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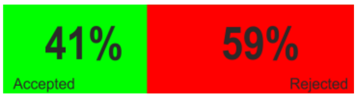

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SECTION 2. Applied mathematics. Mathematical modeling.

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THE APPLICATION OF SYSTEM MAPLE AND DELPHI TO SOLVE PROBLEMS OF DISCRETE MATHEMATICS

Abstract: *A modern approach to the solution of problems of discrete mathematics due to the necessity of introducing and using known methods of solving problems. Existing programs and algorithms are not implemented to the extent necessary at the present time. The article is devoted to modeling and programming for Delphi and Maple for solving problems in discrete mathematics. The basis of research are well known and tested algorithms for the tasks of kommivojazhera – Greedy algorithm allows to find the optimal route.*

Key words: *greedy algorithm, Delphi, Maple.*
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ПРИМЕНЕНИЕ СИСТЕМ MAPLE И DELPHI К МОДЕЛИРОВАНИЮ ЗАДАЧ ДИСКРЕТНОЙ МАТЕМАТИКИ

Аннотация: *Современный подход к решению задач дискретной математики обусловлен необходимостью внедрения и использования известных методов решения задач. Существующие программы и алгоритмы не реализованы в необходимой мере в настоящее время. Статья посвящена моделированию и разработке программ для Delphi и Maple для решения задач дискретной математики. Основу исследований составляют хорошо известные и апробированные алгоритмы задачи комивояжера – «Жадный алгоритм» позволяющие находить оптимальный маршрут движения.*

Ключевые слова: *жадный алгоритм, Delphi, Maple.*

Introduction

Стремительное развитие уровня всех компьютерных математических приложений привело к парадоксальной ситуации, не оцененной пока должным образом.

С одной стороны, аналитические решения многих задач дискретной математики уже нельзя считать рациональными, так как компьютерные решения проводятся быстрее, то есть часто решать аналитически все равно, что ехать из Тараза в Шымкент через Астану.

С другой стороны, компьютерные решения не принимаются как полноценные! Однако несомненно, что такое положение временное и в недалеком будущем компьютерный способ решения станет если не основным, то равноправным с аналитическим. В Maple имеется мощная справочная система Help с пояснениями и примерами. Рекомендуется использовать ее как можно чаще, тем более что Maple достаточно жесткая система, не допускающая никаких отклонений от установленных в ней правил. До последней версии Maple в пакете student, содержащем встроенные функции основных математических вычислений, необходимых в учебном процессе, была возможность получения пошаговых решений. В последней версии Maple пошаговые функции пакета student переданы пакету Student [Calculusl], хотя сам пакет student остался. Однако основное назначение Maple состоит в оптимизации математических вычислений, включающей в себя получение результата минимумом нажатий на клавиши.

Применение Maple к проблемам дискретной математики довольно обширно:

Горюшкин А. рассматривает особенности применения пакета символьных математических вычислений Maple при исследовании комбинаторных конфигураций, объектов математической логики и алгебры графов [1].

Сдвижков О.А. рассматривает основные правила работы в среде, методы и способы решения задач по элементарной и высшей математике, геометрическим построениям, теории вероятностей и математической статистике. Отдельная глава посвящена математическим моделям в экономике. Приведено много примеров решения задач: теории вероятности, математической статистики, алгебры логики, линейного программирования, матричные игры, транспортная задача, балансовые модели, потоки в сетях, сетевое планирование, целочисленное программирование, задача Эрланга. [2]

Тарасевич Ю.Ю. в книге «Элементы дискретной математики для программистов» рассмотрел следующие разделы: теория графов, теоремы Понтрягина-Куратовского и Эйлера, Эйлеровы и гамильтоновы графы, рёберные и дуальные графы, применение пакета Maple для решения задач теории графов, комбинаторика, матрица перестановок, рекуррентные соотношения, производящие функции, числа Фибоначчи, числа Каталана, неоднородные рекуррентные соотношения, применение пакета Maple для решения комбинаторных задач, алгоритмы обхода двоичного дерева, задача о коммивояжере, алгоритм Хошена-Копельмана, алгоритм поиска в глубину, алгоритм поиска в ширину [3].

Применимость жадных алгоритмов

Общего критерия оценки применимости жад ного алгоритма для решения конкретной задачи н е существует, однако, для задач, решаемых жадн ыми алгоритмами характерны две особенности: в о-первых, к ним
применим *Принцип жадного выбора* , а во-вторых, они обладают свойством *Оптимальности для подзадач*.

