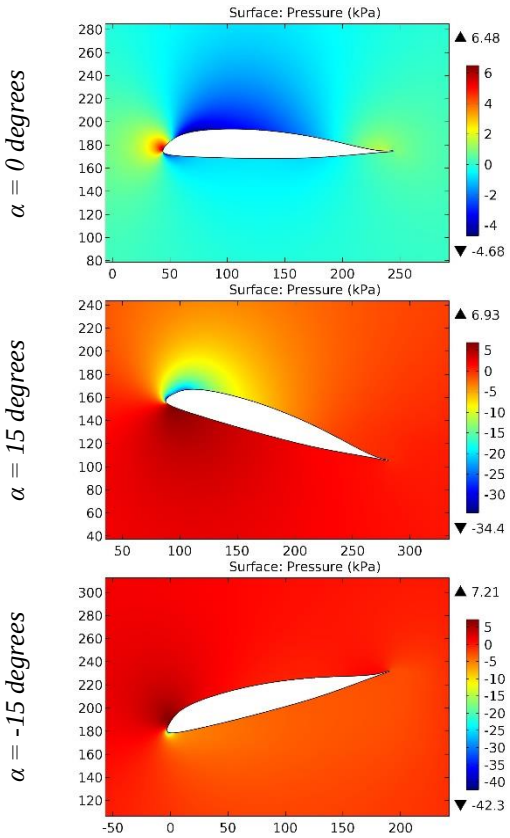


Figure 10. The pressure contours on the surfaces of the ONERA OA213 airfoil.

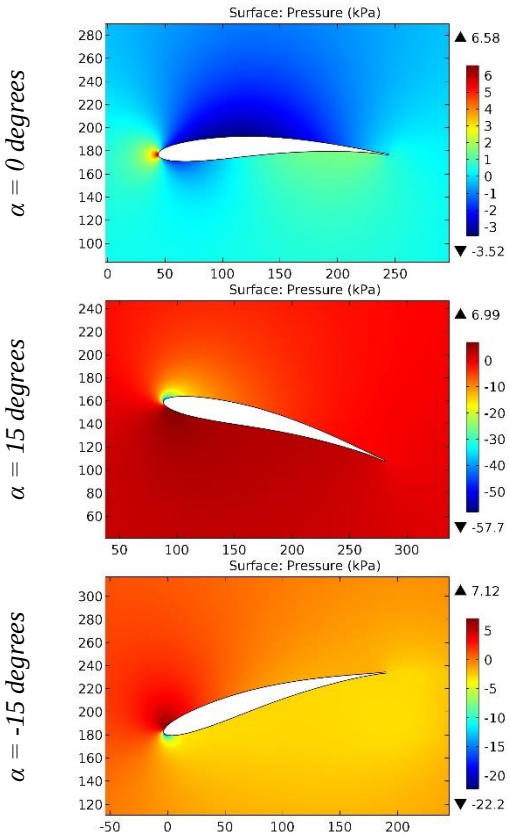


Figure 11. The pressure contours on the surfaces of the ONERA/Aerospatiale OAF095 airfoil.

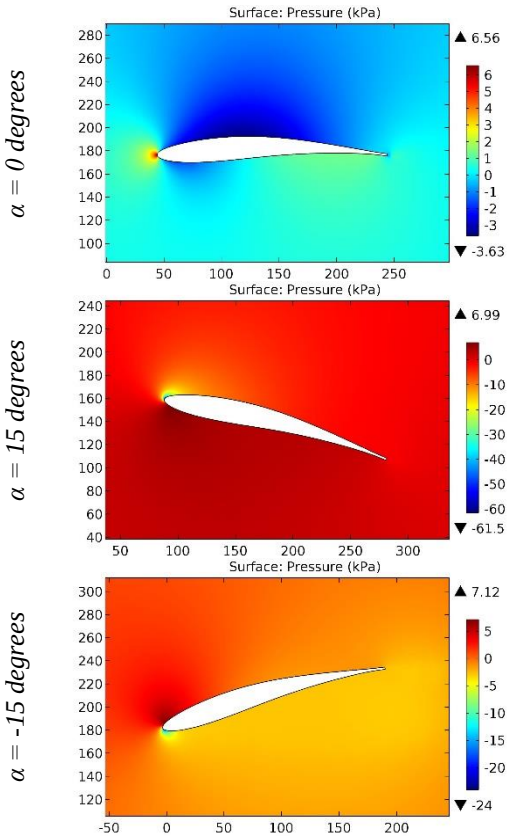


Figure 12. The pressure contours on the surfaces of the ONERA/Aerospatiale OAF102 airfoil.

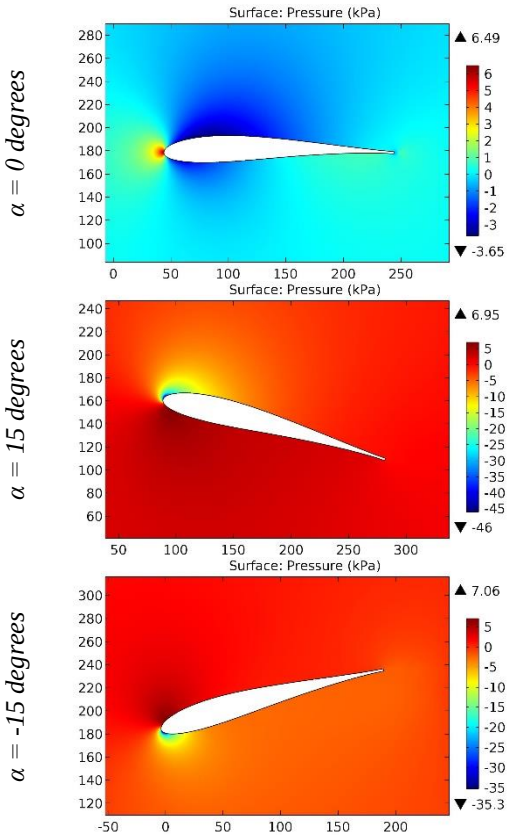


Figure 13. The pressure contours on the surfaces of the ONERA/Aerospatiale OAF117 airfoil.

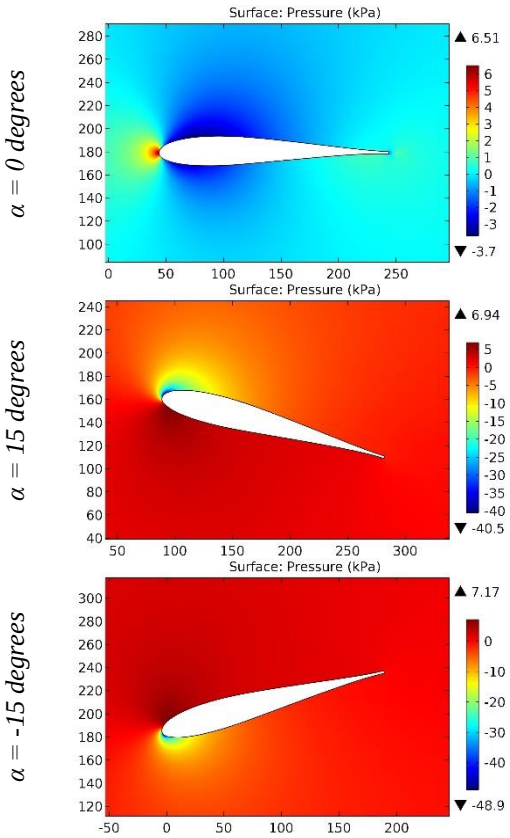


Figure 14. The pressure contours on the surfaces of the ONERA/Aerospatiale OAF128 airfoil.

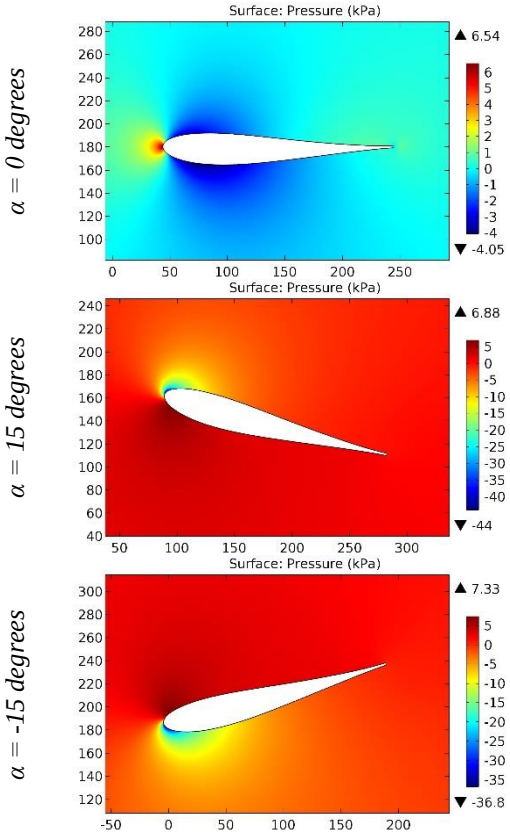


Figure 15. The pressure contours on the surfaces of the ONERA/Aerospatiale OAF139 airfoil.

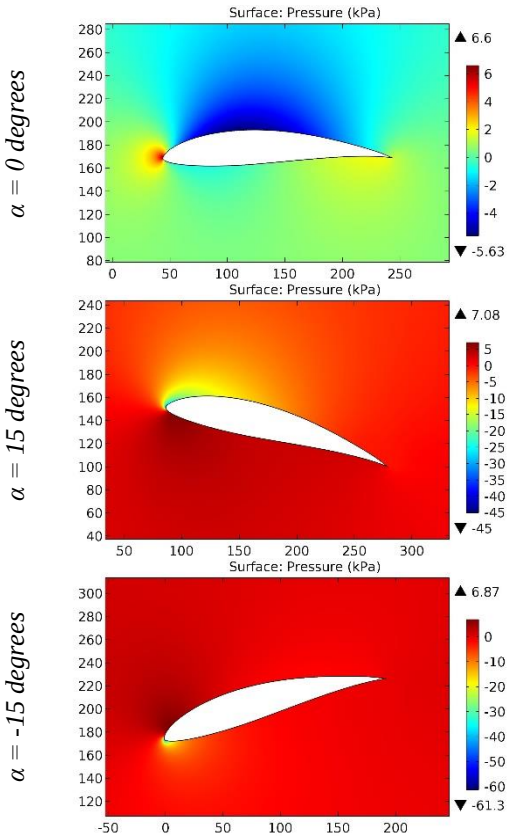


Figure 16. The pressure contours on the surfaces of the Ornithopter airfoil.

During the climb maneuver with the ONERA NACA CAMBRE airfoil, negative pressure is distributed over a larger area of the leading edge than during the descent maneuver. However, the maximum value of negative pressure is noted when the airplane descent.

The Ornithopter is subjected to the greatest drag in the leading edge area at a negative angle of attack of all the considered airfoils.

Conclusion

Based on the analysis of the results of computer calculation of the movement of airfoils in the airspace, the following conclusions can be drawn:

1. Negative pressure decreases with an increase in the leading edge radius of the airfoils of the same configuration. An increase in the leading edge radius by 0.0008% leads to a decrease in negative pressure by 14.5%, an increase in the leading edge radius by 0.0027% leads to a decrease in negative pressure by about 30%, etc.

2. The ONERA OA206 airfoil has the most optimal geometry, since in conditions of horizontal flight and maneuvers of the airplane, the wing experiences minimal loads, which are expressed by the action of negative pressure on the leading edge.

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Issue Article

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ENRICHMENT OF THE BIOLOGICALLY ACTIVE ADDITIVE PHENOLNIMA WITH THE COMPONENTS OF THE EXTRACT OF COMMON THYMUS (THYMUS SERPYLLUM)

Abstract: *Research has been carried out on the main phenolic components of a biologically active additive (BAA) of grape origin of the "Rkatsiteli" variety, prepared by a new technology. A rich and varied spectrum was revealed, representing in the form of proanthocyanidins, catechins, phenolic acids, etc. In the water-alcohol extract of the aerial part of common thyme (collected in the Tusheti mountains, Eastern Georgia) from the phenolic fraction, biologically active substances were identified: isoflavone-formononetin and cynaroside (luteolin glucopyranoside). The phenolic components of dietary supplement-a and water-alcohol extract of common thyme, characterized by high biological activity, are important components of the target product for the formation of both the organoleptic side and the therapeutic and prophylactic point of view, which create the scientific basis for the development of the latest rational technology of highly active and environmentally friendly clean products.*

Key words: *BAA, formononetin, cynaroside, phenolic components, biological activity, antioxidant activity*

Language: *Russian*

Citation: Elanidze, L. (2023). Enrichment of the biologically active additive phenolnima with the components of the extract of common thymus (thymus serpyllum). *ISJ Theoretical & Applied Science, 01 (117),* 636-643.

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ОБОГАЩЕНИЕ БИОЛОГИЧЕСКИ АКТИВНОЙ ДОБАВКИ ФЕНОЛЬНИМЫ КОМПОНЕНТАМИ ЭКСТРАКТА ЧАБРЕЦА ОБЫКНОВЕННОГО (THYMUS SERPYLLUM)

Аннотация: *Проведено исследования основных фенольных компонентов биологически активной добавки (БАД) виноградного происхождения сорта «Ркацители», приготовленной новой технологией. Выявлено богатый и разнообразный спектр, представляющего в виде проантоцианидинов, катехинов, фенолокислот и др. В водно-спиртовом экстракте надземной части чабреца обыкновенного (собранного в горах Тушети, Восточная Грузия) из фенольной фракции идентифицированы биологически активные вещества: изофлавон- формононетин и цинарозид (глюкопиранозид лютеолина). Фенольные компоненты БАД- а и водно-спиртового экстракта чабреца обыкновенного, характеризующиеся высокой биологической активностью, представляют собой важными компонентами целевого продукта для формирования как органолептической стороны, так и лечебно-профилактической точки зрения, которые создают научные основы для разработки новейших рациональных технологии высокоактивной и экологически чистой продукций.*

Ключевые слова: *БАД, формононетин, цинарозид, фенольные компоненты, биологическая активность, антиоксидантная активность.*

Введение

Пандемия Kovid 19 привела к необходимости переключить значительную часть мирового научного потенциала на решение всемирной проблемы. Это означает принятие мер, как с точки зрения борьбы распространения вируса, так и с

точки зрения значительного усиления способности человеческого организма бороться с новым вирусом. Учитывая, что фенольные соединения обладают очень мощным антиоксидантным, антибактериальным, антивирусным деиствием и разного направления биологической активности, недавние исследования показали, что фенольные соединения эффективны в борьбе против Covid 19, как дополнительное средство для лечении ковид- пациентов при остром периоде болезни и пост- ковидом синдроме [1].

Проблема новой Kovid- инфекции еще раз подтвердила, что актуальным направлением XXI века является использованые природных биологически активных соединений и на их основе разработка новейших технологии для производства биологически активных пищевых дабавок (БАД) лечебно-профилактического деиствия. С этой точки зрения заслуживают внимание ароматообразующие компоненты, фенольные вещества и др. Известно разное растительное сырье, богатое отдельными классами природных соединений, которые широко используются в пищевой промышленности. Например, использование эфирного масла в пищевой промышленности. Среди природных соединений интересными являются фенольные вещества, которые представлены в виде флавонолов, катехинов,проантоцианидинов, катехинов, стильбенов, фенолькарбоновых кислот и др. Фенольные вещества характеризуются высокой биологической активностью и обусловливают лечебно- профилактическую ценность целевого продукта Экспериментально было установлено, что продукты, содержащихся полифенолы, характеризуются синергизмом антиоксидантной активности [2-7].

Проантоцианидины обладают выраженным антиоксидантным эффектом. Установлено антибактериальное, противовирусное, противовоспалительное, противоаллергическое, и сосудорасширяющее действия олигомерных проантоцианидинов. Проантоцианидины снижают холестерин крови и липопротеиды низкой плотности, при этом значительно уменьшается площадь атеросклеротического поражения сосудов. Проантоцианидины могут оказать влияние на процессы, происходящие при онкологических заболеваниях [8-10].

Катехины проявляют более высокую Р-витаминную активность, оказывают атеросклеротическое действие, способствуют усваиванию аскорбиновой кислоты организмом человека. Важным свойством d-катехинов является их способность нормализовать структуру белка человеческого тела – коллагена [11].

Фенолокислоты - широко распространенные растительные соединения, обладающие высокой антиоксидантной активностью. Биологическая активность фенолокислот на организм человека проявляется в снижении уровня холестерина в крови и даже в ингибировании ВИЧ-инфекции [12]. Авторами Бежуашвили и др. определена антиоксидантная активность фенолокислот в опытах “ invitro” в виде степени ингибирования образования малондиальдегида в сыворотке крови человека. По выявленной активности фенолокислоты располагаются по следующей последовательностью: коффейная > ферулевая > п-кумаровая > 4-оксибензойная > салициловая > сиреневая. Антиоксидантная активность фенолокислот составило 40-95% [13].

В этом направлении авторам Эланидзе (2013) разработана технология биологически активного пищевого добавка (БАД) «Georgian Vitae rimas XXI». Использовалось экологически чистое, богатое фенольными соединениями природное сырье. БАД содержит разнообразный и широкий спектр фенольных соединении, что обусловливает высокую антиоксидантную активност продукта - не менее 86 % [14].

Цели и задачи исследования. Исходя из этого, разработка технологии биологически активных добавок **(БАД)** с высокой концентрацией полезных природных фенольных соединений, является актуальным направлением. Разработанная нами технология БАД-а, обусловливает получение продукта обогащенного разными биологически активными компонентами. Среды некоторых природных сырьевых ингредиентов, в технологии используется водно- спиртовая настойка чабреца обыкновенного. В связи с этим, целью данной работы являлось исследование водно-спиртовой настойки, в частности, изучение ароматообразующих компонентов эфирного масла и фенольных соединений.

Материал и методы. Обьектом исследования служили БАД виноградного происхождения сорта «Ркацители», приготовленной новой технологией и спиртовый экстракт обрезков виноградной лозы. Общие фенольные вещества определиали с использованием реактива Фолин-Чокалтеу [15]. Проантоцианидины (олигомерные и полимерные) и катехины определяли спектрофотометрическим методом [16]. Для качественного анализа фенолокислот, предварительно из БАД-а извлекали фракцию диэтиловым эфиром и анализировали методом тонкослойнной хроматографии на пластинках “Sorbfil” (силикагель СТХ-1А; 100Х200) в системе хлороформ: метанол (90:10). Хроматограммы проявляли диазотированной сульфаниловой кислотой. Катехины качественно определяли

методом бумажной хроматографии в системе бутанол: уксусная к-та: вода (4:1:2). Хроматограммы проявляли ванилиновым реактивом.

Для приготовления водно- спиртовой настойки (40 об.%) чабреца обыкновенного брали воздушно-сухое и измельченное сырье (надземную часть чабреца обыкновенного, собранного во время цветения (в горах Тушети - Восточная Грузия*), добавляли 40%-ый этиловый спирт и настаивали при комнатной температуре в герметически закрытых условиях, в течение 15 дней. Эфирные масла из настойки выделяли путем извлечения пентан-эфирной смеси (2:1). Извлечение проводили 3 раза , пентан-эфирные фракции соединяли, обезвоживали и легко выпаривали в специальной стеклянной посуде, при температуре 17-18^{o}C. Испаренную и концентрированную фракцию эфирного масла анализировали методом газовой хроматографии в следующих условиях: хроматограф “Perkin Elmer. Clarus 500”; Колонка капиллярная “Supelcowax 10”; 60м х 0,25мм. Газноситель- азот. Скорость 1мл/мин.

*Тушети -это историческая геогрефическая горная область на северном Кавказе в состав которого входит национальный парк Тушети. Автор приносит большую благодарность агентству охраняемых территорий Тушети за оказанную помощь.

Качественный анализ флавоноидов проводили методом бумажной и тонкослойной хроматографии. Для бумажной хроматографии использовали систему растворителей n-бутанол: уксусная к-та : вода (4: 1: 2), хроматограммы проявляли р-ом $AlCl_3$ в этаноле. Тонкослойную хроматографию проводили в системе хлороформ :метанол (80:20), хроматограммы проявляли диазотированной сульфаниловой кислотой. Выявленные неизвестные в-ва в индивидуальном виде выделяли препаративно и идентифицировали с использованием спектральных данных. При идентификации исследуемых соединений в кочестве свидетелей использовали индивидуальные вещества: цинарозид и формононетин. Хроматографическое исследование проводили методом высокоэффективной хроматографии (ВЭЖХ) в следующих условиях: хроматограф “Varian. Prostar”. Колонка- Cupelcosil LC-18-DB, 25смх4,6мм. Элюент А: 0,5%-ый водный раствор H_3PO_4. Элюент В: 50% ацетонитрил, 0,5% H_3PO_4, 49,5% H_2O. Скорость подачи элюента 1мл/мн. Длина волны-280 нм. Детектор - ультрафиолетовый. Условия градиента приведены в табл. 1.

Таблица 1.

Время, мин.	Элюент А, %	Элюент В, %
0	100	0
2	100	0
7	80	20
25	60	40
31	60	40
35	20	80
40	0	100
45	0	100

Ультрафиолетовые спектры снимали на приборе „VARIAN“, CARRY 100, а инфракрасные снимали на „THERMO NICOLET “, AVATAR 370. Температуру плавления определяли на приборе „MEL TEMP 3“. Кислотный гидролиз исследуемого соединения проводили с применением соляной кислоты и гидролизат извлекали этилацетатом. Этилацетатную вытяжку анализировали методом бумажной хроматографии.

Антиоксидантную активность формононетина и цинарозида определяли по методу электронного пара-магнитного резонанса (ЭПМР) [17].