Принцип жадного выбора

Говорят, что к оптимизационной задаче при меним **принцип жадного выбора**, если последов ательностьлокально оптимальных выборов даёт глобально оптимальное решение. В типичном случае доказательство оптимальности следует такой схеме:

- Сначала доказывается, что жадный выбо р на первом шаге не закрывает пути к оптимальному решению: для всякого решения есть другое, согласованное с жадным выбором и не хуже первого.
- Затем показывается, что подзадача, возникающая после жадного выбора на первом шаге, аналогична исходной, и рассуждение завершается по индукции.

Materials and Methods

Теоретическая постановка задачи

Задача коммивояжёра — это одна из самых известных задач, заключающаяся в отыскании самого выгодного маршрута, проходящего через указанные города хотя бы по одному разу с последующим возвратом в исходный город. В условиях задачи также указываются критерий выгодности маршрута:

- кратчайший,
- самый дешёвый,
- совокупный критерий

и т. п.

Маршрут должен проходить через каждый город только один раз (выбор осуществляется среди **гамильтоновых** циклов).

Поскольку коммивояжер в каждом из городов встает перед выбором следующего города из тех, что он ещё не посетил, существует

$$\frac{(n-1)!}{2}$$

маршрутов для симметричной задачи коммивояжера. Таким образом, для случаев

№	n	Число маршрутов
1	10	$\frac{9!}{2} = 181440$
2	100	$\frac{99!}{2} \approx 4 \cdot 10^{155}$
3	300	$\frac{299!}{2} \approx 5 \cdot 10^{611}$

Совершенно очевидно, что решить задачу методом прямого перебора (или «грубой силы») не сможет даже самый мощный компьютер!

Не случайно в условии сделан акцент на приближённый алгоритм.

«Жадный алгоритм», или «метод ближайшего соседа» — это один из простейших методов решения задачи коммивояжёра.

Его можно сформулировать следующим образом:

- Города последовательно включаются в маршрут,
- при этом каждый очередной включаемый город должен быть ближайшим к последнему выбранному городу среди всех остальных, ещё не включенных в состав маршрута.

2.3 Разработка компьютерного алгоритма и блок схемы программы

Составим математический алгоритм.

Пользователь задаёт количество городов – константа CITY_COUNT.

Расстояния между городами хранятся в квадратном массиве Distances[1..CITY_COUNT][1..CITY_COUNT].

А оптимальный путь, представляющий собой оптимальную последовательность индексов городов, хранится в линейном массиве Path[1.. CITY_COUNT].

1. Происходит первоначальная инициализация карты городов. Для этого используем случайный алгоритм (выполняя требование исходной задачи *«Города определить случайным образом»*).
2. Ищется путь коммивояжёра – процедура CalculationPath.

1. В ней рассчитывается матрица взаимных расстояний между городами Distance. По диагонали в матрице хранятся -1, верхний треугольник матрицы рассчитывается и копируется в нижний, т.к. матрица симметрична относительно главной диагонали.
2. Далее «пробегаем» по всем городам (переменная iCurrent), начиная с начального (iStart), и для каждого ищем ближайший город (до которого расстояние минимально), запоминаем его в переменной iMedian и добавляем в путь Path. При поиске ближайшего города игнорируем те города, в которые уже заходили (дистанция до которых =-1). Попутно ищем общую протяжённость пути (Length);
3. После включения очередного города в путь, вычёркиваем его из рассмотрения (ставим в матрицу расстояний -1 в соответствующие этому городу столбец и строку).

Анализ найденных решений, особенно для трёхсот городов (длинная дорога, по которой коммивояжер возвращается в родной город из последнего пункта назначения), подтверждает тезис о том, что «жадный алгоритм» может давать результат, не более чем в два раза превышающий действительно оптимальный маршрут. Одним из эвристических критериев оценки решения является правило: если путь, пройденный на последних шагах алгоритма, сравнимым с путём, пройденным на начальных шагах, то можно условно считать найденный маршрут приемлемым, иначе, вероятно, существуют более оптимальные решения.