Результаты и их обсуждение. Данные указывают на богатый спектр фенольных соединеный исследуемого БАД-а. В нем фиксируются такие биологически активные фенольные вещества, как проантоцианидины (олигомерные, полимерные), катехины, фенолокислоты и др. (табл.2). Как известно, они характеризуются высокой биологической активностью и соответствующими лечебно-профилактическими свойствами против таких заболевании, как сердечно-сосудистые, раковые, алергические и др. Фенольные компоненты БАД-а обуславливают высокую биологическую активность целевого продукта.

Таблица 2. Фенольные в-ва БАД-а виноградного происхождения сорта «Ркацители»

Наименование компонентов	Концентрация
Общие феноли	10 г/л
проантоцианидины – олигомерные	3,2 г/л
проантоцианидины – полимерные	5,1 г/л
катехины	800 мг/л
фенолокислоты, в том числе:	
галловая	+
протокатеховая	+
4-оксибензойная	+
п-кумаровая	+
ферулевая	+
коффейная	+
сыреневая	+
ванилиновая	+

Пентан-эфирная вытяжка, содержащая эфирные масла, оказалась богатой по содержанию разных компонентов (рис.1).

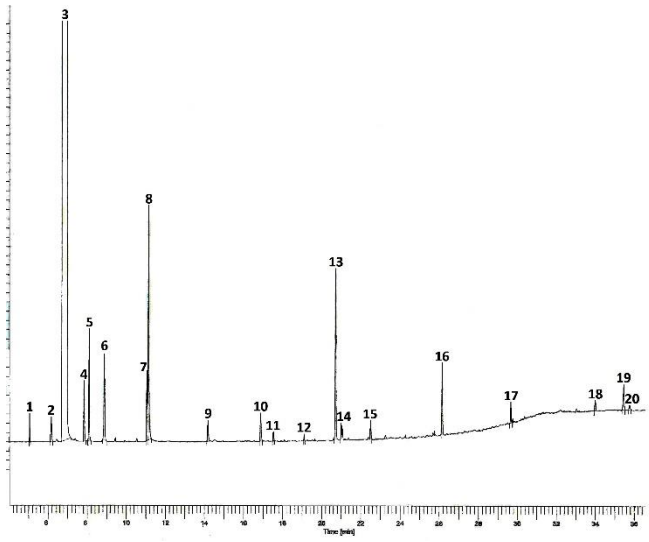
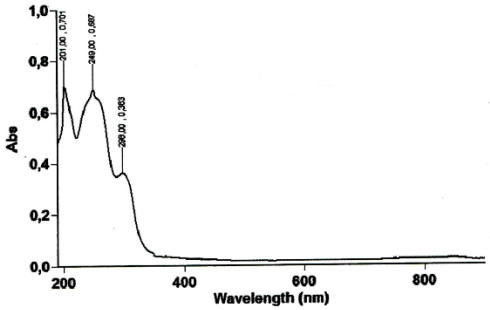


Рис.1. Газовая хроматограмма пентан-эфирной фракциинастойки чабреца обыкновенного. 3) α-пинен; 6) мирцен; 7) лимонен; 9) терпинолен; 12) линалоол; 13) карвакрол; 14) тимол; 15) цитронелон.

Благодаря разнообразному составу эфирного масла настойки чабреца обыкновенного, продукт преобретает свой специфический аромат. В составе настойки зафиксировано два вещества, которые заслужили внимание для идентификации. Они были выделены препаративно и исследованы спектральными данными. Вещество I характеризуется Rf- 0,7 (в системе хлороформ:метанол) и с диазотированной сульфаниловой кислотой дает желто- окрашенное пятно,что указывает на ее фенольную природу.

Ультрафиолетовый спектр вещества I : (EtOH) λ_{max} 201 нм, 249 нм, 298 нм. Инфракрасный спектр($см^{-1}$) 2923, 1596, 1458, 1373. Температура плавления составляет 257-261°C.

По спектральным данным выделенное вещество I оказалось идентичным индивидуальному изофлавона – формононетина (рис 2,3).



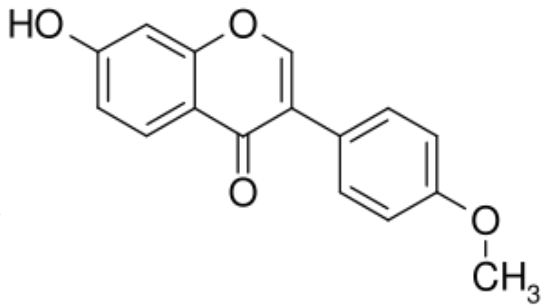


Рис.2. Ультрафиолетовый спектр формононетина формононетин $C_{16}H_{12}O_4$ Mr- 268

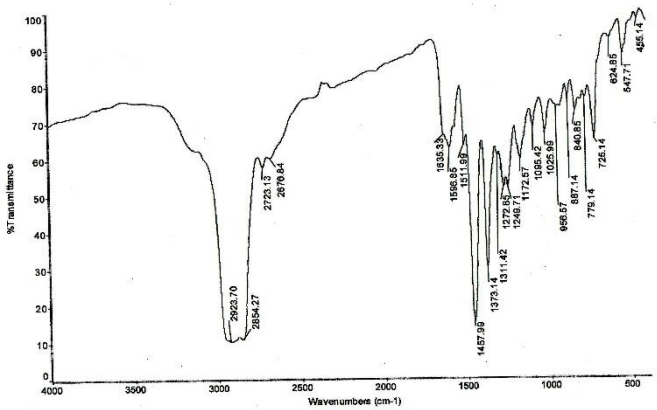
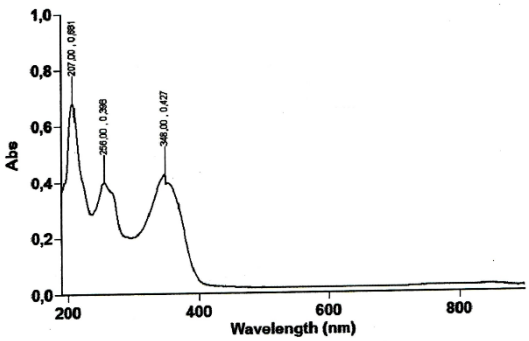


Рис.3. Инфракрасный спектр формононетина

Вещество II методом бумажной хроматографии (в системе n-бутанол: уксусная кислота: вода (4:1:2)) характеризуется Rf- 0,43. При проявлении оно дает желто окрашенные пятна. На основе кислотного гидролиза, оно выявлено как гликозид лютеолина. Выделенное нами вещество II, идентифицировано как цинарозид (глюкопиранозид лютеолина) (рис 4,5). Ультрафиолетовый спектр вещества II : (EtOH) λ_{max} 207 нм, 256 нм, 348 нм. Инфракрасный спектр ($см^{-1}$) 2923, 1604, 1658, 1458, 1374, 1272. Температура плавления составляет 240-242ºC.



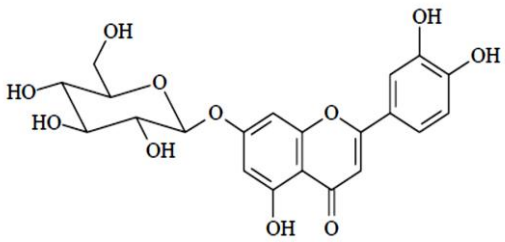


Рис.4. Ультрафиолетовый спектр цинарозида цинарозид $C_{21}H_{20}O_{11}$ Mr- 286

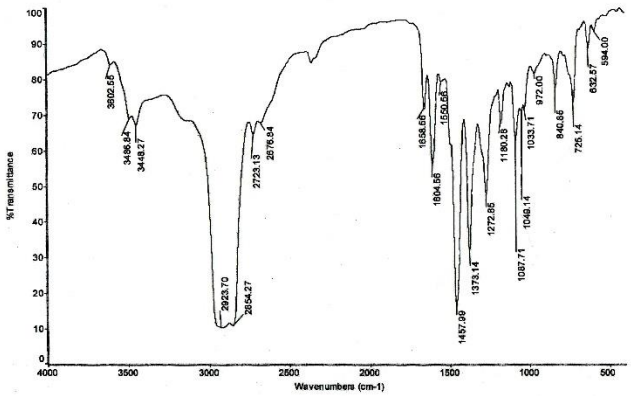


Рис.5. Инфракрасный спектр цинарозида

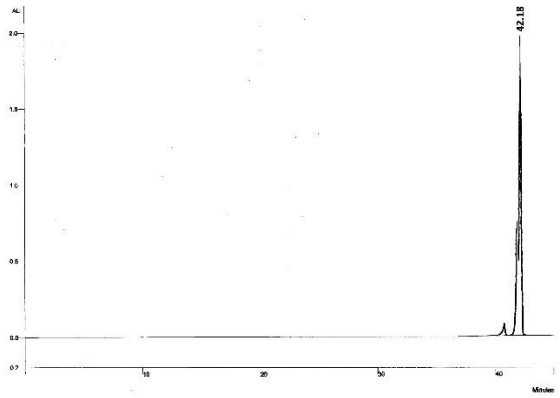


Рис.6. ВЭЖХ формононетина

По хроматографическим данным время удерживания формононетина составляет 42,18 мин., а цинарозида- 27,466 мин. (рис.6,7).

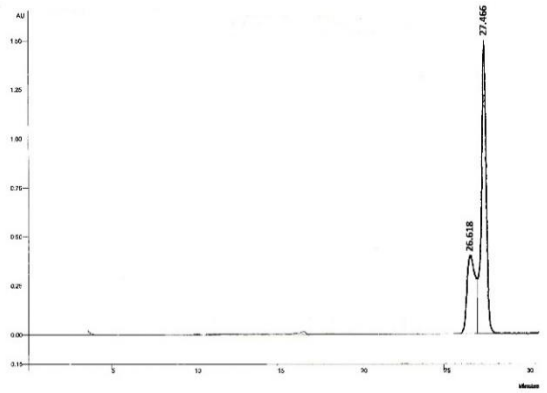


Рис.7. ВЭЖХ цинарозида

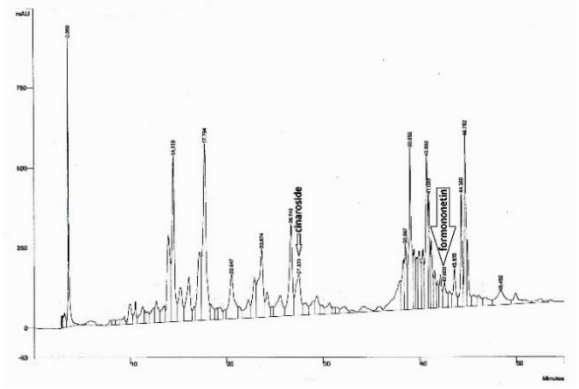


Рис.8. ВЭЖХ водно-спиртовой настойки чабреца обыкновенного

В результате ВЭЖХ, в водно-спиртовой настойки (рис.8) цинарозид содержится 5,7мг/л, а формононетин- 1,8мг/л.

По литературным данным идентифицированные вещества, характеризуются определенной биологической активностью.Чанг и соавторы [18] в люцерне и в клевере обнаружили изофлавон формононетин и установили его фитоэстрогенные свойства. Установлено, что формононетин ответствен за репродуктивную дисфункцию и бесплодие у жвачных животных [19]. Изофлавоны также связываются с репродуктивной дисфункцией крыс [20]. Толезоном и соавторами [21] установлено, что формононетин и биоханин А, которые были добавлены в здоровую пищу, может быть усвоены человеческой печенью и потвергаются превращению микосомальными ферментами. Изофлавоны имеют полезные эстрогенные эффекты, оказывают положительные действые при лечении сердечно- сосудистых заболеваний и могут понизить риск возникновения рака. Авторами установлено как фитоэстрогенная, так и антиоксидантная эффективность формононетина [22]. Цинарозид обладает выраженным гипоазотическим действием. Цинарозид положительно вляет на азотистый обмен, приводя к заметному снижению содержания мочевины и остаточного азота в крови у животных с почечной патологией. Цинарозид обладает высокой гиполипидемической и антиатероматозной активностью [23].

Выводы. Таким образом, в результате проведенного исследования и обсуждения литературных данных, можно заключить,что фенольные вещества, входящие в состав БАД-а виноградного происхождения сорта «Ркацители», разработанной новой технологией, представляют собой надежным и реальным источником для формирования лечебно-профилактической ценности и дает научное обоснование функционального назначения целевого продукта. В результате проведенного эксперимента в водно-спиртовом экстракте надземной части чабреца обыкновенного (собранного в горах Тушети, Восточная Грузия) из фенольной фракции идентифицированы биологически активные вещества: изофлавон- формононетин и цинарозид (глюкопиранозид лютеолина). Ввиду того, что водно спиртовая настойка чабреца обыкновенного представляет собой ингредиент экспериментального БАД-а, наличие в нем биологически активных веществ: изофлавона-формононетина и цинарозида (глюкопиранозид лютеолина) является важными компонентами целевого продукта Определенные компоненты являются важными для целевого продукта, как органолептической стороны, так и лечебно-профилактической точки зрения. Особенно это является важным фактором против борьбы с ковид инфекцией, как допольнительное средство для лечении ковид- пациентов при остром периоде болезни и пост- ковидом синдроме.

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Issue Article

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FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT AGRICULTURE IN MODERN CONDITIONS OF ECONOMIC REFORMS LOCATED IN TASHKENT CITY, REPUBLIC OF UZBEKISTAN

Abstract: *This scientific article examines the theoretical foundations of the policy in agriculture and improvement of its implementation, the composition and trends of agricultural development, the development of agriculture in Uzbekistan, directions for increasing investment and improving the effectiveness of innovative technologies, prospects for the development of agriculture in the regions in the context of globalization.*

Key words: *agricultural Economics, food security, agricultural producers, agriculture, digital technologies, global economic development, cluster approach.*

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Introduction

The development trend of the world economy proves that in all spheres and aspects of human society, particularly in many parts of the world under the influence of global climate change, economic activity of agricultural producers and service providers is one of the key factors in the elimination of poverty and hunger. Innovative organization is of strategic importance, and continuous improvement of this process is becoming a requirement of the times. The development of the agricultural sector plays an important role in the development of the economy. While the success of economic growth in China, India, Brazil, Chile and Vietnam is largely due to the rapid growth of agriculture, the underdevelopment of some African countries is explained by the fact that these countries do not provide sufficient labor productivity in agriculture.

This is primarily due to the important role of agriculture in the development of other sectors and industries of the economy in the early stages of economic development, which has a high share of employment and GDP in the agricultural sector. In this case, agriculture contributes to the growth of other sectors of the economy by offering factors of production (raw materials, labor, capital accumulation, attraction of foreign currency).

Thus, the growth of agricultural production can have a large multiplier effect in stimulating the growth of industrial production. Studies show that a $ 1 increase in agricultural production leads to a $ 1 increase in output in other sectors of the economy, while a $ 1 increase in output in other sectors of the economy provides a $ 0.18 increase in agricultural output. These multipliers of agricultural growth are generally observed to be high in low-income countries, as the main share of the industrial sector (processing of agricultural products) and the services sector in these countries largely depend on agricultural indicators.

On the other hand, the growth of labor productivity in agriculture will provide food for a

growing proportion of the population engaged in non-agricultural activities, while at the same time contributing to the growth of the urban population. In addition, increased productivity in agriculture will help reduce food prices, which in turn will reduce nominal wages in cities.

2. MATERIAL AND METHODS

Problem statement. Due to the existence of a direct link between agriculture and industry, agriculture provides an uninterrupted supply of raw materials to the agricultural processing industry. Also known as financial trade in agriculture, i.e. cash flows from agriculture can be directed as an investment by supporting the growth of other sectors of the economy.

The demand for agricultural products from other sectors of the economy, especially industrial products (fertilizers, tools and machinery), will increase as the income of the population engaged in agriculture and living in rural areas increases. Thus, the growth of agricultural incomes encourages industrialization. This factor once formed the basis of land reform policy in India and China. In particular, China has been able to develop the domestic market of industrial products among 800 million agricultural households by giving land users the right to own land. It should be noted that China has been able to drastically reduce the size of poverty by regulating land use relations. The use of China's experience in the development of anti-poverty programs in Uzbekistan will also have a positive effect. China has done a great deal today to end poverty. According to the World Bank, 850 million people in China have been lifted out of poverty to date. In China, the poverty rate was 88 percent in 1981, while in 2019 the figure was 0.7 percent. This figure is fully consistent with the poverty rate in developed countries, in particular, the poverty rate is in the United States (1%), Sweden (0.61%), Germany (0.19%), Italy (1.5%).

In addition, because low-income countries have comparative advantages in agriculture, agricultural development is a priority in the context of an open economy. Leading scholars conducting research on economic development point out that agriculture offers comparative advantages in the short term, while the development of the agro-industrial complex opens up great opportunities for industrialization in the long run. For these countries, investment in agriculture serves as a cost-effective growth strategy for industrialization and successful structural change. It should be noted that the development of the agricultural sector has served as an important basis for reducing poverty in Asian countries [9].

At the same time, there are certain difficulties in defining priorities in agriculture, based on today's requirements, in particular, it is necessary to clarify the following issues:

- to reduce the prices of agricultural products in order to reduce hunger and increase real incomes of the population or to encourage the increase of these prices in order to encourage farmers to invest more in agriculture;

-use budget funds to alleviate short-term food problems (for example, through food assistance programs) or direct these funds to invest in agriculture and solve long-term productivity problems;

- to pay more attention to solving the problem of food security at the expense of self-sufficiency or to expand trade in food and agricultural products using comparative advantages;

- Accelerate the development of small agricultural producers and farms that are effective in reducing poverty, or large farms that are effective in accessing complex markets through integrated chains of increasing productivity and value creation.

Thus, it is important for low-income countries, including Uzbekistan, to use the existing potential of agriculture to develop the economy and increase the welfare of the population, to choose effective approaches to the development of the national economy and to use modern methods and tools for efficient use of agricultural resources. is important.

Analysis of the relevant literature. Economists and specialists of the country are conducting large-scale scientific research on the rapid development of agriculture, its transformation into one of the leading sectors of the economy. In particular, i.f.d. prof. B. While Khodiyev was concerned with the development of the country's exports and increasing the competitiveness of the food industry through the cultivation of fruits and vegetables, i.f.d. G. Ahunova studied the impact of improving food quality on agricultural competitiveness. In addition, i.f.d. B. While Salimov focused on expanding the role of small business and private entrepreneurship in agriculture, i.f.d. U. In his research, Gafurov pays special attention to the development of family business in rural areas. Although a lot of research has been done in the field of agriculture in our country, the current economic crisis requires a new approach and research on the organization of the economy of the sector.

Research methodology. Methods such as statistical analysis, generalization, grouping, classification, comparative analysis, and cross-comparison were used in the research process.

3. RESULT AND DISCUSSION

Analysis and results. About 16.4 million people live in Uzbekistan people (49.4% of the total population) live in rural areas (2019). The birth rate in our country is high (23.3 per thousand), and the excess of labor force in rural areas is obvious. In Uzbekistan, the population under the age of 25 is 45.5%, and the population under the age of 30 is more than 55%. Due to the lack of alternative sources of income other than agriculture, today agriculture is the basis of the economy of most regions of the country. In turn, a large number of citizens:

- mainly live on agriculture (including agriculture, animal husbandry, forestry and fisheries). They use natural capital as their main source of livelihood, while owning natural capital (land, water, animals, trees);

- mainly use family labor in production. Hired labor is used in a limited amount than family labor;

- is relatively lowly integrated with the market, based on self-sufficiency in terms of consumption (household consumption) and resource use (resources of household production, such as family labor, seeds, organic fertilizers) [10].

In 2019, the share of agriculture in the GDP of Uzbekistan was 28.1%, and in 2019 the share of agriculture in GDP growth was 0.9%. In the past 2019, 3.543 million people (26% of the total number of employed) were employed in the agricultural sector, of which 1.066 million were officially employed and 2.477 million were employed in the informal sector or self-employed. Sales of agricultural products abroad provide up to 25% of total export earnings to Uzbekistan.

During the analysis of the distribution of the share of gross agricultural output by categories of farms, it was found that the highest rates in all regions fall on dehkan (personal assistant) farms. Thus, in 2019, they will account for 88.4% of the total volume of potatoes, 74.3% of vegetables, 60.8% of melons, 62.6% of fruits and berries, 55.0% of grapes, 92.3% of meat, milk was produced 95.1%, eggs 52.6%, fish 7.4%. Farms produced 78.7% of grain and 96.2% of raw cotton. Agricultural enterprises mainly produce eggs (36%), fish (64.1%), and vegetables (18%). At the end of 2019, we can see that the share of small business in gross value added in the main sectors of the economy: agriculture, forestry and fisheries - 98.6%. While 85.2% of the land allotted to crops, orchards and vineyards fell on farms, in 2019 these farms produced 27.4% of agricultural products. Although only 11.3% of the land allotted to crops, orchards and vineyards is owned by dehkan farms, they produce 71.2% of agricultural products. Organizations engaged in agricultural activities account for 2.8% of agricultural production.

Studies and observations show that among the main agricultural products, eggs and fish are consumed below the norm recommended by the Ministry of Health. Consumption of not only eggs and fish, but also meat and meat products, fruits, milk and dairy products is lower in low-income households. This is due to the low incomes of the population, especially in rural areas, and the high cost of agricultural products.

Uzbekistan is pursuing an active policy of agricultural reform. Abandoning cotton exports and focusing on food production, creating clusters instead of scattered farms and ensuring the integration of the agricultural sector with agricultural processing industries are the main directions of state policy in agriculture today.

In Syr Darya region, the Uzbek-British joint venture Bek Cluster was established as an experiment in Syr Darya region as the first cluster in the agro-industrial sector, and today this experience is becoming more popular in all regions of the country. In short, the new structure of the economy of our country, cotton and textile clusters, has begun to achieve great efficiency.

In particular, the analysis of the Uzbek-British joint venture "Beck Cluster" shows that in the short term the yield of cotton will increase from 17.2 ts / ha to 30.2 ts / ha, and the yield of grain - 22.5 ts / ha. from 61.5 ts / ha. In addition, 2,622 citizens were provided with permanent jobs and stable wages.

In October 2019, the Decree of the President of the Republic of Uzbekistan on the approval of the Strategy for Agricultural Development for 2020-2030 was adopted. The priorities of the strategy are:

development and implementation of the state policy of food safety, providing for food safety and improvement of consumer rations, providing for the cultivation of the required amount of food products;

wide introduction of market principles in the purchase and sale of agricultural products, development of quality control infrastructure, export promotion, creation of a favorable agribusiness environment and value chain, providing competitive, high value-added agricultural and food production in target international markets;

introduction of mechanisms to reduce state participation and increase investment attractiveness in the field, which provides for the modernization, diversification and support of sustainable growth of the agricultural and food sectors, increasing the inflow of private investment capital;

improvement of the system of rational use of natural resources and environmental protection, providing for the rational use of land and water resources, forest resources;

development of modern management systems in agriculture, providing for the restructuring and further development of public administration;

increase the efficiency of public spending and gradual redistribution through the development of sectoral programs aimed at increasing labor productivity on farms, improving product quality, creating high added value;

development of a system of science, education, information and consulting services in agriculture, providing for the use of effective forms of knowledge and information dissemination integrated with the production of research, education and consulting services;

implementation of rural development programs aimed at promoting balanced and sustainable development of rural areas;

creation of a transparent system of network statistics, which provides for the introduction of reliable methods of collection, analysis and dissemination of statistical data through the widespread introduction of modern information technologies [2].

At the same time, in order to ensure that the population living mainly in rural areas are engaged in entrepreneurial activities and have a stable source of income, the President of the Republic of Uzbekistan adopted Resolution No. PP-3777 of June 7, 2018. In 2019, more than $ 700 million was directed to support business initiatives on preferential terms through commercial banks [1]. It should be noted that in today's pandemic, support for agriculture is more important than ever. To this end, in recent months, "On urgent measures to improve the efficient use of water resources and land reclamation in Jizzakh and Syrdarya regions" [3], "On measures to support the fishing industry and increase its efficiency" [4], "On measures to implement the project" Modernization of Agriculture of the Republic of Uzbekistan "with the participation of the International Bank for Reconstruction and Development and the International Development Association" [5], "Accelerated development of the food industry and full supply of quality food products" On measures to ensure the provision of "Uz.Res. Resolutions of the President of the Republic of Uzbekistan [6] and "On measures to further develop silkworm breeding and karakul farming in the Republic of Uzbekistan" Uz.Res. The adoption of the Presidential Decree [7] alone clearly shows how much priority is given to the rapid development of agriculture. Agriculture plays a special role in ensuring sustainable growth in our economy. In order to modernize the industry, projects worth $ 1.2 billion are being implemented at the expense of international financial institutions.

In particular, the World Bank has attracted $ 500 million to establish modern agro-service centers in each region.The state pays special attention to the creation of clusters as a more competitive form of production and business organization, which will facilitate the export of agricultural products to foreign markets. In particular, the number of cotton-textile clusters increased from 15 in 2018 to 73 in 2019. In 2019, clusters accounted for 1.8 million tons of raw cotton grown in the country, or 66% of the total harvest.

Among the positive effects of clusters are productivity growth, job creation, export growth, cost savings, and more. For example, by the Resolution of the President of the Republic of Uzbekistan dated September 15, 2017 No PP-3279 "On measures to establish a modern cotton and textile cluster in Syr Darya region" [8] Initially, 18,000 hectares of land were allocated, of which 3.4% of the allocated land area is 60 and above, 15% is 51-60 points, 63.2% is 41-50 points, 18.3% is 40 and had a lower score quality. To date, due to the organization of agricultural production on the basis of modern approaches and methods, in a short period of time the yield of cotton has increased from 17.2 t / ha to 30.2 t / ha, and the yield of grain - from 22.5 t / ha. 61.5 ts / ha. In addition, 2,622 citizens were provided with permanent jobs and stable wages. To date, JV LLC "BEK KLUSTER" has implemented 10 major projects in the field of industry and agriculture worth 380 billion soums and 572 thousand US dollars, and in the near future plans to launch two more large projects worth 142 billion soums.

It is gratifying that today, at a time when the economy is paying close attention to the use of digital technologies in industries and sectors, the cluster has allocated $ 790,000 for the implementation of projects on digitization of agricultural production, which in practice has achieved significant economic benefits [11].

It is planned to implement 96 projects in the country within the framework of agricultural clusters on the organization of processing, storage and drying of products with a capacity of 430,000 tons. Also, projects have been developed to create intensive orchards on 6,000 hectares and vineyards on about 8,000 hectares. During the current year, 410 mln. It is planned to export cluster products worth $ 1 billion. It should be noted that in 2019, clusters created 11,000 new jobs across the country.

Based on the study of world experience, we can include the following among the factors that have a great positive impact on the development of agriculture:

Price incentives. The world’s best practices show that agricultural producers are vulnerable to price incentives. Therefore, setting the "right" prices for agricultural products is one of the important factors in ensuring agricultural growth.

Establishing integrated chains of value creation. Food markets are increasingly being transformed into advanced integrated value chains such as supermarkets. They bring together farmers, processors, retailers, and consumers to share valuable information, provide funding when needed, define and enforce sanitary and phytosanitary standards, encourage risk sharing, and fund research and innovation. allows Cooperation with support sectors such as financial services, telecommunications, transport and energy will also be facilitated. Significant increase in volume efficiency and quality of products delivered to the consumer is achieved. On the other hand, while supermarkets are leading to the loss of traditional retail stores and the loss of many jobs, process participants are equally interested in lower prices.

Appropriate technology selection. The future development of agriculture due to limited land resources depends on the efficiency of use of these resources. Technology plays a big role in this. There

are labor-saving, land and water-saving, risk-reducing, product-friendly and environmentally friendly technologies. In the context of limited financial resources, the priority in choosing technologies depends on the relative cost of production resources.

The COVID-19 pandemic poses a serious threat not only to human life, but also to its sources of livelihood.

In some countries, the spread of the pandemic has slowed and the number of infections has been declining, while in others, the rapid spread of COVID-19 has continued and the number of infections has started to increase again. in a word, the pandemic remains a global problem that requires a global response.

Unless emergency measures are taken, it is natural that we will face a food security problem of a global nature that can have long-term consequences for millions of children and adults.

This is mainly due to food shortages — declining incomes, declining remittances, and, in some cases, rising food prices. In countries where food security is at stake, the food crisis is now a major threat, along with food shortages.

We are facing a COVID-19 pandemic at a time when the number of people suffering from hunger or malnutrition in the world continues to grow. According to the latest UN data, the number of people suffering from hunger in the world as a result of the economic downturn caused by the pandemic in 2020 could reach at least 83 million, and most likely even 132 million. According to the latest UN estimates, nearly 690 million people will suffer from hunger in 2019, up from 10 million in 2018, up from 60 million five years ago. In addition, as a result of high food prices and limited financial resources, billions of people on the planet do not have access to nutritious and healthy food.

According to a UN report, by the end of 2020, the number of people suffering from chronic hunger as a result of the COVID-19 pandemic could increase to 132 million. Meanwhile, the Global Report on Food Crisis notes that by the end of 2019, 135 million people living in 55 countries and regions around the world were living in conditions of acute food shortages. In addition, in 2019, 75 million children in the world will lag behind in growth, while 17 million children will suffer from fatigue and anemia due to malnutrition, according to international experts.

According to the World Bank, the economic consequences of the pandemic could put nearly 100 million people at risk of poverty. The steady rise in unemployment, the loss of sources of income and rising food prices threaten the uninterrupted supply of food to consumers, both in developed and developing countries, and pose serious risks to food security. In addition, as the pandemic causes a deep recession in national economies, countries around the world need to take serious measures to mitigate the negative impact of the pandemic on food supply systems. According to the World Bank, this year the risk of food shortages in the world is very high due to the inability of agricultural producers in the world to carry out crop production at the required level. should be one.

Experts from the International Food Organization (FAO) identify three factors that cause people to fall into the trap of starvation COVID-19:

• Declining employment and declining incomes mean a reduction in the amount of food that citizens can spend on food. The decline in remittances from migrants also exacerbates the problem. At the same time, the escalation of political, racial, economic, ethnic tensions between the countries of the world is leading to rising food prices and shortages.

• Various mandatory barriers and interruptions caused by the pandemic and health-related pandemic interventions also have serious consequences for food production and food supply.

• A sharp decline in government revenues makes it difficult to fund social protection measures of various characteristics and means that the state is unable to meet growing needs.

As a result of consistent measures taken in our country to eliminate the negative effects of the pandemic, we have every right to say that the impact of the pandemic on agriculture has not been catastrophic. Preliminary data from the State Statistics Committee of the Republic of Uzbekistan show that in the first half of 2020, the economy continued to grow, albeit slightly. Gross domestic product (GDP) amounted to 255.3 trillion. soums and increased by 0.2%, while in the same period last year there was an increase of 6%. The increase in the gross value added of the sectors was 0.3%. For comparison, we can say that neighboring countries in the vicinity are experiencing a recession. GDP in Kazakhstan decreased by 1.8% in the first half of the year, and in Kyrgyzstan - by 5.3%. According to the Central Bank of Russia, the annual GDP decline in the country will be 9.5-10%. Although the Chinese economy grew by 3.2% in the second quarter, the country's economy contracted by 1.6% in the first half.

Although the dynamics in most sectors of the economy slowed down compared to the same period last year, growth continues. The services sector grew by 2.6%, construction by 7.3% and consumer goods production by 1.2%. Industrial production decreased by 1.9%, mainly due to a 20.1% decline in the mining industry. At the same time, the processing industry, which accounts for 81% of all industrial production, grew by 2.2%.

The government has taken all necessary measures to ensure the success of the spring field work, the unimpeded delivery of the new crop of fruits and vegetables to consumers, and the relatively free movement of industrial workers to carry out

production tasks. In addition, the government has taken large-scale measures to significantly increase food production, strengthen the country's food security, and increase exports in the face of disruptions in the world's food supply chains. Therefore, in agriculture, by contrast, growth in the same period last year was 2.4%, while in the first half of this year, growth in the sector accelerated to 2.7%. The fastest growth was observed in the fishing sector - the growth rate compared to the same period last year was 16.7%. In January-July 2020, agricultural producers of the country exported agricultural products worth $ 498.7 million.

However, we are far from believing that the pandemic in Uzbekistan has not affected agriculture. The introduction of quarantine restrictions on public catering establishments and the severe testing of the tourism industry have had a significant impact on the decline in demand for agricultural products and the incomes of producers and suppliers [10].

Table 1. The structure of agricultural production (%)

Category of farms	2017	2018	2019
Total			
Husbandry farm	29,3	26,0	26,9
Farming	68,4	71,2	70,1
Organizations engaged in agricultural activities	2,3	2,8	3,0
Crop Production			
Husbandary farm	49,2	45,3	48,7
Farming	49,1	52,2	48,4
Organizations engaged in agricultural activities	1.7	2,5	2,9
Livestock			
Husbandary farm	3,7	4,6	5,0
Farming	93,1	92,3	91,9
Organizations engaged in agricultural activities	3,2	3,1	3,1

Resourse: *https://review.uz/ru/post/strategicheskie-prioritet-selskogo-xozyaystva*

Table 2. Cotton-textile clusters established in the regions of Uzbekistan (2018)

#	Region	Cluster core	Land area (ha.)
1.	Republic of Karakalpakstan	"Amudaryotex" LC	7 000
2.	Andijan	"Vodiy Sanoat Faxri" LC, "Marhamattekstil" LC, "Al'yorteks" LC, "Best Textile International", "Sohib Omad Barakasi" LC	41690
3.	Bukhara	"Merganteks" LC, "Parvoz Humo Ravnaq Trans" LC, "Qorako'l Kumush Kalava" LC, "Bahor Chance Textile" LC, "Peshkuteks" LC, "Buxoro Zarhal Teks" LC	25 000
4.	Jizzakh	"Jizzax Industrial To'qima" LC	5 000
5.	Kashkadarya	"Bunyodkor" LC, "Oq saroy textile" LC, "Shaxrisabz Tekstil" LC, МЧЖ "Sulton Teks Group" LC	31700
6.	Namangan	"Toshbuloq Teks" LC, "Namangan To'qimachi" LC, "Namimpekstekstil" LC, "Namangan Momiq Sochiqlari" LC, "Uztex Uchkurgan" LC, "Uchkurgan Textile" LC	45468
7.	Samarkand	"Baht Invest Hamkor Tex" LC, "Daka Tex" LC, "Marokand Sifat tekstil" LC, "Amin invest international" LC, "Artek International" LC	26 300
8.	Syr Darya	"BEK KLUSTER" LC	23896
9.	Surkhandarya	"Nortex Style" LC, "Chinoz Textile" LC, "Billur Teks" LC, "Surhonteks" LC, "Surxon Sifat Tekstil" LC	33920
10.	Tashkent	"Maxim Gold Tex" LC, "Ko'kcha tekstil" LC, "Agro Teks Alliance" LC, "Textile Technologies Group" LC	37320
11.	Fergana	"Baxodir Log'on Tekstil" LC, "Fergana Oseana" LC, "Bulut Textile" LC, "Expo Kollor Prin Teks" LC, "Global Textile Solutions" LC, "Fergana Global Textile" LC	29810

12.	Khorezm	"Xorazm Tex" LC, "Shovot Tekstil" LC, "Kobotex" LC	25505
Total land area			**3332609**

Resourse: *Based on the data of the Ministry of Agriculture of the Republic of Uzbekistan.*

Conclusion and recommendation.

Based on the long-term prospects for the development of the agricultural sector, the risks posed by the pandemic and the study of world experience, it is advisable to implement the following measures aimed at its development:

- Establishment of cooperative relations between small agricultural producers and large agricultural processing enterprises, trade and intermediary organizations on the basis of such systems as "one village - one product" or "one neighborhood - one product", market and the development and implementation of regional production programs to expand the production of export-oriented products.

- to take into account the advantages and risks of specialization in the production of a particular type of agricultural products, to make proposals to remove barriers to effective specialization.

- Development and distribution, production and distribution of free manuals, brochures and other manuals on the technology of cultivation of fruits and vegetables and other high value-added crops on the basis of the principle of "one village - one product", their processing together with large enterprises to consider the organization on a scientific basis as a priority.

- Recommend that commercial banks provide microcredits for farmers and private households without a legal entity to grow and expand fruits and vegetables and other liquid and export-oriented crops at a rate not higher than the refinancing rate of the Central Bank of the Republic of Uzbekistan .

- as well as the allocation of additional land plots to farmers and unemployed people for the cultivation and expansion of fruit and vegetable and other consumer and export-oriented crops and their provision with the necessary means and funds on favorable terms.

- to create conditions for large foreign trade intermediaries and processing enterprises to provide comprehensive assistance to small producers in the cultivation, storage, packaging and primary processing of quality fruits and vegetables and similar market-oriented, export-oriented crops; to convince them that their products will be sold in any situation and to set up activities on the basis of futures contracts.

- Organization of short-term training courses on the basics of modern agriculture in the newly established technical schools and vocational schools.

- Further revitalization of research in the field, special attention to the practical orientation of research, development of cooperation between universities and agricultural producers, the organization of training of specialists and personnel for the industry in response to changing market requirements.

- to take into account the pros and cons of cluster development of agricultural production, with special emphasis on the role of enterprises in various forms of ownership, rather than the initiating state.

- One of the main goals of the ongoing reforms in agriculture is the production of high quality agricultural products. The same is true of the agricultural development strategy. Particular attention should be paid to creating a system that meets the International Food Safety Standards Hazard Analysis and Critical Control Points (HACCP) for the production of high quality and safe agricultural products.

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	GIF (Australia) = 0.564	ESJI (KZ) = 8.771	IBI (India) = 4.260
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MORPHOLOGICAL ERRORS IN WRITING OF UZBEK EFL LEARNERS

Abstract: *The aim of the study was to uncover the types of morphological errors that Uzbek EFL students write in their IELTS (International English Language Test System) essays. A petrified morphological error is defined as an error that arises or has arisen from the morphological aspect of their EFL student learning to write English in the IELTS. The nature of this study is descriptive. The study revealed that the students made inflectional morphological errors. In addition, the IELTS essay writing materials of Uzbek students were analysed. The results showed that Uzbek EFL learners still made morphological errors when writing. This study concluded with several findings based on samples and corresponding suggestions for both EFL learners and instructors.*

Key words: *writing, morphological errors, morphemes, language, acquisition.*

Language: *English*

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Introduction

Learning grammar is one of the biggest challenges for ESL learners. This is because, due to the influence of the learner's mother tongue, mistakes are made when it comes to the grammatical rules of the language being learned. This is especially common in the written language of a foreign language learner. That is, when it comes to expressing thoughts or a certain meaning in the written language, grammatical weaknesses show up. One of these errors concerns morphology.

Therefore, this study investigates different types of errors that English-as-a-foreign-language learners in Uzbekistan (EFL) commit in their academic English essays. The aim of the study is to find answers to the following questions by analysing the morphological errors in the written papers of EFL students. To what extent do the learners of EFL understand their subject in such a way that they can overcome the mistakes they make? How much attention should be paid to the language skills of EFL students?

Therefore, this study analyses EFL students' mistakes in using compound morphemes in writing, especially inflectional morphemes, and suggests ways to eliminate them. This is because most students commit certain errors because they usually focus on generating ideas. In this study, the materials of the

"IELTS Mock Test" conducted at the Opus Study Centre in the Uzbek city of Fergana were selected for analysis. Some writing materials were happily accepted by the director of the centre. Thus, the students' results from EFL were used to study their morpheme errors. The result shows that in the written language of EFL learners, there is a tendency to generalise one grammatical rule to another. In other words, learners were confused in converting the rules because English has different patterns than Uzbek morphology. At the same time, they are not able to distinguish morpheme errors from the grammatical peculiarities of learning a foreign language (English) and the peculiarities of the mother tongue (Uzbek). One of the most important points is that some students do not have sufficient knowledge of English morphology.

2. Literature review

Writing is a complex task that requires EFL learners to be able to perform different actions simultaneously (Flynn and Stainthorp, 2006). Writing involves many different elements such as vocabulary, spelling, grammar, etc., which is challenging for EFL learners. This is because it involves more than putting words and sentences together. By default, writing should convey a certain message or content. It needs to include many different elements such as vocabulary, spelling, grammar, etc. Cam and Tran (2017) attribute the main reason for writing errors to a lack of grammatical knowledge. In this sense, the practise of writing is a difficult process for foreign language learners. Thus, there are many aspects that EFL students need to master in order to avoid essay writing mistakes. Even after many years of study, foreign language learners have difficulty with linguistic rules that are fundamentally different from those of their mother tongue. The reason is that the student has done something wrong in the course of frequent foreign language learning. Duray (et al., 1982) distinguishes errors according to their cause: firstly, performance errors due to factors such as fatigue and inattention, and secondly, ability errors due to lack of knowledge of a particular language. Performance errors are classified as errors. The above definition states that an error is "the student's mistake at that stage and can be corrected. An error, on the other hand, is a linguistic mistake made by the pupil that cannot be corrected. The points of error that the student has incorporated into an utterance or sentence should be identified. Furthermore, some explain that errors can be self-correcting, but errors are systematically deviant (Gas and Selinker, 2001; Abushihab 2014). In other words, errors cannot be separated from the language learning process. During the learning process, the student makes some mistakes in the spoken sentences, the teacher corrects them, and the student memorises them. Even if the students make mistakes the next time, they will make fewer mistakes and they already know the correct ones. When this is the case, students are usually able to recognise the mistakes they have made and reproduce the correct ones.

Therefore, EFL students often make spelling mistakes related to morphology and many other aspects of language. Although it is human nature to make mistakes, these errors can be persistent due to factors such as lack of concentration in the foreign language classroom, lack of work on the errors or lack of use of effective language teaching methods by the teacher. As a result, these problems become apparent when analysing written utterances. For example, many EFL learners have problems choosing the correct word forms. The presence of morphological errors indicates that EFL learners do not fully understand the meaning and function of morphemes and morphological norms. To write well, morphology must be considered as one of several aspects of language (Bauer 2007). This is because language is a human communication system consisting of structure and order, from morpheme to speech (Richards and Schmidt, 2002).

Based on the above description, it can be defined that it is possible to divide error types into categories: Omission is the absence of an element that must occur in a well-formed utterance, for instance, *"John has two apple"* (correction: John has two apples). Addition, on the other hand, is indicated by the presence of *"unwanted"* items in sentences. This item does not appear in well-formed utterances, such as, *"I will coming"* (correction: I will come). Mis-formation is the use of wrong forms of certain morphemes or structures, such as *"Kate runned"* (correction: Kate ran). Mis-ordering is indicated by the incorrect placement of certain morphemes, for instance, *"Peter went yesterday to his grandma's house"* (correction: Peter went to his grandmother's house, yesterday).

Morphological Errors

In linguistics, morphology is the study of words, their formation, and their relationships to other words of the same language. In other words, morphology is the study of the smallest meaningful units and how they are formed into words. According to Aronoff and Fudeman (2011), morphology refers to the mental systems involved in word formation, or the branch of linguistics that deals with words, their internal structure, and formation. This idea was developed by Carstairs-McCarthy (2002). Morphology describes the area of grammar that deals with the structure of words, including the morphemes that make up words. Morphology deals with word formation, where words can be formed from the smallest units in the correct form, usually called morphemes.

There are different ways words are formed in English. The most obvious way is to add something to the beginning or end of the word. For example, you can add "*–ed"* to the end of a word to indicate a past

action ("play" becomes "play + ed=played"). Another example is the word "*un*believable".

The first two characters "*un-"* have meaning independently, just as the first character "*u-"* alone has no meaning. The morpheme "*un-"* means *"not"* or expresses a negative or opposite force in adjectives and their derived adverbs and nouns. The word "*-believe-"* is a free morpheme. In other words, a pause can be meaningful and stand alone as a word. The last part of the word can mean able, susceptible, suitable, prone, or given. "*-able"* is also a free morpheme because it can stand alone. Therefore, "*unbelievable"* has three morphemes: "*un-believe-able"*. It should be noted that when the last part *-able* is added the letter -e disappeared from the part of *-believe*. However, there are other ways to form words. B. By changing the root form of the word. For example, "*drink"* becomes "*drank"* in the past tense, and "*woman"* becomes "*women"* in the plural. Some words have only one morpheme and cannot be broken down into smaller meaningful subparts.

A morpheme is sometimes a single syllable, but other times a morpheme may have several syllables. Aronoff and Fudeman (2011) state that a morpheme may consist of a word, such as *"apple"*, or a meaningful piece of a word, such as the "-ed" of "played", that cannot be divided into smaller meaningful parts. Since morphology deals with the formation and modification of words, it determines how words are composed into phrases and sentences. In morphology, a meaningful unit is called a morpheme. A morpheme can be represented by one or two sounds or syllables. English morphology can be divided into free and bound morphemes. In morphology, morphemes are divided into two types known as free morphemes and combinatory morphemes. A morpheme that can stand on its own is known as a free morpheme and a morpheme that cannot stand on its own is known as a bound morpheme. A bound morpheme must be connected to another unit *(affix) prefix, suffix, and infix*. Affixes are also classified according to whether they are before or after the base form. An affix that precedes a base form is called a "prefix". Anything in the middle of the base form is called an infix. And everything that comes after the base form is called a "suffix". English morphemes can be divided into two categories: derived morphemes and inflectional morphemes. They have different functions. Derived morphemes create new words from the root and can significantly change its meaning, while inflectional morphemes fulfil grammatical functions and create new forms of the same word but with the same meaning. However, there are very few true infixes in English. For example, the suffix -er is a derivative suffix that turns a verb into a noun. "Punch" (v) + -er = puncher (n). Inflectional morphemes are added to create new forms of the same part of speech to indicate grammatical characteristics. For example, adding "–s" to noun-based words: "apples" (s) + -s = apples(n). In table 1, there are several examples of inflectional morphemes.

Table 1.

English Inflectional Morphemes		Added to	Examples
-s	plural	*Nouns*	*She has got two guitar**s**.*
-'s	possessive	*Nouns*	*Zeynep**'s** hair is long.*
-er	comparative	*Adjectives*	*Zeynep has long**er** hair than Derya.*
-est	superlative	*Adjectives*	*Zeynep has the long**est** hair.*
-s	3rd person singular present tense	*Verbs*	*Zeynep play**s** the guitar.*
-ed	past tense	*Verbs*	*She play**ed** the guitar at the party.*
-ing	progressive	*Verbs*	*She is play**ing** the guitar at the party*
-en	past participle*	*Verbs*	*She has take**n** the guitar to the party.*

Source: Husein Oz, Oct 2014.

Ramadhan (2015) classified errors for refractive morphemes as plural forms of nouns -s omission of morpheme, noun plural -s added morpheme, incorrect formation of past tense of irregular verbs; omission of possessive morpheme, misuse of possessive morpheme, omission of third person present tense. Santoso (2017) also classified inflectional morpheme errors as plural inflexion, singular inflexion and present inflexion. Morphological errors concern word affixes. This concerns both derived and inflected affixes (Whitaker 2010).

Morphological errors of EFL learners mostly manifest in the intermediate language. In relation to English, the errors usually occur because the student's first language (L1) EFL is impeded and he does not fully understand the English system of inflectional

morphemes. Some common morphological errors include plural markers (–s), possessive markers (–s), third singular markers (–s), past tense markers (–ed), Progressive markers (–ing), perfect and participle markers (–ed and –en), and comparative and superlative adjective makers (–er and –est). Thus, morphological errors made by students can lead to changes in traits and hinder the reader's interpretation of the essay. From the explanation above, errors in inflectional morpheme can distinguish include:

1. Omission in plural nouns: *–s/-es* morpheme as the absence of the *–s* plural suffix that must be attached to singular noun: *Andy has three apple* (correction: *Andy has three apples*);
2. Addition to plural nouns: *–s/-es* morpheme which is indicated by the presence of *–s* morpheme to singular noun: *Can you give me a hamburgers?* (Correction: *Can you give me a hamburger?*). A similar case also appears in double mark plurality by adding the *–s* morpheme to irregular plural nouns: *Peoples are coming to Korea.* (correction: *People are coming to Korea*). The other case is overgeneralization by adding the *–s* plural morpheme to uncountable nouns: *I have informations about Jeju island*. (correction: *I have information about Jeju island*).
3. The wrong formation of the past form of irregular verbs is the wrong use of the *–ed* past morpheme by adding the *–ed* past suffix to the irregular main verb. It also can be recognized as overgeneralization: She catched a bird yesterday (correction: She caught a bird yesterday).
4. Omission of the possessive *–s* morpheme could be divided into two types of errors: a) in which students omit the apostrophe: players uniforms (correction: players' uniforms); a player's uniform (correction: a player's uniform) and b) in which students omit the apostrophe and the *–s* morpheme: my teacher book (correction: my teacher's book).
5. Misuse of possessive –s morpheme by adding the –„s morpheme: speaking's club (correction: speaking club).
6. Omission of the 3rd person-present tense morpheme as the absence of –s morpheme that is added to the 3rd person verb in the present simple tense: Jane play tennis (correction: Jane plays tennis).
7. Omission of the morpheme –er in comparative adjective: I am smart than you (correction: I am smarter than you);
8. Omission of the morpheme –est in superlative adjective: I am smart in the class (correction: I am the smartest in the class);
9. Misformation of the morpheme –er in comparative adjective: This shirt expensiver than yours. (correction: This shirt is more expensive than yours);
10. Misformation of the morpheme –est in superlative adjective: I am the gooddest boy in my class. (correction: I am the best boy in my class).

3. Method

In this study, several essays were collected from students in an IELTS writing test conducted at the above language centre to test their language proficiency before the actual IELTS examination. The purpose of the IELTS writing test was to check the students' performance until the real IELTS exam in order to give them feedback and corrections. The essays helped to examine morphological errors. The learners who wrote the essays were between 18 and 22 years old and are preparing for the IELTS academic exam, which they will use to apply to universities overseas. The learners had been studying English since middle school (around the age of 12), but the public school curriculum did not provide enough lessons and time for this subject to improve their English skills. So they attended IELTS courses at various private English teaching centres. So their language skills varied: from Pre-Intermediate to Advanced. Therefore, the essays in this study were evaluated morphologically, and the study focused primarily on morphological errors to define the exact boundaries of the study.

4. Morphological error types in writing tasks.

The number of morphological errors and their types were attentively evaluated, and the errors were classified into categories according to the frequency of the occurrences which could be seen (Table 2).

Table 2.

No.	1	2	3
Type of Morphological Errors	Omission	Addition	Misformation

As Table 2 shows, learners committed three types of morphological errors. The errors occurred in all areas of morphology. The most noticeable type with the highest frequency of errors is omission. Most morphological errors were committed in omission, followed by addition, with fewer errors committed in addition in the writing materials. The fewest errors committed by learners were errors of form.

According to the study, the test takers committed morphological errors. Most of them were able to write English essays, but still, there are enough errors in the texts. Their errors are found at many different levels.

In the observed materials, the learners repeatedly made mistakes or errors. Many persistent errors have become fossilised errors. In this study, errors are categorised into different types: Omission (absence of an element that must occur in a well-written form), Addition (presence of an element that must not occur in a well-written form) and Misformation (use of the wrong morphological form). A description of each type follows.

1) Omission

(Omission of morpheme –s /–es in countable plural noun)

Omission errors are characterized by the omission of elements that must appear in a well-formed document. In this case, it has been found several mistakes belong to forming plurals. In general, to show a plurality of nouns in the English number system is used –s and –es morphemes. There are two ways of forming plurals.

First, regular plural nouns called overt morphemes, by adding –s and –es. e.g., student-students, story-stories.

Second, irregular plural nouns are called zero morphemes, such as man-men, and child-children. Here are the examples of the omission of morpheme –s and –es occurring in plural form:

E.g.: made up a third of *"viewer"*

Thus, the error occurs in the form of using the plural form of the noun. It seems, some learners wanted to write "made up a third of viewers" in English, but some others wrote, "made up a third of viewer". The word "viewer" must be written in the plural form, "viewers". The consideration is it refers to the previous word "a third of" which gives the plurality to the word "viewers" but one of the writings, there was a put singular form "viewer". They made an error because the morpheme –s was omitted in the word "viewer", it should be „a third of viewers".

The same condition is also found in other students' cases including:

E.g.: many *"kind"* of songs

Some of the writing materials have such sentence: "in reasonable price" (here the student did not use "a" article after "in". That's why "s" plural marker should be added to the word of "price".

Another example: for many "*traveller"*(The word of "many" should provide morpheme "s" to the word of "traveller").

Omission of morpheme –s / –es in the third person singular in the present tense.

Omission in inflectional morpheme –e and –es is also found in verbs, especially in regular verbs to form a simple present tense in the third person singular. It is called subject-verb agreement where a singular subject requires a singular verb, and a plural verb requires a plural verb. In the present tense third person singular (she/he/it) takes a singular verb that verb ends in –s or –es. So, most learners being investigated in this research omitted –s/-es for the third-person singular verb form in the present tense. Fewer students omitted the errors of this form.

For instance, "It *"show"* that"

Or, "*continuous usage of laptops or other electronic equipments "create" high risk of health issues".*

The use subject third singular person (she/he/it) in simple present tense must be followed by singular verb. So, the English learners committed errors because they omitted the morpheme –s or – es in singular verbs. Here are the reconstructions:

1. E.g.: It shows that
2. E.g.: continuous usage of laptops or other electronic equipment create high risk of health issues

Omission of morpheme –s in possessive

The possessive form is used to show a relationship of belonging between one thing and another. To form the possessive, add apostrophe + s to the noun. The possessive of singular nouns is formed by adding an apostrophe and –s, and the possessive of plural nouns is formed by adding only an apostrophe, and by adding both an apostrophe and –s when it ends in a letter other than s. Here some examples again:

1. rapid increase in senior citizens numbers may put government into a trouble…

2. important role in youngsters life…

2) Addition

Addition of morpheme –s/–es in singular noun

As the opposite of omission, addition is characterized by the presence of an item that must not appear in well-formed writing. In this case, there are also several errors committed by the EFL students. There are some errors committed by them in forming singular noun forms. A singular noun is a noun that refers to one person, one place, one thing, or one idea. Singular nouns do not need to be attached to the morpheme –s/-es. Here are the examples of errors of addition morpheme –s/–es in singular form:

1. E.g.: to use public transports...
2. E.g.: I agree this views

In the examples above, the students added the morpheme –s at the end of the singular noun (transports, views). In this case, the morpheme –s should be omitted at the end of the singular noun (transport, view). Because in the first sentence meaning of the context demands singularity and the pronoun *"this"* demands the singular form of a noun after itself (e.g., 2). Here are the reconstructions:

E.g. 1: to use public transport...

E.g. 2: I agree this view…

Addition of morpheme –s/ –es in non-third person singular in the simple present tense

Error in addition to inflectional morpheme –e / –es is also found in verbs. In this case, some students add the morpheme –s/-es in infinitive verbs after the plural subject in the simple present tense. A singular subject requires a singular verb, and a plural verb requires a plural verb.

Addition plurality -s in the exceptional plural forms *(see the samples below)*

- communicating *peoples*
- who do different *researches*

Addition of morpheme –ing in Infinitive Verb

In this term, the error is related to the additional suffix –ing in a verb. In this case, the students use the verb +suffix -ing (the present continuous) in the present simple tense.

E.g.: do not speaking

You may also see the morphemic error in the usage of (verb + suffix + ing) after to "to speaking". The correct form of the verb should be an infinitive verb or main verb "speak". The reconstruction is: "do not speak...".

3) Mis-formation

Mis-formation of morpheme –en in the present simple tense

Mis-formation error occurs when the students chose the wrong form of a morpheme. In this case, the students commit some errors in choosing tenses. The students tend to choose present tense instead of past tense or past participle, especially irregular verbs: "It *shown* that (correction: It shows that)". Here, the errors occurred in the form of using a past participle verb. So, you may count those sentences as an error. Thus, the students commit some errors in choosing tenses. The EFL students tend to choose present participle instead of simple present tense or past tense. The students were confused about constructing sentences consisting of tenses. It happened because they did not find an equivalent tense or morphological feature in the Uzbek language.

5. Findings

The following three main points emerged from the above discussions:

1. The student EFL made a morphological error, especially in the use of inflectional morphemes. Students generally made three types of morphological errors: omission, addition, and malformation.

2. The student from EFL made a morphological error in using the morphemes -s/-es with plural nouns. Learners made many errors in forming plural nouns. The learners made mistakes because they did not really know the correct form.

3. Interference with the native language is one of the most basic mistakes that the learners made. It interferes with the English language in a way that greatly affects language production. For example, students often forgot the rules of inflectional morphology and formed crooked sentences. They may be familiar with grammar, but this knowledge does not occur to them when writing. In addition, lack of language skills, lack of pedagogical measures, and lack of opportunities to use English also contribute to the main causes of learners' fossilized errors.

6. Conclusion

The results of the study show that in addition to morphological errors, errors related to other language features, such as phonetics, syntax, and punctuation, also occur in essay writing. Thus, errors are made in the process of language learning. However, it is very important to identify the reasons why errors occur. Within the framework of this ban, the most frequent types of morphological errors in the written works of Uzbek students were identified: Omission, Addition, and Incorrect Formation. The study also showed that these errors occur mainly in inflectional morphemes. At the same time, there is an influence of native language on L2. The participants in this study were only adolescents, so further research is needed to determine the differences between children and early and late bilinguals in terms of morphological errors. Thus, the errors that students make in writing in English are often related to morphology. Morphology encompasses many aspects of language. Morphological errors were found in students' written work from EFL in the form of incorrect construction or disorganization.

Recommendations are also given to EFL instructors on the research results: it is necessary to change their own teaching methods based on the students' writing errors. In this case, feedback can be given after grading the essays. We conclude that the results will inform teachers on how to help their students write their essays better by understanding their students' writing weaknesses. Although this study was conducted on a very small scale, the results of the study point to effective solutions. In other words, solutions to such errors can be found by explaining intra- and/or interlanguage factors. It should be noted that these conclusions help predict or reduce morphological errors in EFL teaching and learning.

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Issue Article

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REFLECTIONS ON AMBITION AND HUMAN LIFE IN THE STORY "MALVERN HILLS" OF KAZUO ISHIGURO

Abstract: *This article was written primarily in essay form. In it, Anglo-Japanese author Kazuo Ishiguro explores how musicians succeed in the music world and how they become happy in "Nocturnes: Five Stories of Music and Nightfall". This article mainly describes the important points in the story "Malvern Hills" in the book. Relevant personal and learned reflections were shared. In the concluding part, the fact that a person can lose his life and neglect his family because of his ambition, as well as important considerations against or preventing this, were presented considering the review of the story.*

Key words: *music, life, narration, literature, reality, characteristics, challenges, ambition.*
Language: *English*
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Introduction

Table 1. Article's profile

Theme	Reflections on ambition and human life in the story of Kazuo Ishiguro
Purpose of the study	The aim of this work is to analyze the story and determine the author's message in it. It is to investigate what aspects or views the readers have about the content of the story. Thus, it is about the analysis of literary texts and the influence of literature on esthetic life.
Method and results	The qualitative method was used in the research work. The reason is the aesthetic interpretation of the literary text - the story and the comments about its vitality. That is, this study did not use a questionnaire or quantitative data analysis. The results are that success conundrums are common to people globally. A person can lose his life and neglect his family because of his ambitions
Main source	"Nocturnes: Five Stories of Music and Nightfall" of Ishiguro, the story of "Malvern Hills".

Nowadays we are experiencing globalization. Among other things, we see people struggling in their careers for fame and/or fortune. In this case, the devotion to the professional activity takes place and completely pulls a person into its trap. As a result, a person involuntarily distances himself from his family. Therefore, I would like to share my thoughts on this subject by analyzing a passage from the work of Kazuo Ishiguro. The aim of this work is to analyze the story and determine the author's message in it. It is to investigate what aspects or views the readers have about the content of the story (Malvern Hills). Thus, it is about the analysis of literary texts and the influence of literature on esthetic life. The qualitative method was used in the research work. The reason is the aesthetic interpretation of the literary text - the story and the comments about its vitality. That is, this study did not use a questionnaire or quantitative data analysis. The results are that success conundrums are common to people globally. A person can lose his life and neglect his family because of his ambitions

2. A brief overview of Kazuo Ishiguro and his stories

In the stories of Kazuo Ishiguro, I could see a clear picture of it. That is, in this book Nocturnes: Five Stories about Music and the Night, the author explores the mystery of how musicians succeed in the music world – how they can live happily ever after. It can be said that the art of creating characters in his stories is given at a high level.

One of the most interesting points in the stories is that the challenges a musician faces at different stages of his career are brilliantly portrayed. The description of the "rise or fall in the business world" situation is particularly interesting. Moreover, in this way, the musician is confronted with a fierce struggle between three things (music, life, and love) in different career situations - very skillfully portrayed. One of the highlights is the stories - little tales from the lives of humble people. These people are humble, but their accomplishments are high.

One of the strange things about the stories is that the trinity of time, music, and love also to reflect emotional details and tender human relationships. Ishiguro's works are full of wonder. These stories should be enough for those who want to imagine the world of musicians.

I mean, career, love, and marriage are portrayed in various examples of musicians and couples. From some or complete estrangement from marriage to a close union that leads to true happiness in life, these stories offer unique meanings to the reader. Ishiguro's stories have their own vocabulary. So, welcome to the world of esthetic literature!

3. The story of "Malvern Hills" and related reflections.

The name of the story I will mainly tell in this essay is "Malvern Hills." The story - told in the second person, in simple language - is wonderful. The story is set in the Malvern Hills. The main character was a young, aspiring singer. He believes strongly in his talent. He writes and sings, too. So, the young guitarist in "Malvern Hills" is also a songwriter. He fights against superficial and unrealistic dreams or visions.

So, in the story, the young singer meets a couple who serve guests in a café. And the café has come here because it belongs to the musician's sister. The musician used to play guitar here. Talking to the couple, the young musician advises them on which hotel they should spend their vacation in. The couple gets into a heated argument, which seems to be the reason for the divorce. However, they behaved like little children. The musician believes that the two are incompatible lovers. So, the musician talks to the woman while talking to the couple. The woman says, "As it is, life will bring enough disappointments [...] if you have dreams like this on top of it" [...]. The woman's key message was that music is like a dream - a dream in which two incompatible elements are mixed. These two elements are 1) beauty and purity of voice; 2) desperation is the key to success.

So, in the pursuit of success, a person can take several insults or destroy his personality. How does a person destroy his personality? Someone can wear ridiculous clothes. Sometimes one has to put up with an "unpleasant" spouse. Sometimes the opposite happens: a person leaves a happy marriage. In this case, he is sequestered for hours in small soundproof rooms as a musician and devotee. This requires a long time to practice their instruments. The author uses the phrase "you know" in the background of this narrative, which can refer to many meanings. One of these meanings can be as follows. An in-depth study of original creations and contradictory relationships is not very helpful. However, it is more useful to avoid the simplistic image of the musician who falls into a cliché. Ishiguro, then, seems to have focused on avoiding contradictory narratives rather than addressing them directly through a "you know" manner or tone.

I also want to address the image of the couple in the story. The couple was professional Swiss musicians who were a bit weird. Ishiguro uses dialog to describe life in European cities. The dialogs are interesting, though not unique. The young musician thought they were German. The man's name is Tilo, and the woman's name is Sonja. Judging by the image of the dialog, the husband is a person who praises everything. That is, as positive as possible.

A woman is a complainer, she can get angry quickly. They had a son. But because of the so-called "peripatetic life", the poor boy did not enjoy enough parental love. Now I said above that the musician had spoken to this couple.

The couple had more or less heard him playing the guitar while they were having a moody argument and turned to the musician. As said, the husband loves praise, he praised the musician and encouraged him. The wife did not encourage him in music. As mentioned before, the musician gave her "life advice" to the young man. In other words, Sonja warned him about possible future disappointments. This warning took place when they saw each other for the second time. That is, the couple met the musician again in the mood of a quarrel. For the young musician was one of the promising young people. The woman noticed it. Sonja wanted to tell the young man that his family indulged in the ambition that followed the music, and that this led to unhappiness in his family.

As I mentioned earlier, the café where the young musician came from belonged to his sister. The young man helped out there and tried to write a song. Ishiguro shows us the following picture using the example of a young man and a couple. A musical career has its own arrogance. For a reasonable person, this is a bitter truth. He befriended the musical couple and listened to them talk. It is as if, through this silence, Ishiguro is telling us about the inner problems a person has after a career. Or, through the silence, he wanted to give us advice on self-control.

Although the text of the story seems simple, it contains many remarkable images. Coming back to the musician, he indeed seems to be a selfish guy who dreams of fame. Why did he go to Malvern? Why did he leave? Finally, he had gone to Malvern to prepare for London. Her sister, who runs a busy café in “Malvern Hill”, has become a "refuge" for her.

As I mentioned above, was not this guy supposed to be helping with coffee? What was he doing? He played guitar, wrote music, and met and befriended a tourist couple. And why? Because he prefers to give priority to his compositions! But he had to work for his hands. Why are a couple and a young man told together here? Because, as said, he and his wife heard the young man “singing a little” and the husband praised him (the musician, narrator, musician). Praise exalts a person. When a person is praised, he flies, he feels satisfied in his work, and he strives to grow.

So, the author Ishiguro loves artists. However, against the background of this story, the author shows that musicians and artists are very selfish. The dialogs and images of this couple’s situation embody the repressed drama. Because the couple had a long musical career. As I said before, this musical career did not bring happiness to the family.

4. About a wonderful aspect of this story

Another aspect of this story is that the musician is also the narrator of the couple's story. Ishiguro tells of this man who was a songwriter. The path of this young man can be understood as a “journey to success.” For he encountered many minds. Therefore, the background of events in Malvern Hills embodies love, serenity, warmth, musical inspiration, affection, and belonging, especially nostalgia. It is also amazing that the story of the experiences of this young musician shows feelings of discipline and loneliness. Also interesting is this man's encounter with Maggie and Geoff. Why is this interesting? Because this couple does not like the man's music. Was the musician in their cafe! However, this couple has a different attitude towards music than the man. That is, they see the musician as having an “unacceptable career” in real life. Instead, it seems that they want the young man to work hard in their cafe. The young man's attempts to love music appeared to them as “laziness” and “inactivity.”

The narration of the places where the young man plays music reflects that the young man wants to share his music with them, as he did when he was a child. I wish they would listen to the music and support him as he sings. But the young man is faced with the opposite reaction. In one of the strangest passages, he has tried to write loud songs for Geoff’s ears. But instead of appreciating his music, the family preferred to watch a movie. This may have been their way of expressing that they should value family time more. One of the interesting points is that the musical composition in the background of this episode can be compared to working in the café - in terms of usefulness. So, even though the young man was faced with these objections, he held on to his musical dream. This is also a very interesting fact. Because, as already mentioned, he was motivated by two professional Swiss musicians?!

Eventually, the Swiss musician found out that the couple was making music while on tour in Europe. The Swiss couple liked the man's guitar playing. According to the author, they looked at the young man with love and joy, delight, and happiness, as if they were looking at a baby. The Swiss woman gave him life advice, but their general attitude was very positive. They praised the young man's talent with their smiles and applause. The guy flew into the sky as if. Although they explained to the young man that a professional music career does not depend on material wealth, but on his belief in music. So, the Swiss couple liked the young man more. With their encouragement, the young man began to find the strength to overcome other negativities.

5. Discussion.

One of the interesting points I must raise here is why the woman advised the young man I briefly mentioned some aspects above. The man (Tilo) was prone to praise, was not he? Therefore, we gave the young man an ideal perspective so that he could start a group in London and succeed! However, the answer to the question is that the woman's advice is essential that "success" in real life sometimes requires disappointment. The woman's point is that if this young man learns from his negative experiences and

is encouraged by his positive experiences, he can achieve his dreams even in times of despair and difficulty

I said earlier that this Swiss couple did not seem to fit the musician. In what way were they not suitable? They were just different in terms of marriage and marriage. But in music, they were very compatible. Because even if they quarreled and bickered as a family, they showed mutual tolerance in disagreements. So, Sonja and Tilo are very compatible in music. They also tolerate disagreements in marriage, despite having different points of view. Tilo is an ideal and bright personality compared to Sonja.

6. One of the central points

While commenting on this story, I would like to share another wonderful observation about the Swiss couple. Because it is one of the central points of the selected store.

According to some commentators, in the music of the hill called Elgar, the country was seen in the imagination of wonderful landscapes that exceed Tilo's imagination. In contrast to this view of the man (Tilo), the woman (Sonja) imagines the real hills as a simple garden. Therefore, Sonja considers the actual hills to be a public park that cannot be compared to the "magnificent and mysterious" Elgar hills. This serves to distance Tilo from Sonja.

Sonja's character is such that, according to some analysts, she learned to be brave and critical from a woman named Mrs. Fraser. At the same time, it can be said that tolerance of other points of view in resolving disagreements and responding to real life is one of the highlighted points.

Now back to the young musician he encounters, "love, discipline, frustration and encouragement" on his path to music. These things are brought into focus: "truth, determination, and tolerance." So, this young man is a hero in this story in the style of a youthful narrator. It is no wonder that in the person of this young man, the author embodies the image of a teenager who is on the "awkward threshold" of maturity. Thus, a young musician should maintain a balance between the ideal and the practical in his determination. He should strive for mutual tolerance with his family.

7. Conclusion

So, I will mention here some points that should be understood. In this story, there are indications of what strategies a person can use to fight against the trials of life. We have already said something about this above. At the same time, a person should know how to deal with disappointment. We need to know when it is appropriate to be angry and upset. In this case, it is important to consider whether anger or denial is the better strategy.

We ought to comfort each other in the face of an unknown future. We have learned from history that every career always falls victim to one of two things: rise and fall. To make a career, the following things are necessary: talent and effort. The important point is that a person can lose his/her life and neglect his/her family because of his/her ambition.

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Issue Article

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INDICATORS FOR ASSESSING OF DEVELOPMENT OF THE DIGITAL ECONOMY OF THE REPUBLIC OF UZBEKISTAN

Abstract: *This article is devoted to the analysis of indicators for assessing the development of the digital economy in the Republic of Uzbekistan, which is currently actively trying to resolve issues related to the use of digital technologies in various fields of activity, provides methods and indicators for assessing the level of development of the country's digital economy.*

Key words: *Digital technologies, infrastructure, communication, development index, big data, digital platform, Internet of things, cloud computing.*

Language: *English*

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Introduction

Currently, data is in digital form, more and more often become the main factor in production, for example, in digital platforms. Thanks to them, it is possible to reduce the organizational and contractual, but also to establish the order of relations among the participants. Therefore, the digital economy should develop primarily in the practical plane, and not theoretical, as is now happening in our republic. This is the key to the formation of the country's strategic competitiveness.

In recent years, work on the wide implementation of digital technologies in the social sphere has also set priority tasks to use electronic services by the population, phased transfer of public services to electronic format, and increase digital skills among the population.

In order to ensure the accelerated digital development of the Republic of Uzbekistan, the formation of a digital economy based on the data by creating the necessary environment for the production of innovative products, increasing the efficiency of public administration, providing the population and entrepreneurship subjects of the relevant public services in 2020 year, a decree of the President of the Republic of Uzbekistan was adopted Strategies of "Digital Uzbekistan - 2030" and measures for its effective implementation "(No. UP - 6079, 05.10.2020).

According to the President's decree on the development of the digital economy and electronic governments, the share of the digital economy in the GDP of the Republic of Uzbekistan is planned to be increased by 2 times by 2023 year, and the share of electronic public services is to bring to 60% to 2022 year.

In addition, in the resolution of the President of the Republic of Uzbekistan "On measures to create conditions for accelerated implementation technologies of artificial intelligence "stipulates that in accordance with the Strategy" Digital Uzbekistan - 2030 "and in order to create favorable conditions for the accelerated implementation of artificial intelligence technologies and their widespread use in the country, ensure the availability and high quality of digital data, the training of qualified personnel in the specified area To approve the program of measures to study and implement artificial intelligence technologies in 2021–2022 years, as well as a list of pilot projects for the implementation of artificial intelligence technologies implemented in 2021–2022 year, including the involvement of residents of the technological park of software products and information technologies. Digital economy - a set of social relations that develop when using electronic technologies, electronic infrastructure and services, technologies for analyzing large volumes of data and forecasting in order to optimize production, distribution, exchange, consumption and increase the level of socio -economic development of states [1-10]. The use of digital technologies leads to the emergence of new requirements for communications and technologies, as well as to change in human everyday life, production relations, and the structure of the economy.

The digital economy has a great influence on such various industries as banking, retail trade, transport, state, cybersecurity, energy, marketing, advertising, education, healthcare, media and entertainment (Fig. 1).

Media and entertainment are divided, in turn, to three levels: specialized development of solutions, exchange of experience (master classes) and the general level.

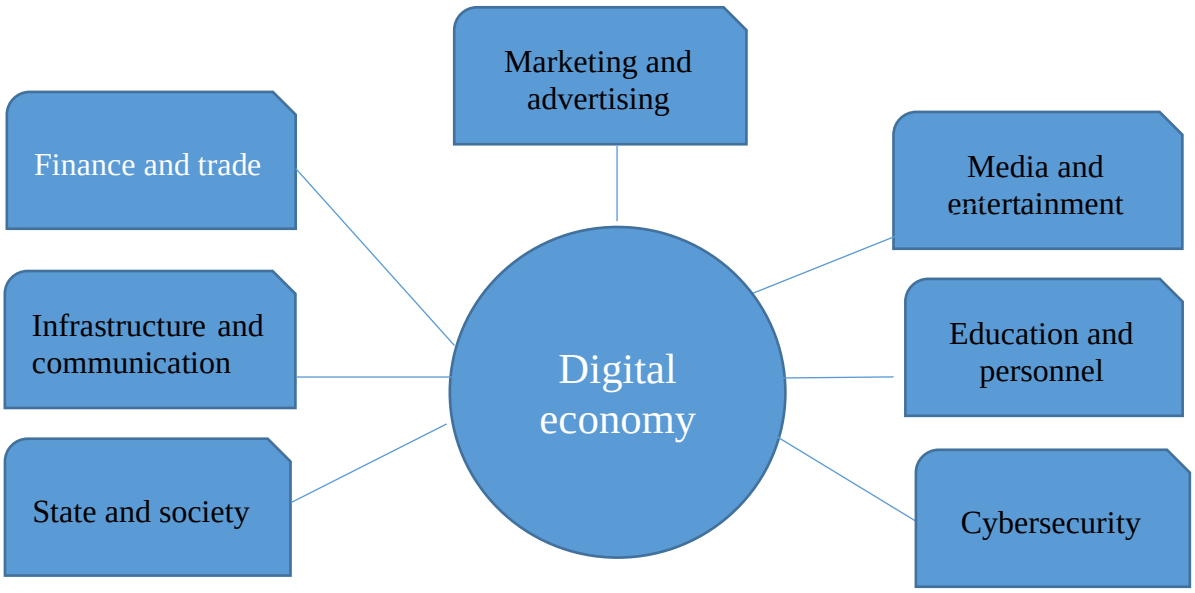

Fig. 1. Industries that are affected by the digital economy

In the Republic of Uzbekistan, they are currently actively trying to resolve issues related to the use of information technology in various fields of activity. However, often significant barriers are created on the way of forming new institutions of the digital economy, revealing significant shortcomings in the regulatory and regulatory environment, in some cases. The number of citizens of our republic who recognize the need for digital competencies is gradually growing, but this level is still not high enough, it is still lower than in other countries, and there is a serious gap in digital skills between individual groups of the population.

The configuration of global markets undergoes significant changes under the influence of digitalization. Many traditional industries lose their significance in the structure of the global economy amid the rapid growth of new sectors that generate radically new needs. Research and development are gaining decisive importance in the ongoing transformation, which requires the creation of a system of research and development in the field of a digital economy, which ensures the coordination of the efforts of interested parties to the executive bodies, companies, higher educational institutions and scientific organizations. Also in the Republic of Uzbekistan, much attention is paid to the use of digital technologies in the education system. All educational organizations must have access to the Internet and are presented there on their sites in accordance with state requirements.

However, educational programs and the number of graduates do not always correspond to the needs of the digital economy. In educational organizations at all levels there is a serious shortage of personnel. Also in the Republic of Uzbekistan, technology parks, infrastructure for science and innovation, business incubators that can and should be used to develop a digital economy are created. In order to implement the strategy for the formation of an informative society, a project was developed aimed at the formation of the conditions for the development of the Society of Cognitions in our republic, the improvement of the well - being and the conditions of the existence of the people of our state by increasing the availability and quality of goods and services performed in the digital economy using the current numerical technologies, and the level of level growth, and growth in the level of levels awareness and digital literacy, improving the availability and quality of public services for citizens, and in addition to security both within the state and beyond its borders.

The digital economy is depicted by three corresponding levels, which in their close interaction have a great influence on the life of people and the environment as a whole: markets and areas of economics (areas of activity), where certain entities (manufacturers and buyers of goods, work and services) are carried out; platforms and technological processes where competencies are created for the formation of markets and areas of the economy (areas of activity); The environment that forms the conditions for the formation of platforms and technologies and the effective interaction of market subjects and sectors of the economy (areas of activity) and includes normative settlement, informative infrastructure, personnel composition and informative safety.

Due to the fact that the effective formation of markets and sectors (areas of activity) in a digital economy is permissible only with the presence of formed platforms, technologies, institutional and infrastructure spheres.

Telecommunication infrastructure develops dynamically, almost 3.8 times from 17.9 to 68.6 thousand km increased the length of the paved fiber-optic communication lines. The number of basic mobile stations increased 1.8 times from 17.7 to 31.7 thousand units; only in 2020 year more than 5,600 new mobile telephone stations were installed and launched.

The expansion of the network of basic mobile communication stations made it possible to create conditions for the provision of services (bring coverage) of mobile communications for 98% of the country's population, including high -speed bonds of up to 90%.

There are various methods and indicators of assessing the level of development of the country's digital economy. A fairly common indicator of digitalization development is the network readiness index (Network Dreadiness index-NRI), which, starting since 2002 year, has been published by the World Economic Forum and International Business School of InSead [2]. The index includes four Podindex with two or three components, which are calculated on the basis of individual indicators:

- Wednesday (political and regulatory, business and innovative);
- Readiness (infrastructure, accessibility, skills);
- Use (population, business and state);
- Impact (economic and social).

When calculating the index in the aggregate, more than 50 indicators are used. Some of them are based on international statistics; the other part was obtained on the basis of an expert survey of enterprise managers in evaluated countries.

Another widespread index in the field of measuring the development of a digital economy is the UN Electronic Government Development Index (E-Government development Index- EGDI). The named index was first calculated in 2001 year, and to this period is published once every two years by the Department of Economic and Social Affairs of the UN. According to the indicators of this index, Uzbekistan has improved its indicators from 0.54 to 0.67 since 2016 year and takes 87th place in the ranking among 193 states [11-16].

EGDI consists of the three Subindex characterizing the state of human capital, ICT infrastructure and web pricing of state authorities.

The calculation of the first two indicators is based on official statistical data.

The third indicator is based on the results of the survey of the website of the government (as well as the portal of public services) and six ministries - finance, healthcare, education, labor, social support, and ecology. The examination of websites is carried out as part of the preparation of the index, and they are evaluated from the point of view of information

filling, functionality, as well as their use to provide public services in electronic form and involve citizens in management processes.

The third index of the development of information and communication technologies (ICT Development index -IDI), developed in 2007 year by the International Union of Electro -Superior. The index is built on the basis of three Podindex-access to ICT, the use of ICT and ICT Reduces.

For calculating IDI, 11 indicators are used that characterize the penetration of fixed telephone communication, mobile cellular communication, broadband mobile and fixed Internet; access to computers and the Internet of households; the throughput of international channels of access to the Internet; the literacy level of the adult population and involvement in the education of youth. In the latest rating of the IDI index, the Republic of Uzbekistan rose to 8 positions compared to 2016 year and took 95th place (4.9) among 176 countries of the world.

The fourth index of world digital competitiveness (World Digital competiveness' index (WDCI), developed by the Swiss business school. This index reflects the readiness and ability of countries to adapt to the development of a digital economy.

The index is based on 50 criteria aggregated in three subornments: knowledge (education, science, talents), technology (regulation, level of communication development, export), readiness (adaptation, business flexibility).

The fifth index of digital evolution (Digital evolution index, DEI) is calculated according to the results of the study of inter -string differences conducted by the Institute for Study of Business in the Global Context of the Fletcher (USA, University of Taft) together with MasterCard. The basis of the index is 170 indicators combined in the following areas: consumer sentences and demand for digital technologies, institutional environment, innovative climate. In accordance with the value of the DEI of the country, they are divided into 4 groups: countries with a high level of development and preserving the growth rate of digitalization; countries with a high level of development, but slowed down growth; countries with a low level of development, but demonstrating confident growth; Low levels of development.

The sixth index - the index of the digital economy and society (DESI), was developed by the European Union to assess the level of development of the digital economy in the EU countries (28 countries). The index evaluates the progressiveness of countries in the direction of movement to the formation of a digital economy and digital competitiveness.

Work with the index provides the possibility of performing four types of analysis:

1. Analysis of the general characteristics of the results of the activities of individual member states by comparing their common index points;

2. Determination of areas in which, under certain state influences, an improvement in indicators can be achieved;

3. Assessment of progressiveness (regressiveness) of development by the method of dynamic comparisons;

4. Comparative analysis with the allocation of groups of countries with a close level of development and the development of measures to increase the level in accordance with the current state for each group. This index is complex and is calculated as the weighted average of the five components of its parameters with the release of individual indicators for each of them.

In addition, it can be shown, the telecommunication infrastructure index (Telecommunication Infra structure index - TII), which is formed on the basis of the following indicators per 100 residents of the country: the number of users of the Internet and stationary telephone lines, as well as mobile subscribers, wireless broadband and stationary broadband networks. Since 2016 year, the Republic of Uzbekistan has improved its indicators for this index from 0.246 to 0.472.

The global cybersecurity index is also compiled by the International Union of Electroxy and evaluates the level of state obligations in five areas: legal measures, technical measures, organizational measures, the development of potential and international cooperation. Since 2016 year, the Republic of Uzbekistan has improved its indicators in this rating from 0.1471 to 0.666 and rose from 93rd to 52nd place among 175 countries.

The mobile communications index is compiled by the International Association of Mobile Operators (or the GSMA Association), which also includes all the mobile operators of the Republic of Uzbekistan. The index shows the degree of development and use of mobile Internet. The index measures the indicators in more than 170 countries in comparison with key factors that contribute to the implementation of mobile Internet: infrastructure, accessibility, consumer readiness, content and services.

The index helps the mobile communication industry determine what your efforts should be concentrated on to contribute to the wider implementation of mobile Internet.

Over the past four years, the Republic of Uzbekistan has improved its indicators in this index from 36.9 to 46.8 and approached the medium -speed value of 50.

The complexity of the coverage of spheres, which are taken into account when calculating the index, allows you to monitor the state and evolution of digitalization processes, determine the competitive positions of states in this area, makes it possible to

annually identify quantitative and qualitative differences in the levels of development of digitalization processes.

By decree of the President of the Republic of Uzbekistan, "The Digital Uzbekistan-2030 strategy" provides for more than 280 projects of digital transformation of regions and sectors of the country's economy in the next two years. In the near future, the task of increasing the share of digital services in the country's GDP is by half. In the next two years, it is planned to attract about $2.5 billion for the development of digital infrastructure. The launch of three large new data centers in the cities of Tashkent (expansion by 5 PB and bringing up to 10 PB), Bukhara and Kokand (each by 50 PB), as well as the further expansion of a fixed telecommunication network and modernization of the mobile communications network. As a result, in each settlement for households, access to the Internet with a speed of at least 10 Mbit/s will be provided.

Given the experience of the fight against pandemic, it is planned to expand digitalization in the field of healthcare, the completion of the introduction of an electronic clinic and telemedicine in the regions of systems. The digital transformation of the banking sector will continue, including automated control systems and financial technologies. For the digitalization of agriculture, more than $600 million will be attracted to introduce modern agricultural technologies and innovative solutions.

Despite the initiation of state strategies for the development of a digital economy in the Republic of Uzbekistan, prerequisites for the transition to the economy of a new format were not fully formed. Among the main barriers that lead the development of a digital economy in the Republic of Uzbekistan, there are a lack of institutional infrastructure, significant digital inequality, insufficient information security, shortcomings in the training system of qualified personnel. At the moment, the task is to determine specific steps to accelerate the digitalization of society - what technologies and how should be applied, what are the factors of the effective development of the digital sphere and the electronic trade sphere, to what extent the development of the spheres of the digital economy in the republic is ensured.

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Issue Article

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SPIDER MITES IS A SERIOUS PEST OF LEMON PLANTS

Abstract: *In this article Vertimayk duo, em.k. (0.2 l/ha), Vertimek, KE (0.25-0.5 l/ha), and Agroplan neo 20% s.e.c. (0.3 l/ha) preparations were tested. According to the results of the conducted research, Vertimayk duo, em.k. 87.1% efficiency of the drug was observed by the 21st day, Vertimek, KE preparation up to 90.4% on the 21st day, Agroplan neo 20% s.e.c. and the drug was 86.0% effective by the 21st day.*

Key words: *Lemon plant, spider mite, development, distribution, damage, preparation and biological effectiveness.*

Language: *English*

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Introduction

UDC: 632: 632.5: 632.914

It is observed that citrus plants are severely damaged by several pests during the growing season, resulting in loss of yield and poor quality. Therefore, it is an urgent task to study the spread of pests in lemon plants grown in greenhouse conditions, to study the features of biological development and to determine the level of damage, and to develop effective measures to combat them.

Tetranychus urticae Koch belongs to the phylum Arthropoda, subphylum Chelicerophora, class Acaromorpha, order Acari, family Tetranychidae. This pest is widespread in the countries of Central Asia, China, Australia, Africa, South and North America, Western Europe and causes serious damage to plants [2, 3, 4].

The body of the spider mite has an oval shape and is 0.3-0.6 mm long. Its joints in spring and summer are blue-yellow, and those that emerge in winter are orange-red. Tetranychus urticae Koch emerges in early spring when the average overnight air temperature exceeds 7.3°C. The first generation of the pest develops in weeds, such as weeds [6].

T.urticae Koch is a polyphagous pest affecting 248 plant species belonging to 62 families. Of these, 173 species are weeds and wild grasses, 38 species are trees and shrubs, and 37 species are field crops [1, 5].

It settles on the back side of the leaves belonging to the spider mite and causes damage to it. On the upper roof of the affected leaves, pale spots are found, and brown and reddish spots are found in severely affected areas. Strongly broken leaves are woven, the plant becomes bare and becomes very weak [6].

In the fight against T. urticae Koch, the high efficiency of Spirodiclofen treatment preparations has been cleared during loads [9, 10].

Research location and methods.

The research was conducted in 2021-2022 in the greenhouses where lemon plants are grown belonging to Umidjon LLC located in Okdarya district of Samarkand region.

The tested drugs were used in 10 trees in 3 repetitions. Chemical treatment was carried out 3 times during the growing season, depending on the mechanism of action of the drugs used. Abbot's formula and methodological manuals on "Testing of insecticides, acaricides, biologically active substances and fungicides" were used to determine the biological effectiveness of drugs used against pests [7, 8].

Research results. Vertimek, KE 0.25-0.5 l/ha, against the spider mite found in lemon plants during research, Agroplan neo 20% s.e.c. Tested at a flow rate of 0.3 l/ha. As an example, Vertimayk dua, em.k. drug was selected (table). Anti-spider mite Vertimek, KE drug 0.25-0.5 l/ha 80.6-81.3% by the 3rd day, and 88.0-90.4% by the 21st day, biological efficiency was achieved.

Agroplan Neo 20% s.e.c. 77.8% biological efficiency was achieved on the 3rd day in the version where the drug was used at a consumption rate of 0.3 l/ha, and by the 21st day, this indicator was 86.0%.

Vertimayk dua in the template variation, em.k. 79.5% efficiency was achieved on the 3rd day when the drug was used at 0.2 l/ha, and on the 21st day this indicator was 87.1%.

In the control option, it was observed that the number of pests did not decrease. In short, Vertimek, KE (0.25-0.5 l/ha), Agroplan neo 20% s.e.c. (0.3 l/ha) and Vertimayk duo, em.k. (0.2 l/ha) allows to dramatically reduce the amount of pests when used correctly in the specified periods.

Table 1. Biological efficacy of preparations against spider mite on lemon plant field trial, Samarkand region, Akdarya district, Umidjon LLC, 2022.

№	Options (name of drugs)	Consumption rate, l/ha	The average number of mites per leaf, pcs					Biological efficiency in days, %			
			before processing	in the days after processing							
				3	7	14	21	3	7	14	21
1.	Control (not processed)	-	15,0	15,8	16,4	17	18,1	-	-	-	-
2.	Vertimayk prayer, em.k. (template)	0,2	14,8	3,2	2,8	2,6	2,3	79,5	82,7	84,5	87,1
3.	Vertimek, KE	0,25	15,2	3,1	2,8	2,4	2,2	80,6	83,1	86,1	88,0
		0,5	14,7	2,9	2,5	2,2	1,7	81,3	84,4	86,7	90,4
4.	Agroplan neo 20% s.e.c.	0,3	15,4	3,6	3,3	3,1	2,6	77,8	80,4	82,2	86,0

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Issue Article

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INVESTIGATION OF THE OSCILLATION OF AN ELASTIC ROD IN TIME TAKING INTO ACCOUNT THE RELAXATION PROPERTIES OF MATERIALS

Abstract: *In the present work, a mathematical model of oscillations of an elastic rod under the action of an external harmonic load is developed, taking into account the relaxation properties of the material and the resistance forces exerted by the rod to the process of changing its shape. The differential equation of the model was obtained taking into account the time dependence of stresses and strains in the formula of Hooke's law, reduced to the form of complicated Maxwell and Kelvin-Voigt models. The results of studying the model by the numerical method allow us to conclude that when the frequency of natural oscillations of the rod coincides with the frequency of oscillations of the external load, a resonance is observed, accompanied by an unlimited increase in the oscillation amplitude (in the absence of medium resistance).*

Key words: *elastic deformation, rod oscillations, relaxation coefficient, drag coefficient, resonant vibrations.*
Language: *Russian*
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ИССЛЕДОВАНИЕ КОЛЕБАНИЯ УПРУГОГО СТЕРЖНЯ ВО ВРЕМЕНИ С УЧЁТОМ РЕЛАКСАЦИОННЫХ СВОЙСТВ МАТЕРИАЛОВ

Аннотация: *В настоящей работе разработана математическая модель колебаний упругого стержня под действием внешней гармонической нагрузки с учётом релаксационных свойств материала и сил сопротивления, оказываемого стержнем процессу изменения его формы. Дифференциальное уравнение модели получено с учётом зависимости от времени напряжений и деформаций в формуле закона Гука, сведённой к виду усложнённых моделей Максвелла и Кельвина – Фойгта. Результаты исследований модели численным методом позволяют заключить, что при совпадении частоты собственных колебаний стержня с частотой колебаний внешней нагрузки наблюдается резонанс, сопровождающийся неограниченным возрастанием амплитуды колебаний (при отсутствии сопротивления среды).*

Ключевые слова: *упругая деформация, колебания стержня, коэффициент релаксации, коэффициент сопротивления, резонансные колебания.*

Введение

Вызванная некоторым возмущением упругая деформация твёрдого тела распространяется с зависящей от свойств среды скоростью. При этом волновой процесс колебания среды не сопровождается перемещением вещества. Уравнения, описывающие эти процессы, относятся к гиперболическому типу [1]. Применительно к техническим устройствам довольно часто встречается случай, когда процесс собственных колебаний, инициированный некоторым начальным смещением,

сопровождается приложенной на свободном конце стержня нагрузкой, действующей по определённому закону [2]. Особый интерес представляет нахождение резонансных возрастаний амплитуды колебаний, когда частота собственных колебаний совпадает с частотой колебаний приложенной к стержню нагрузки [3].

Постановка задачи и методика решения

В основе вывода дифференциального уравнения колебаний стержня, лежит закон Гука

$$\sigma = E\partial U / \partial x, \quad (1)$$

и второй закон Ньютона, выполненный в форме уравнения движения

$$\partial\sigma/\partial x=\rho\partial^2 U/\partial t^2, \quad (2)$$

где σ – нормальное напряжение, *Н/м²* ; *U* – перемещение, *м* ; *x*-координата, *м* ; *t* – время, *с* ; ρ – плотность, кг / м³ ; E – модуль нормальной упругости (модуль Юнга), *Па* ; $\varepsilon=\partial U / \partial x$ – деформация, *м* .

Подставляя (1) в (2), находим [4]

$$\frac{\partial^2 U(x,t)}{\partial t^2} = e^2 \frac{\partial^2 U(x,t)}{\partial x^2}, \quad (3)$$

где e $=\sqrt{E/\rho}$– скорость распространения продольного возмущения, *м* /с .

Уравнение (3) является волновым гиперболическим уравнением, описывающим незатухающие колебания упругих тел. Отсутствие затухания объясняется тем, что в данном уравнении отсутствует слагаемое, учитывающее внутреннее сопротивление, которое оказывает среда при воздействии на неё механической нагрузки, вызывающей упругие перемещения. Для учёта сопротивления среды примем, что сила сопротивления F_c пропорциональна скорости перемещения во времен

$$F_c=-r\partial U/\partial t, \quad (4)$$

где *r* − коэффициент сопротивления, *кг/с,* знак минус в формуле (4) означает, что сила сопротивления имеет направление, противоположное скорости перемещения. Подставляя (4) в уравнение второго закона Ньютона, находим

$$F=ma=m\frac{dv}{dt}=m\frac{d^2 U}{dt^2}=\rho S\Delta x\frac{d^2 U}{dt^2}, \quad (5)$$

с учётом того, что сила сопротивления F_c относится к объёмным силам, находим

$$\rho\frac{d^2 U}{dt^2} = \frac{d\sigma}{dx}-\frac{r}{V}\frac{dU}{dt}, \quad (6)$$

где F – сила, действующая на тело, *кг · м/с²* ; *m* – масса тела, *кг* ; *a= dv /dt* – ускорение, *м / с²* ; $\upsilon=dU/dt$ – скорость, *м/с*; *S* – площадь поперечного сечения тела, *м²* ; Δ*x* – длина элементарного участка, *м*; *V* – объём, *м³*.

Подставляя (1) в (6), находим волновое уравнение, описывающее затухающие колебания [5]

$$\frac{\partial^2 U}{\partial t^2} = e^2 \frac{\partial^2 U}{\partial x^2} - \gamma\frac{\partial U}{\partial t}, \quad (7)$$

где $\gamma = r /(\rho V)$ − коэффициент сопротивления, имеющий размерность 1/*с*. При выводе уравнения (6) использован закон Гука, в котором, как известно, отсутствует причинно – следственная связь явлений. Причиной (действующей силой) здесь является деформация $\varepsilon = \partial U/\partial x$, а следствием – напряжение σ . Отсутствие в формуле закона Гука временной переменной свидетельствует о том, что причина и следствие в данном случае не разделены во времени и, поэтому следствие с изменением причины наступает мгновенно (скачкообразно). Однако скорости распространения потенциалов любых физических полей не могут принимать бесконечных значений. В реальном теле процесс их изменения происходит с некоторым запаздыванием во времени согласно релаксационным свойствам материала, учитываемым коэффициентами релаксации.

Для учёта релаксационных свойств материала формулу (1) закона Гука представим в виде линейной комбинации производных напряжения и деформации по времени в произведении с соответствующими коэффициентами релаксации τ_1 и τ_2

$$\sigma+\tau_1\frac{\partial\sigma}{\partial t}+\tau_1^2\frac{\partial^2\sigma}{\partial t^2}+\cdots = E\left(\frac{\partial U}{\partial x}+\tau_2\frac{\partial^2 U}{\partial x\partial t}+\tau_2^2\frac{\partial^3 U}{\partial x\partial t}+\cdots\right), \quad (8)$$

где τ_1 , τ_2 – коэффициенты релаксации напряжения и деформации, *с* .

Ограничиваясь двумя первыми членами в правой и левой части, соотношение (8) приводится к виду

$$\sigma=E(\frac{\partial U}{\partial x}+\tau_2\frac{\partial^2 U}{\partial x\partial t})-\tau_1\frac{\partial\sigma}{\partial t} \quad (9)$$

Соотношение (9) полностью совпадает со стандартными моделями вязкоупругого тела, известными как модели Максвелла, Кельвина – Фойгта и реального тела [6]. Отметим, что соотношение (9) соответствует усложненной модели Максвелла и Кельвина – Фойгта, в которой добавляется третий элемент – пружина, расположенная параллельно к последовательно соединённым телам Гука и Ньютона (в модели Максвелла) и демпфер (расположенный параллельно к последовательно соединённым телам Гука и Ньютона) в модели Кельвина – Фойгта [7].

Модели Максвелла и Кельвина – Фойгта отличаются лишь различными формулами для коэффициентов релаксации τ_1 и τ_2 . Физический смысл этих моделей в том, что в них учитывается временная зависимость напряжений и деформаций и их взаимное влияние друг на друга. Совпадение модели (9) с моделями Максвелла, Кельвина – Фойгта и реального тела (с точностью до постоянных) свидетельствует [8] об использовании одинаковых исходных принципов.

Для вывода дифференциального уравнения, в котором учитывается изменение во времени напряжений и деформаций в формуле закона Гука, подставим (9) в уравнение движения (6)

$$\rho \frac{\partial^2 U}{\partial t^2} = E \frac{\partial^2 U}{\partial x^2} + E\tau_2 \frac{\partial^3 U}{\partial x^2 \partial t} - \tau_1 \frac{\partial}{\partial t}\left(\frac{\partial \sigma}{\partial x}\right) - \frac{r}{V}\frac{\partial U}{\partial t}$$

Заменяя в последнем соотношении величину $\partial\sigma/\partial x$ ее значением из (2), получаем

$$\tau_1 \frac{\partial^3 U}{\partial t^3} + \frac{\partial^2 U}{\partial t^2} = e^2 \frac{\partial^2 U}{\partial x^2} + e^2 \tau_2 \frac{\partial^3 U}{\partial x^2 \partial t} - \gamma \frac{\partial U}{\partial t} \quad (10)$$

Очевидно, что при $\tau_1 = \tau_2 = \gamma = 0$ уравнение (10) приводится к уравнению незатухающих колебаний (3).

Найдем решение краевой задачи о колебаниях стержня, один торец которого жестко закреплен, а на втором на единицу площади приложена сила F , изменяющуюся по косинусоидальному закону.

$$\frac{F}{ES} = \frac{\partial U(x,t)}{\partial x} = \cos(\omega t) \quad (11)$$

где S – площадь сечения стержня; $\omega = 2\pi\nu$, *1 с* – круговая частота.

В начальный момент времени стержень деформирован по линейному закону, согласно которому максимальное перемещение имеет свободный торец стержня. Математическая постановка задачи в данном случае имеет вид

$$\tau_1 \frac{\partial^3 U(x,t)}{\partial t^3} + \frac{\partial^2 U(x,t)}{\partial t^2} = e^2 \left[\frac{\partial^2 U(x,t)}{\partial x^2} + \tau_2 \frac{\partial^3 U(x,t)}{\partial x^2 \partial t}\right] - \gamma \frac{\partial U(x,t)}{\partial t}; \quad (12)$$

$$(t > 0,\ 0 < x < \delta$$

$$U(x,0) = b(\delta - x); \quad (13)$$

$$\partial U(x,0)/\partial t = D(\delta - x); \quad (14)$$

$$\partial^2 U(x,0)/\partial t^2 = 0; \quad (15)$$

$$\partial U(0,t)/\partial x = \cos(\omega t); \quad (16)$$

$$U(\delta,t) = 0, \quad (17)$$

где δ – длина стержня, *м* ; *b* – коэффициент, учитывающий начальное перемещение стержня; *D* – коэффициент, определяющий интенсивность изменения перемещения во времени при $t = 0$, $с^{-1}$.

Из начального условия (13) следует, что при $t = 0$ перемещение стержня линейно зависит от координаты *x*, принимая максимальное значение $U(0;0) = U_0 = b\delta$ в точке $x = 0$ и минимальное U(δ, 0) = 0, – в точке $x = \delta$. Введем следующие безразмерные переменные и параметры

$$\Theta = \frac{U}{U_0};\ \xi = \frac{x}{\delta};\ F_o = \frac{et}{\delta};\ F_1 = \frac{e\tau_1}{\delta};$$

$$F_2 = \frac{e\tau_2}{\delta};\ F_3 = \frac{\delta\gamma}{e};\ B = \frac{D\delta^2}{eU_0}, \quad (18)$$

где Θ – безразмерное перемещение ; ξ – безразмерная координата; F_o – число Фурье (безразмерное время);$U_0 = b\delta$; F_1,F_2 – безразмерные коэффициенты релаксации; F_3 – безразмерный коэффициент сопротивления среды; D – безразмерный коэффициент.

С учётом (18) задача (12) – (17) принимает вид

$$F_3 \frac{\partial\Theta(\xi,F_0)}{\partial F_0} + F_1 \frac{\partial^3\Theta(\xi,F_0)}{\partial F_0^3} + \frac{\partial^2\Theta(\xi,F_0)}{\partial F_0^2} = \frac{\partial^2\Theta(\xi,F_0)}{\partial\xi^2} + F_2 \frac{\partial^3\Theta(\xi,F_0)}{\partial\xi^2\partial F_0}; \quad (19)$$

$$(F_0>0;\ 0<\xi<1)$$

$$\Theta(\xi,0) = 1-\xi; \quad (20)$$

$$\frac{\partial\Theta(\xi,0)}{\partial F_0} = B(1-\xi); \quad (21)$$

$$\frac{\partial^2\Theta(\xi,0)}{\partial F_0^2} = 0; \quad (22)$$

$$\frac{\partial\Theta(0,F_0)}{\partial\xi} = F_4 \cos(F_5 F_0); \quad (23)$$

$$\Theta(1,F_0) = 0, \quad (24)$$

где $F_4 = \delta/U_0$; $F_5 = \omega\delta/e$; B – безразмерный коэффициент.

Для решения задачи (19) – (24) конечно – разностным методом в рассматриваемой области вводится пространственная сетка с шагами

$\Delta\xi = 0{,}005$, $\Delta F_0 = 0{,}005$ соответственно по переменным ξ и F_o так, что

$$\xi_k = k\,\Delta\xi,\ k = \overline{0,K};\quad Fo_i = i\Delta F_0,\ i = \overline{0,I}, \quad (25)$$

где K = 200, I = 50000 – число шагов по координатам ξ , Fo.

На сетке (25) вводятся сеточные функции $\Theta_k^i = \Theta(\xi_k, Fo_i)$. Используя принятую схему аппроксимации дифференциальных операторов, задача (19) – (24) записывается в виде

$$F_3 \frac{\Theta_k^{i+1} - \Theta_k^i}{\Delta F_0} + F_1 \frac{\Theta_k^{i+1} - 3\Theta_k^i + 3\Theta_k^{i-1} - \Theta_k^{i-2}}{\Delta F_0^3} + \frac{\Theta_k^{i-1} - 2\Theta_k^i + \Theta_k^{i+1}}{\Delta F_0^2} = \frac{\Theta_{k-1}^i - 2\Theta_k^i + \Theta_{k+1}^i}{\Delta\xi^2} + F_2\left(\frac{\Theta_{k-1}^i - 2\Theta_k^i + \Theta_{k+1}^i}{\Delta\xi^2\Delta F_0} - \frac{\Theta_{k-1}^{i-1} - 2\Theta_k^{i-1} + \Theta_{k+1}^{i-1}}{\Delta\xi^2\Delta F_0}\right);$$

$$\Theta_k^0 = 1 - \xi_k;\ \frac{\Theta_k^1 - \Theta_k^0}{\Delta F_0} = B(1-\xi_k);\ \frac{\Theta_k^0 - 2\Theta_k^1 + \Theta_k^2}{\Delta\xi} = 0;$$

$$\frac{\Theta_1^i - \Theta_0^i}{\Delta\xi} = F_4 \cos(F_5 Fo_i);\qquad \Theta^i{}_K = 0$$

Результаты выполненных исследований приведены на рис. 1 – 5. При $F_1 = F_2 = F_3 = 0$ колебания незатухающие при любых значениях коэффициента *B*. При $B = 0$, $F_3 = 0{,}3$ и $F_1 = F_2 = F_4 = F_5 = 0$ колебания становятся затухающими с экспоненциально уменьшающейся амплитудой (рис.1). С увеличением B изменяется профиль волн (рис. 2) и происходит уменьшение их амплитуды (в сравнении с вариантом, представленным на рис.1).

При $F_1 = F_2 = F_3 = 0$ и $F_4 = 0{,}5$, $F_5 = 1{,}575$ безразмерная частота собственных колебаний стержня $\nu = 1{,}575$ совпадает с частотой вынужденных колебаний, возникающих под действием внешней нагрузки вида (23). При этом наблюдается неограниченное возрастание амплитуды колебаний (рис. 3) при любых значениях коэффициента *B*. С увеличением коэффициента сопротивления среды F_3 амплитуда колебаний стержня уменьшается и при каком-то большом его значении ($F_3 \geq 100$) возврат стержня в исходное состояние происходит практически при отсутствии колебательного процесса внутренних

точек стержня при неизменной амплитуде колебаний внешней нагрузки(рис.4).

В случае учета сопротивления среды и релаксационных свойств материала при совпадении частоты собственных колебаний стержня и частоты колебаний внешней нагрузки (резонансные колебания) могут возникать явления бифуркационного резонанса в затухающих и незатухающих процессах колебаний [9-10].

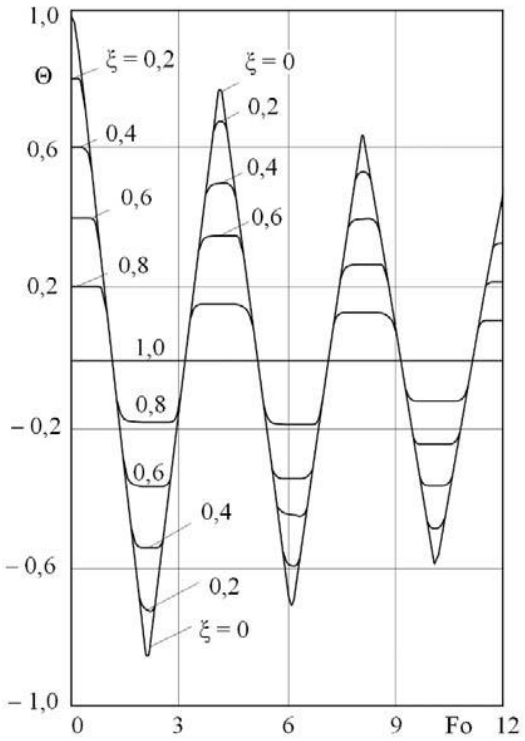

Рисунок 1 – Изменение перемещений стержня во времени (затухающие колебания)

B = 0; $F_1 = F_2 = F_4 = F_5 = 0$; $F_3 = 0,3$

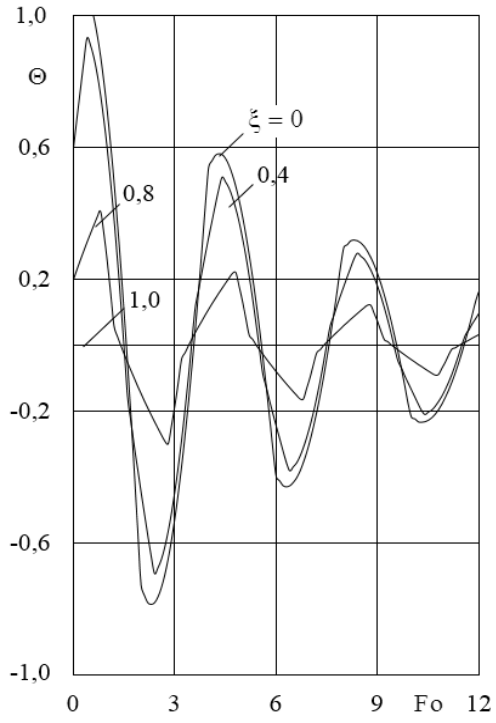

Рисунок 2 – Изменение перемещений стержня во времени (затухающие колебания);

B = 1,5 ; $F_1 = F_2 = F_4 = F_5 = 0$; $F_3 = 0,3$

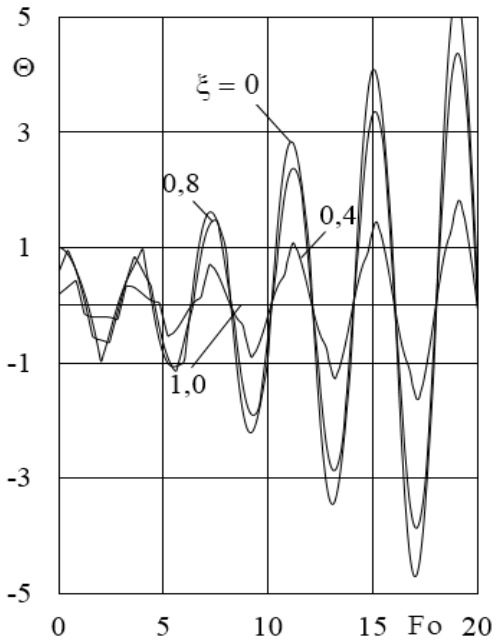

Рисунок 3 – Изменение перемещений стержня в резонансных частотах:

B = 1,5; $F_1=F_2=0$; $F_3=100$; $F_4=1$; $F_5=1,575$

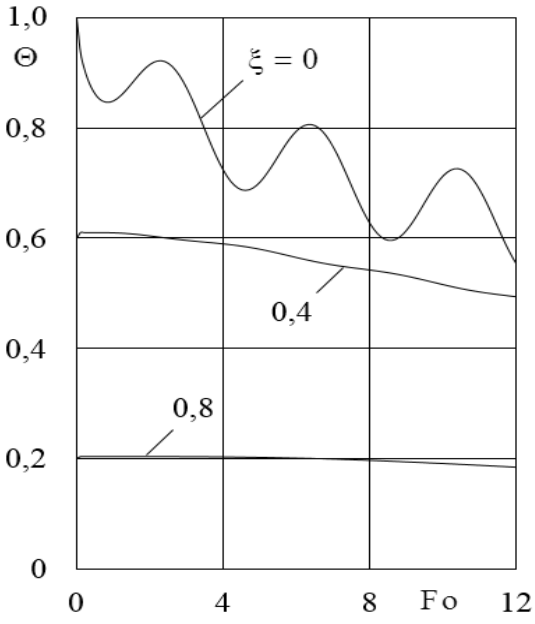

Рисунок 4 – Изменение перемещений в резонансных частотах:

B = 1,5 ; $F_1=F_2=F_3=0$; $F_4=0,5$; $F_5=1,575$

На рис. 5 приведены результаты расчетов для случая резонансных колебаний (F_5 = 1,575) при B = 0, F_1=F_2=0,1и F3 = 0,3 . Их анализ позволяет заключить, что в диапазоне 0 ≤ F_o ≤ 9 амплитуда колебаний экспоненциально уменьшается. Затем в диапазоне 9 ≤ F_o ≤ 25 она возрастает, стабилизируясь на отметке A= 0,4 при незатухающем во времени процессе колебаний.

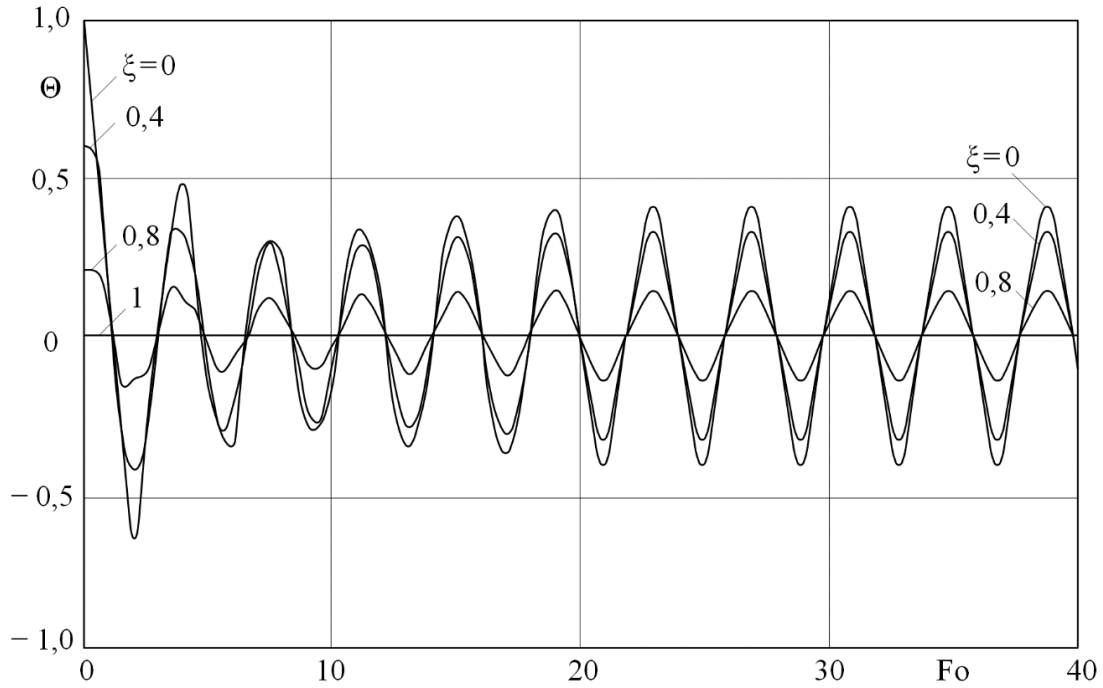

Рисунок 5 – Изменение перемещений стержня в резонансных частотах при B = 0 ;
F_1 = F_2 = 0,1; F_3 = 0,3; F_4 = 0,1; F_5 = 1,575

Выводы

1. В случае равенства нулю коэффициента сопротивления среды и коэффициентов релаксации процесс колебаний стержня является затухающим, а форма профиля волны зависит от коэффициента *B* (рис. 1, 2).

2. При совпадении безразмерной частоты собственных колебаний стержня (ν = 1,575) с частотой колебаний внешней нагрузки (F_5 = 1,575) для случая, когда F_1=F_2=F_3=0, при любых значениях коэффициента *B*, наступает резонанс, при котором происходит неограниченное возрастание амплитуды колебаний (рис. 3).

3. При больших значениях коэффициента сопротивления среды (F_3 ≥ 100) наблюдается критическое затухание процесса колебаний (рис. 4).

4. В условиях резонансных колебаний (F_5 =1,575) при F_1=F_2=0,1 и F_3 = 0,3 амплитуда колебаний сначала уменьшается (Fo ≤ 9), а затем (при Fo > 9) возрастает, стабилизируясь на отметке A = 0,4 (при Fo > 25), в незатухающем во времени процессе колебаний (рис. 5).

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Issue Article

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ON THE ROLE OF JUVENAL JUSTICE IN THE KYRGYZ REPUBLIC

Abstract: *The article presents information and statistical data necessary to indicate the role and place of legal provision of guarantees of medical care for minors in Kyrgyzstan. For the protection of the health of minors is a priority area of state policy to strengthen, maintain a long-term active life of a person through various activities, including the creation of favorable conditions for work, life, recreation, education and training of future citizens, quality nutrition - includes the production and sale of food, provision of affordable medical and social assistance to the population.*

Key words: *minors, law, convention, monitoring, medical care, health of minors.*

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Introduction

The Constitution of the Kyrgyz Republic is a normative act that has the highest legal force in Kyrgyzstan. It defines the foundations of the constitutional order of the state and the legal status of the individual as a citizen. The legal capacity of a citizen arises from the moment of birth and accompanies the citizen throughout his life. Legal capacity does not depend on the age, state of health, the possibility of exercising rights and obligations, the legal capacity of a person. The Constitution of the Kyrgyz Republic proclaimed human rights and freedoms as the highest value.

Article 20 of the Constitution of the Kyrgyz Republic states that children are the most valuable asset of the Kyrgyz Republic, that the state creates conditions for the comprehensive development (physical, intellectual) of children, and article 19 of the same law states that the Kyrgyz Republic develops a system of medical care [1].

One of the fundamental rights - the right to free use of the network of public health organizations is enshrined in Article 43 of the Constitution of the Kyrgyz Republic. In accordance with Article 41 of the National Program of State Guarantees for Providing Citizens with Medical and Sanitary Care[2] in the Kyrgyz Republic, the provision of citizens with medicines in stationary conditions is carried out at the expense of the state budget, compulsory medical insurance funds, special funds, co-payments, as well as humanitarian aid and other means not prohibited by the legislation of the Kyrgyz Republic.

Health protection - its strengthening, maintenance of long-term active human life through various types of activities, including environmental protection, creation of favorable conditions for work, life, recreation, education and training of citizens, quality nutrition - includes the production and sale of food products, the provision of affordable medical and social assistance to the population.

Despite the general wording of Article 19 of the Constitution, the laws of the Kyrgyz Republic pay special attention to the health of children. For example, Article 9 of the Children's Code of the

Kyrgyz Republic establishes the rights of minors to health protection: to dispensary observation and treatment when providing services to children and adolescents; research and work in conditions that correspond to the physiological characteristics and state of health of minors and exclude the influence of unfavorable factors on them; Special mention is made of obtaining the necessary information about the state of health and some other rights available to children.

The same article of the Code emphasizes that the state healthcare system guarantees children, in accordance with the procedure established by law, accessible and qualified medical care, which provides for the prevention of diseases, medical diagnostics, medical and recreational work, including dispensary observation, medical rehabilitation of disabled children and children suffering from chronic diseases. , as well as medical and rehabilitation treatment of children.

The law prohibits clinical trials of medicinal products for minors in order to protect the health of children, except in cases where the medicinal product is intended only for the treatment of childhood diseases or the purpose of clinical trials is not to obtain information on the best dosage of the medicinal product for the treatment of minors [3].

The Code of the Kyrgyz Republic on Children dated July 10, 2012 No. 100 is a legal act that defines the range of fundamental rights, freedoms and obligations of minors in all spheres of public life. The Code establishes the basic guarantees of the rights and legitimate interests of children, provided for by the Constitution of the Kyrgyz Republic and the United Nations (UN) Convention on the Rights of the Child.

Neither the Children's Code nor other regulatory legal acts contain the concept of "children of labor migrants", but there is a definition of "children left without parental care and in a difficult life situation." According to Article 5 of the Code of the Kyrgyz Republic “On Children” and the Law of the Kyrgyz Republic of December 19, 2001 No. 111 “On the Fundamentals of Social Services for the Population”, the provision, along with children with disabilities, children are victims of armed and interethnic conflicts, this category includes children with disabilities in behavior, as well as children whose lives are disrupted as a result of circumstances and who cannot overcome these circumstances on their own or with the help of a family.

Therefore, it is obvious that a child living separately from his parents due to internal or external labor migration cannot independently get out of the situation of the impossibility of obtaining basic services, such as education and health care, social and legal public services. This Law [4] contains a list of categories of persons entitled to receive social services. However, this Law does not contain a direct reference to the children of migrant workers living separately from their parents as subjects of social services. The children of some migrants may be in a good or sufficient financial situation, but they are also in a very difficult psychological situation. Therefore, children of labor migrants should receive the status of a child in a difficult life situation in order to receive social and legal services, material assistance, and social adaptation.

Consider some cases of leaving children unattended. For example. The child was abandoned by his parents and grandmother. At the same time, the grandmother was not appointed as a guardian in accordance with Article 76 of the Children's Code of the Kyrgyz Republic. In fact, a grandmother cannot make any decisions about her grandchildren. Thus, if an emergency operation is necessary for a child, in accordance with Article 74 of the Law of the Kyrgyz Republic “On protecting the health of citizens in the Kyrgyz Republic”, only their legal representatives should give consent to medical intervention of persons under the age of 16 [5]. According to Article 68 of the Family Code of the Kyrgyz Republic, parents have the right and obligation to raise their children, are responsible for their upbringing and development, and therefore are obliged to take care of health, physical, mental, spiritual and moral development [6]. Therefore, in this case, a parent who is not a legal representative does not have the right to make a decision on medical intervention in relation to the child.

Consider the following statistics based on research conducted by UNICEF [7]. Out of 22 children of labor migrants abroad, 13 children (59%) were adopted and lived with their grandparents, 6 children (27%) lived with their relatives - with uncles and aunts. The remaining 3 children (13%) reported living with their siblings. These data are consistent with the responses of the guardians - the guardians were mostly the grandparents of the children of migrant workers (39 out of 52 guardians or 75%). In 8 cases (15.4%) the guardians of the children were uncles and aunts, and in 5 cases (9.6%) older brothers. Of the 52 guardians surveyed, only 10 (19.2%) were officially registered as guardians. The remaining 41 guardians (78.8%) were not specially registered, and in the remaining 1 case the situation was different.

As a result of migration, social orphanhood has increased dramatically, and minors are subjected to physical and other forms of violence. Young children are at risk of suicide, crime or delinquency.

In addition, the situation of orphans and children left without parental care in boarding schools causes serious concern, that is, the requirements of the law on proper funding of these institutions are not everywhere observed. The weakness of laws and the arbitrariness of state bodies make it impossible for social orphans to exercise their constitutional rights to education, health care and medical care, leaving them

without identity documents and property.

According to the Ministry of Health, in 2018, 50 minors were admitted with signs of violence, of which 23 were boys and 28 were girls; in 2017, 55 such cases were registered, of which 32 were boys and 23 were girls.

In the period from 2009 to 2018, an analysis conducted by the Ministry of Health of the Kyrgyz Republic showed that in most cases violence against minors had the following indicators: by the father - 163, by the mother - 47, by the stepfather. - 49, from a stepmother - 8, from a relative - 55, from a teacher - 8, from a neighbor - 34, from others - 59, from unknown people - 41, from police officers - 2 cases [8].

Also, according to the analysis, it became known that the main reason for the above cases of violence against children is the loss of the institution of the family, family values, lack of knowledge and skills to be responsible parents. The increase in cases of violence against children indicates the weakness of preventive measures to address the causes of violence against children. Measures at the level of state and municipal authorities on child protection issues cannot respond to the current situation.

State and municipal authorities should promptly identify all children left without parental care, especially children of labor migrants. It is important for the state to know about every child in the country, especially when their rights are violated, and their life and health are in danger.

E.A.Salamakhina stated that “no country in the world can show itself as an example in the field of protecting the rights of the child. Even the most democratic and economically developed countries are characterized by an increase in juvenile delinquency, the presence of families with a low standard of living, child mortality due to insufficient medical care, and the growth of street children. "Even the rise in juvenile delinquency, the presence of families with a low standard of living, the death of children due to lack of medical care and the increase in the number of abandoned children are characteristic of the most democratic and economically developed countries." However, even if we are convinced of the essence of this statement, we voluntarily or involuntarily agree with the opinion of T.V.Lobanova: “The problems of realizing and protecting the rights of children may be the same for different countries, but the quantitative and qualitative characteristics of these problems are completely different”[10].

The proportion of young people in Kyrgyzstan is relatively high: teenagers (under 19 years of age) make up almost a fifth of the population, and currently more than half of the country's population is under 25 years of age. Most of them live in rural areas and have limited access to healthcare, education, social assistance and recreation.1

Child survival rates in Kyrgyzstan have improved in recent years as a result of investment in infant and under-five health care. Until now, adolescent health has not been a national priority, but reducing child mortality allows a focus on adolescent health to ensure progress made in early childhood continues through the second decade of life towards adulthood.

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Issue Article

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MULTILATERAL COOPERATION TO CREATE A NUCLEAR WEAPONS-FREE ZONE IN CENTRAL ASIA

Abstract: *This article examines the multilateral cooperation of the newly independent states of the Central Asian region to ensure stability and strengthen peace in the region, reveals the assistance of the countries of the region to international efforts to ensure global and regional security, their participation in international agreements and treaties in the field of disarmament and non-proliferation of weapons of mass destruction. The article pays special attention to the initiatives of Uzbekistan and other countries of the region to create a nuclear-free zone in Central Asia.*

Key words: *Central Asia, nuclear-free zone, globalization, stability, international terrorism, weapons of mass destruction.*

Language: *English*

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Introduction

Since gaining independence, Uzbekistan and other countries of the region are pursuing a comprehensively balanced foreign policy based on national interests, which has received wide recognition in the world community.

One of the main tasks of the foreign policy activity of the states of the region is the preservation and strengthening of peace and stability in Central Asia (CA), the transformation of the region into a zone of security and sustainable development to the heads of state and parliaments of the countries that recognized the state independence of Uzbekistan, in which it was noted that «considering the strengthening of international security as a priority, the Republic of Uzbekistan expresses its determination to pursue a responsible balanced policy in the military field and reaffirms its readiness to accede to the Treaty on the Non-Proliferation of Nuclear Weapons» [1].

The states of the region actively contribute to international efforts to ensure global and regional security. Realizing the threat to humanity throughout its history posed by the dangers arising from armed conflicts, especially in the 20th century with the use of weapons of mass destruction (WMD), the countries of the region became parties to all important international agreements and treaties in the field of disarmament and non-proliferation, in particular, the Treaty on the Non-Proliferation of Nuclear Weapons, the Comprehensive Nuclear-Test-Ban Treaty, the conventions on chemical and biological weapons, and others. Moreover, in the light of awareness of the possible consequences of a nuclear and, consequently, environmental catastrophe, the closure by Kazakhstan in August 1991 of an important strategic facility located on the territory of Central Asia – the Semipalatinsk nuclear test site, as well as put forward by Uzbekistan in September 1993 on the 48th session of the UN General Assembly, an initiative to create a nuclear-weapon-free zone in Central Asia (CAWFZ), which is an effective measure to strengthen the nuclear non-proliferation regime in the region.

At the same time, in the conditions of the modern world, when armed conflicts are intensifying in various regions, the problems of international terrorism, WMD proliferation, and other threats that

do not recognize national borders are aggravated, the Central Asian states, in the framework of cooperation with influential international and regional organizations, actively participate in the discussion and resolution of issues global and regional nature, and also focus the attention of the world community on the acute problems of ensuring stability and security in the Central Asian region. Preserving and strengthening peace and stability in Central Asia, turning the region into a zone of security and sustainable development, and strengthening the international WMD non-proliferation regime are designated among the priority areas of foreign policy activities of the Republic of Uzbekistan and other countries of the region.

Prevention of the threat of proliferation of weapons of mass destruction in the former USSR

As you know, one of the most important modern security problems of the world community is the issue of nuclear disarmament. The collapse of the Soviet Union exacerbated the problem of nuclear arms control since the nuclear weapons of the former USSR ended up on the territory of four new independent states – Russia, Ukraine, Belarus, and Kazakhstan.

For the Central Asian region, the relevance of this problem was that by the beginning of the 90s. In the last century, a huge arsenal of weapons of mass destruction was concentrated on the territory of Kazakhstan: 1040 nuclear warheads for intercontinental ballistic missiles and 370 warheads for air-launched cruise missiles [2, p. 49]. The most important strategic object was the Semipalatinsk test site, where hundreds of nuclear and thermonuclear explosions were carried out over the course of half a century. And the experience of the only use of nuclear weapons in history (1945) showed the whole world that this weapon poses a threat to the security and even the existence of all mankind.

Under these conditions, with the beginning of the formation of the Commonwealth of Independent States (CIS) in its fundamental documents, in particular, in the Declaration of Alma-Ata signed on December 21, 1991, to ensure international strategic stability and security, it was determined that the CIS would maintain a united command of strategic military forces and unified control over nuclear weapons. The Declaration also stated that the parties would respect each other's aspirations to achieve the status of a nuclear-free and (or) neutral state. In addition, the signed document declared that "with the formation of the Commonwealth of Independent States, the Union of Soviet Socialist Republics ceases to exist" and that "the member states of the Commonwealth guarantee, by their constitutional procedures, the fulfillment of international obligations arising from treaties and agreements of the former USSR" [3].

In the initial period of the formation of the CIS, military-political problems were the central issues of the Commonwealth. It was necessary, along with other issues, to resolve the most complex issues of settling the Soviet nuclear legacy. In this regard, on March 20, 1992, at the summit of the Council of CIS Heads of State in Kyiv, in order to ensure the security of the CIS member states, maintain control of strategic forces and prevent conflicts, the "Decision on the High Command of the Joint Armed Forces of the Commonwealth", [4] including Strategic the CIS forces and the General Purpose Forces, as well as the "Agreement on the Joint Armed Forces for a transitional period"[5]. In accordance with these documents, the temporary control of strategic nuclear weapons located on Ukrainian, Belarusian and Kazakh territory was carried out by the Commander of the CIS Strategic Forces.

At the same time, with the collapse of the Soviet Union, the Soviet-American START-1 treaty signed in Moscow in the summer of 1991 [6] could not enter into force without its ratification by not one state – the USSR, but by four – Russia, Ukraine, Belarus and Kazakhstan, on whose territories the nuclear weapons of the former Soviet Union were located. In this regard, representatives of the United States, Russia, Ukraine, Belarus, and Kazakhstan on May 23, 1992, in Lisbon signed the Protocol [7] to the Soviet-American START-1 treaty, according to which the last three countries agreed to assume the obligations of the former USSR under the START treaty -1 and pledged to accede to the Treaty on the Non-Proliferation of Nuclear Weapons as non-nuclear countries. On December 5, 1994, the START-1 Treaty entered into force. And by the mid-1990s, adhering to the status of non-nuclear-weapon states defined in the Lisbon Protocol, Kazakhstan, Ukraine, and Belarus transferred the nuclear weapons located on their territory to the Russian Federation. Russia has become the sole internationally recognized successor to the Soviet Union's nuclear arsenal.

The First President of Kazakhstan N. Nazarbayev, commenting on the issue of transferring nuclear weapons to the Russian side, noted that he had to make difficult decisions at that time, which were not dictated by the political situation. "First of all, the case concerned vital issues. Too many on our earth have experimented with the «nuclear genie». For forty years, 752 nuclear explosions were carried out at the Semipalatinsk test site: 26 in the atmosphere, 78 on the ground, and the rest underground. Nearly half a million people have been directly or indirectly affected by these nuclear weapons tests. In December 1991, when the Soviet superpower collapsed, Kazakhstan got a huge nuclear potential – the fourth largest in the world in terms of its capacity. We had to make a choice, guided by a civilized approach to this problem. From the first days of its existence, our country declared its commitment to the principles of peace. Only Russia could, as a great power, claim

ownership and real control of this former nuclear complex"[8].

Initiatives to create a nuclear-weapon-free zone in the region

In modern conditions, when full-scale hostilities and armed conflicts are taking place in various regions of the world, the problems of terrorism, extremism, and the uncontrolled proliferation of various types of weapons are aggravating, one of the most important problems in ensuring international security is the nonproliferation and elimination of existing nuclear arsenals.

At the global level, a multilateral international act, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), developed in 1968 by the UN Disarmament Committee, was called upon to put a barrier to the spread of nuclear weapons.

The participants of this Treaty are 190 states of the world, including five newly independent states of Central Asia that signed the NPT: the Republic of Uzbekistan – May 7, 1992; the Republic of Kazakhstan – May 20, 1994; Kyrgyz Republic – July 5, 1994; Turkmenistan – September 29, 1994; Republic of Tajikistan – January 17, 1995[9].

The NPT is a fundamental treaty in ensuring global peace and security, preventing the threat of nuclear proliferation, and the peaceful use of nuclear energy.

At the same time, the creation of nuclear-weapon-free zones (NWFZs) is an effective measure to strengthen the international nuclear non-proliferation regime at the regional levels. The right of any group of states to conclude regional treaties to ensure the complete absence of nuclear weapons in their respective territories" is enshrined in Article VII of the Treaty on the Non-Proliferation of Nuclear Weapons [10].

Unlike the NPT, the nuclear-free zones that are being created not only prohibit the production and acquisition of nuclear weapons but also prohibit their deployment by nuclear powers on the territory of the NWFZ. In addition, participants in nuclear-free zones receive legally binding security guarantees from nuclear powers, which non-nuclear participants in the NPT are deprived of.

For the first time, a nuclear-weapon-free zone was created by the signing in 1967 of the Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (the so-called Treaty of Tlatelolco). After the ratification of the relevant document by Cuba in 2002, the Latin American and Caribbean nuclear-weapon-free zone includes all the states of this region. After this agreement, three more treaties on the establishment of NWFZs were signed: in the South Pacific (Treaty of Rarotonga, 1985), in Southeast Asia (Treaty of Bangkok, 1995), and Africa (Treaty of Pelindaba, 1996). By these treaties, the entire populated part of the southern hemisphere has a status free from nuclear weapons. In addition, Mongolia has the status of a nuclear-free state (1998).

The beginning of the policy of creating a nuclear-weapon-free zone in the Central Asian region was the closure of the Semipalatinsk nuclear test site by Kazakhstan on August 29, 1991, and eighteen years later, on the initiative of the Republic of Kazakhstan, the UN General Assembly on December 2, 2009, by adopting resolution 64/35, announced 29 August International Day against Nuclear Tests[11].

For the first time, a proposal to create a zone free of nuclear weapons in Central Asia was put forward by the President of Uzbekistan I. Karimov on September 28, 1993, during the 48th session of the United Nations General Assembly. Speaking from the rostrum of the UN, the head of state said that "Uzbekistan stands for the complete elimination of nuclear weapons, for effective actions and the extension without a term of the Treaty on the Non-Proliferation of Nuclear Weapons. The Republic is a staunch supporter of declaring the Central Asian region a nuclear-free zone"[12].

This initiative of Uzbekistan received wide recognition and support in the world community and fully met the interests of the countries of the region on the path of nuclear-free development and active counteraction to the threats of uncontrolled proliferation of weapons of mass destruction. However, the practical implementation of the idea of creating an NWFZ in Central Asia required long and painstaking work on the part of both the Central Asian states and the nuclear powers and relevant UN structures.

On May 1, 1995, the Kyrgyz Republic also made a proposal to create an NWFZ, in which it was noted that the nuclear-free zone being created would contribute to peace, stability, and security in the region. Kyrgyzstan's statement emphasized that "the region is located on the border between two powerful nuclear states (Russia and China – S.R.). The hope was expressed that the creation of the NWFZ would encourage them to reduce their nuclear arsenals and to soften the policy of nuclear deterrence"[13, p.41].

In February 1997, the heads of the five Central Asian states at a meeting in Kazakhstan signed the Almaty Declaration, in which they unanimously supported the initiative to create a nuclear-weapon-free zone, and also called on the eve of the 50th anniversary of the Semipalatinsk test site, all interested countries to support the idea of declaring Central Asia a nuclear-free zone open for accession by other states [14].

This document confirmed the desire of all Central Asian states for the nuclear demilitarization of the region, and from that moment on, the creation of a nuclear-weapon-free zone in Central Asia acquired the character of a regional initiative.

The NWFZ initiative received further conceptual development during the International

Conference "Central Asia – a Nuclear Weapons Free Zone" held in Tashkent in September 1997, which made it possible, through the joint actions of many countries and international organizations, to transfer the construction of a nuclear safety zone into practice.

Representatives of 56 states of the world and 16 international organizations took part in the work of the Tashkent conference. Among them: are the UN, the European Union, the Organization for Security and Cooperation in Europe (OSCE), the Organization of the Islamic Conference (OIC), the North Atlantic military bloc (NATO), the International Atomic Energy Agency (IAEA), and others.

During the Tashkent Conference, Russian First Deputy Minister of Foreign Affairs Igor Ivanov voiced the position of the Russian Federation on the political support of the CWFZ[15, p.41].

As a result of this conference, a Regional Expert Group was established to prepare the Treaty on the CANWFZ.

The activity of the Central Asian states in the formation of a nuclear-free zone was actively supported by the UN, the IAEA, and other international organizations. In particular, UN General Assembly resolutions 52/38S of December 9, 1997, 53/77A of December 4, 1998, 55/33W of December 20, 2000, 57/69 of November 22, 2002, 58 /518 of December 8, 2003, 59/513 of December 3, 2004, and 60/516 of December 8, 2005, titled «Establishment of a nuclear-weapon-free zone in Central Asia», demonstrating international support Central Asian states to create a zone free of nuclear weapons, contributing to the strengthening of peace and stability at the regional and global levels. The document of the General Assembly of December 9, 1997, also contains an appeal to the UN Secretary-General to provide, within the available resources, assistance to the Central Asian states in developing forms and elements of an agreement on the creation of a regional nuclear safety zone. The initiators of these resolutions of the UN General Assembly were the newly independent states, and members of the UN – Uzbekistan, Kazakhstan, Kyrgyzstan, Turkmenistan, and Tajikistan.

In July 1998, a consultative meeting of experts from the Central Asian states, the five nuclear powers, and the UN was held in Bishkek, as a result of which practical work began on the development of the text of the Treaty on a nuclear-weapon-free zone in Central Asia.

Subsequently, experts from the five Central Asian republics, with the active assistance of the UN Department for Disarmament Affairs and IAEA experts, developed a draft of the future treaty at meetings in Geneva, Tashkent, Sapporo, and Samarkand, which was subjected to comprehensive discussion. In September 2002, the first draft of the Treaty was agreed upon in Samarkand, which was submitted for consideration to the countries of the «nuclear five».

As a result of intensive consultative meetings and negotiations with the nuclear powers on the text of the draft Treaty, at the seventh meeting of the Regional Expert Group, held on February 7-9, 2005 in Tashkent, the common position of the countries of the region on the text of the Treaty was agreed upon, taking into account the proposals and comments of the nuclear powers, IAEA and the UN Office of Legal Affairs. And the signing of the historic Treaty on a nuclear-weapon-free zone in Central Asia by Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan took place on September 8, 2006, in Semipalatinsk. It is necessary to note the symbolism of the place of signing this document on the territory of Kazakhstan, which suffered the most from long-term nuclear tests at the test site of the same name. The UN General Assembly hailed the CANWFZ Treaty as an important step in strengthening regional and international peace and security.

The agreement entered into force on March 21, 2009, after ratification by the parliaments of the Republic of Uzbekistan (10.05.2007), the Kyrgyz Republic (27.07.2007), the Republic of Tajikistan (13.01.2009), Turkmenistan (17.01.2009) and the Republic of Kazakhstan (19.02.2009) and is indefinite.

It should be noted that the Treaty makes a huge contribution not only to strengthening regional security but also to the international regime for the non-proliferation of weapons of mass destruction. The treaty provides that all its participants refuse to develop, manufacture or otherwise acquire nuclear weapons, possess or control them, refrain from deploying or transporting nuclear weapons by any means, from testing or using nuclear weapons, and also undertake not to allow such actions by other states on their territory. . At the same time, this Treaty does not prohibit the use of nuclear energy for peaceful purposes.

Obligations of nuclear powers on security guarantees to the countries of Central Asia

It should be noted that the final international legal formalization of the Treaty on the Establishment of a Nuclear-Weapon-Free Zone in Central Asia receives after the signing by the states officially possessing nuclear weapons – Great Britain, China, Russia, the United States, and France – obligations on security guarantees to the states of the region.

On May 6, 2014, a historic event took place at the UN Headquarters in New York – for the first time since the creation of the Organization, representatives of the «nuclear five» unanimously and simultaneously signed the Protocol on Security Assurances to the Treaty.

In his statement, the then UN Secretary-General Ban Ki-moon welcomed the signing at the UN Headquarters in New York by representatives of the

nuclear-weapon states of an additional Protocol on Security Assurances to the Treaty on a Nuclear-Weapon-Free Zone in Central Asia, and the high UN Representative for Disarmament Affairs Angela Kanne stressed that today's event was an important milestone in strengthening both regional security in Central Asia and the global nuclear non-proliferation regime[16].

The signing ceremony was also attended by the Permanent Representatives to the UN of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

Speaking at the signing ceremony of the Protocol, the Permanent Representative of the Republic of Uzbekistan to the UN Muzaffar Madrakhimov expressed hope that this act would strengthen regional and global security. «Nuclear-weapon-free zones have become one of the most effective ways to limit proliferation and respond to potential future nuclear catastrophes while ensuring nuclear security and strengthening the non-proliferation regime has become one of the most important international security issues facing the world,» he said. Aksoltan Atayeva, Permanent Representative of Turkmenistan to the UN, said that the signing of the Protocol on negative assurances is the result of many years of work, and "for us, today's Protocol is another huge step towards promoting this Treaty"[17].

The signing by the "nuclear five" of an additional Protocol to the Treaty marked the completion of the process of consultations on the issue of providing security guarantees to the Central Asian states. Namely, in accordance with this Protocol, the states of the "nuclear five" undertake not to use nuclear weapons or threaten to use them against the states parties to the Treaty, and also not to assist in any act constituting a breach of the Treaty, i.e. not to test, support or encourage the testing of any nuclear explosive device, its deployment or transportation within the nuclear weapons free zone in Central Asia.

It is noteworthy that the nuclear-weapon-free zone created in Central Asia differs significantly from all nuclear-free zones existing in the world. In particular, this is the first nuclear-free zone created in a region where nuclear weapons previously existed and were tested, the consequences of which the people living in this territory feel to this day. In addition, the Central Asian zone directly borders two officially nuclear-weapon states, Russia and China, and neighbors two major de facto nuclear-weapon states, India and Pakistan.

Conclusion

Thus, an analysis of the historical processes of the initial post-Soviet period and the formation of newly independent states shows that the priority and necessary measures taken within the CIS made it possible to control and prevent the proliferation of WMD in Soviet arsenals. And in the issues of the liberation of the territory of Central Asia from nuclear weapons, along with the actions of Kazakhstan, on whose territory there were nuclear weapons, close and successful cooperation between the Russian Federation and the United States of America, of course, played a big role.

The initiative to create a nuclear-weapon-free zone in Central Asia, first announced at the UN by Uzbekistan and supported by the countries of the region, became possible thanks to the joint constructive efforts of all five Central Asian states – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – in their desire to ensure security and stability and peace in the Central Asian region. It is generally accepted that the member states of the nuclear-weapon-free zone undertake not to transfer or accept from anyone nuclear weapons or other nuclear explosive devices, manufacture or otherwise acquire nuclear weapons, or accept any help in its production. Consequently, this event was an important contribution to strengthening the nuclear non-proliferation regime, encouraging cooperation in the peaceful use of nuclear energy, and environmental rehabilitation of territories affected by radioactive contamination.

It should also be noted that in the context of the stagnation of the process of global nuclear disarmament, the creation of the CANWFZ is a real and significant contribution of the countries of the region to the implementation of the goals of the Treaty on the Non-Proliferation of Nuclear Weapons, to strengthening regional and international peace and security, as well as preventing nuclear materials and technologies from falling into the hands of international terrorist organizations.

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Issue Article

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FUSARIOSIS DISEASE OF LEMON PLANTS

Abstract: *Researches have been conducted to identify the fungi that cause Fusarium disease in lemon plants. According to the research results, Fusarium oxysporum f., belonging to the Fusarium family, which causes Fusarium disease in lemon plants. citri fungus has been found to cause. The effects of potato-dextrose agar and Chapek media on the color change of these fungal cultures were studied differently.*

Key words: *Fusarium, lemon, plants.*

Language: *English*

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Introduction

UDK:364.31/34.632.4

Relevance of the topic. A number of reforms are being carried out in the Republic of Uzbekistan regarding the cultivation of citrus plants, the introduction of new varieties brought from abroad, the expansion of their area, the production of products and the increase of export volume.

Citrus fruits contain a large amount of vitamins, minerals, organic acids, and healing nutrients necessary for the human body. In particular lemon is the most cultivated citrus plant in Uzbekistan and it is considered one of the most valuable healing and refreshing fruits.

The fruit contains about 2% sugar, 6-8% various acids (mainly citric acid), more than 1% pectin substances, about 0.5% various mineral salts, 60-90 mg. Vitamin C in certain amounts. There will be vitamins A, V1, V2, RR.

Diseases such as fusarium, phytophthora, gommosis, alternaria and fruit rot in lemon plants can greatly damage the expected yield during the plant's vegetation period.

Fungi that cause fusarium diseases in plants belong to the genus Fusarium, which belong to the kingdom of true fungi (Mycota), phylum Ascomycetes (Ascomycota), class Sordariomycetes, family Nectriaceae of the order Hypocreales. The names of the teleomorphic stage of many species of this family (Gibberella, Albonectria, Haematonectria) have been reduced to the level of its synonyms [2, 3].

Species of the genus Fusarium are facultative parasites, and there are four types of fusarium wilt in citrus crops, namely 1) fusarium wilt of seedlings; 2) root dry rot; 3) blight and 4) forms of fusarium rot of fruits [1, 4, 5, 6].

Fusarium wilt disease is caused by Fusarium oxysporum f. sp. citri provokes. The pathogen has been observed in true lime grown on Rangpur lime grafts in Brazil and India; Common in hardy citrus varieties grown in greenhouses in Florida, USA. The first symptoms of the disease are characterized by the formation of reticulate chlorosis on young leaves, they bend down, wither, fall off, dry from the tips of young branches. The formation of glue on the stems of dying plants and staining of their conducting tubes is often observed. The disease kills true limes and other hardy

citrus trees. Rangpur lime, Milam and jambiri lemons are more resistant to the disease, their leaves also show chlorosis and epinasty, tree stunting, but they may die due to the disease in rare cases. Many other types of citrus plants do not develop external symptoms of the disease [1, 6].

Species of the genus Fusarium are widespread in the soil of citrus orchards and nurseries. Most of them are Fusarium solani species and it is the dominant species isolated from the roots of trees affected by root dry rot. In rare cases, F. oxysporum from the roots and rhizosphere of plants, and then other secondary invasive or opportunistic pathogenic species of this family (F. equiseti, F. semitectum) is also separated. Along with F. solani, 2 more species - F. proliferatum and F. sambucinum - were isolated from the roots of infected citrus trees in Greece and it was proved that they cause root rot in citrus in artificial infection experiments. In the Mediterranean region - in Italy, Greece, Egypt and Tunisia, F. solani is dominant (62-75%, 45% in Tunisia), F. oxysporum (50%) takes the 2nd place. was 13% [6].

Root rot caused by F. solani is a serious problem in citrus trees, but its distribution is sporadic, that is, limited. Root dry rot has been reported in citrus plants in Europe (Italy, Greece, etc.), Asia (India), North (USA) and South America (Puerto Rico), Africa (JAR, Egypt, Tunisia) and Australia, new in the Mediterranean region is an emerging problematic disease [1, 4, 5, 6].

The toxicity of the fungus F. oxysporum to citrus is much higher than the toxicity of F. solani; in experiments, 30% and 80% of citrange seedlings treated with the culture fluid of two isolates of F. oxysporum died, and isolates of F. solani killed 20% [6]. In most cases, after the first signs of dry root rot appear, affected trees quickly become severely weakened or die completely within a year or two.

Frequent watering of the soil with benomyl is highly effective against Fusarium disease. The most effective measure is not to introduce the pathogen into the greenhouse [1, 6].

Research methods.

Isolation of pure cultures on standard agar media. For tube-to-tube inoculation of liquid or solid media, both tubes (sterile medium and tube containing fungal culture) are held parallel in the left hand between the fingers and held by the thumb. In this case, the environment in the test tube should be clearly visible. A mycological or bacteriological swab is held in the right hand. The mycological swab is held for sterilization in the fire, then with the fingers of the right hand, the stopper (stopper) of the test tubes is removed, and the mouth of the test tubes is sterilized in the fire.

Isolation of phytopathogenic fungi from plant roots. Freshly dug roots are washed in sterile water and the remaining water is absorbed with filter paper. Then, 1-3 cm cut root pieces or uncut small roots are placed on the surface of Petri dishes lined with filter paper and placed in a thermostat with a temperature of 26°C. Monitoring the growth of fungi and separating them is done after 24-48 hours or in the following days of growth.

Separation from damaged tissue. Using a scalpel heated in the flame of a gas torch or an alcohol lamp, the tissue is cut from the healthy part to the affected side. A small piece is cut from the border of the diseased and healthy tissue and transferred to a test tube containing wort agar medium.

Extraction from stems and leaves. Fungi can be isolated, in some cases, not only from newly introduced plant members, but also from their herbariums. For this, the material brought to the herbarium should be quickly dried and protected from foreign microflora. The plant stems, leaves and their parts are placed on a sterile filter paper and dried. After the stem or leaves are dried, a second sterile filter paper is transferred and stored in this condition until the study is carried out.

The preserved material can be placed in a wet chamber or observed under a binocular microscope. After 1-2 days of drying, the mushrooms are separated.

Research results. In 2021-2022, directional observations were conducted in the Okdarya district of the Samarkand region in order to study lemon diseases.

During the observations, samples of lemon plants infected with diseases (stem, leaf) were brought to the laboratory. Fusarium-causing fungi were isolated from infected parts of lemon in potato-dextrose agar nutrient medium in laboratory conditions, and studies were conducted to determine their species composition.

After washing and cleaning the samples affected by the disease, the affected parts were cut using a special cutting knife. In a laminar box, sterilized Petri dishes were placed with glass and the required amount of water (to create moisture) was placed. The excised specimens were dipped with tweezers first in 96% alcohol and then in distilled water and planted in Petri dishes around a flame lamp.

These samples were sterilized and planted for the experiment and placed in a thermostat at a temperature of 20-24°C. On the 3rd day of observation, fungi began to grow from the samples in the Petri dishes. Fungi grown in flasks were replanted on Chapek and potato-dextrose agar media and placed in a thermostat for growth and propagation.

By the 5th day of the laboratory experiments, the fungal spores grown in the nutrient media in the Petri dishes were replanted in test tubes for propagation and preservation.

According to the results of the research, Fusarium oxysporum f., a member of the family

Nectriaceae, family of Nectriaceae, phylum of Ascomycota, class of Sordariomycetes, which causes the disease of fusarium (gommosis, glue leakage) in lemon plants. citri was found to be caused by a type of fungus.

Figure 1. Micro and macroconidia of Fusarium fungus

Fusarium oxysporum f. Scientific research was carried out in laboratory conditions to study the effect of different potato-dextrose agar and Chapek nutrient media on the development of citri fungus and color change of cultures. Fungal cultures were grown for two weeks at a temperature of 20-24°C.

According to the monitoring results, Fusarium oxysporum f. Citri cultures were exposed to potato-dextrose agar media, which turned white and then purple after 14 days. Chapek appeared white in the nutrient environment.

Fusarium oxysporum f. Citri was observed to grow moderately on potato-dextrose agar and Chapek medium.

Summary. Fusarium oxysporum f. belonging to the genus Fusarium, which causes fusarium disease in lemon plants. It was found that the effects of potato-dextrose agar and Chapek nutrient media on the growth of the fungus citri and the color change of these fungal cultures were different.

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DECISION OF PRESIDIUM OF INTERNATIONAL ACADEMY

According to the results of research work of the past 2022 and published scientific articles in the journal «Theoretical & Applied Science», Presidium of International Academy of Theoretical & Applied Sciences has decided to award the following scientists - rank Corresponding member and Academician of International Academy, as well as give diplomas and certificates of member of International Academy.

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