Разработка программы для Maple

```
restart;
CITY_COUNT := 5 :
s := 1 : ds := 0 : im := 1 :
for i from 1 to CITY_COUNT do
g_x[i] := rand( )mod 750;
g_y[i] := rand( )mod 500;
od;

for i from 1 to CITY_COUNT do
Distances[i, i] := -1;
od;

for i from 1 to CITY_COUNT - 1 do
 for j from i + 1 to CITY_COUNT do
 x := g_x[i] - g_x[j];
y := g_y[i] - g_y[j];
d := trunc(sqrt(x·x + y·y)·100) / 100;

Distances[i,j] := d;
Distances[j, i] := d;
od;
od;
im0 := 1 :
im1 := 1 :

for k from 1 to CITY_COUNT - 1 do
dmin := 10000000;
 for i from 1 to CITY_COUNT do
 d := Distances[i, im];
if (0 < d)and(d < dmin) then
it := i;
dmin := d;
fi;
od;
im := it;

for i from 1 to CITY_COUNT do
 Distances[i, im0] := -1;
Distances[im0, i] := -1;
 od;
s := s, im;
ds := ds + dmin;
im0 := im :
od;
```

284

415

715

459

119

442

590

180

450

265

−1

−1

−1

−1

−1

10000000

3

1, 3

$\frac{16719}{100}$

3

10000000

5

1, 3, 5

$\frac{27127}{50}$

5

10000000

4

1, 3, 5, 4

$\frac{17658}{25}$

4

10000000

2

1, 3, 5, 4, 2

$\frac{25301}{25}$

2

Таблица 1

Проведем ряд расчетов для различных параметров

Количество городов	Оптимальный путь	Длина оптимального пути
10	1, 6, 9, 3, 5, 10, 4, 7, 8, 2	$\frac{166053}{100}$
100	1, 49, 19, 28, 69, 92, 55, 87, 6, 11, 18, 53, 96, 76, 41, 58, 56, 3, 45, 90, 9, 25, 40, 39, 81, 80, 91, 84, 67, 65, 62, 42, 24, 63, 14, 13, 75, 8, 59, 88, 99, 29, 2, 47, 12, 74, 51, 10, 15, 16, 22, 4, 60, 98, 20, 34, 5, 26, 38, 72, 61, 68, 33, 35, 48, 100, 46, 54, 31, 7, 52, 97, 66, 82, 17, 93, 85, 94, 70, 30, 57, 64, 43, 95, 32, 83, 37, 27, 89, 78, 21, 73, 44, 50, 71, 86, 23, 79, 36, 77	$\frac{550317}{100}$

300	1, 191, 268, 49, 284, 179, 200, 146, 13, 14, 235, 219, 294, 230, 75, 233, 208, 259, 8, 159, 59, 155, 266, 51, 209, 136, 187, 281, 111, 271, 150, 85, 93, 166, 189, 17, 213, 260, 117, 31, 103, 210, 161, 156, 272, 239, 115, 289, 100, 48, 129, 107, 192, 206, 142, 26, 262, 34, 288, 188, 267, 261, 251, 274, 256, 215, 278, 250, 290, 291, 264, 214, 196, 182, 88, 123, 275, 228, 242, 186, 74, 157, 125, 12, 175, 220, 47, 286, 2, 180, 163, 245, 29, 183, 254, 99, 164, 207, 168, 176, 160, 133, 199, 237, 217, 293, 92, 69, 55, 153, 87, 6, 131, 244, 132, 165, 11, 18, 53, 248, 280, 128, 283, 96, 76, 41, 151, 114, 102, 154, 184, 120, 232, 40, 148, 25, 39, 134, 224, 172, 121, 201, 138, 81, 285, 226, 143, 45, 108, 3, 56, 243, 90, 229, 135, 9, 300, 299, 58, 101, 221, 106, 231, 185, 227, 152, 212, 23, 296, 86, 71, 126, 170, 141, 295, 44, 223, 89, 177, 263, 78, 190, 21, 277, 292, 110, 36, 137, 37, 252, 276, 32, 43, 95, 236, 234, 105, 270, 72, 61, 253, 147, 109, 140, 57, 64, 255, 77, 83, 124, 149, 171, 198, 27, 205, 50, 193, 282, 116, 241, 112, 197, 73, 297, 119, 222, 269, 79, 91, 80, 204, 238, 84, 67, 65, 127, 249, 194, 225, 240, 42, 130, 62, 139, 195, 104, 38, 265, 145, 178, 24, 63, 5, 20, 98, 246, 144, 60, 4, 22, 16, 181, 257, 15, 10, 211, 30, 70, 298, 167, 202, 158, 66, 82, 97, 203, 118, 122, 174, 52, 7, 54, 162, 46, 35, 33, 216, 113, 68, 287, 279, 94, 218, 247, 19, 28, 258, 173, 273, 169	$\frac{986499}{100}$

Разработка программы для Delphi

Для разработки программы используем Delphi XE8. Разместим на форме необходимые компоненты, разделив выходящие данные на 4 вкладки.

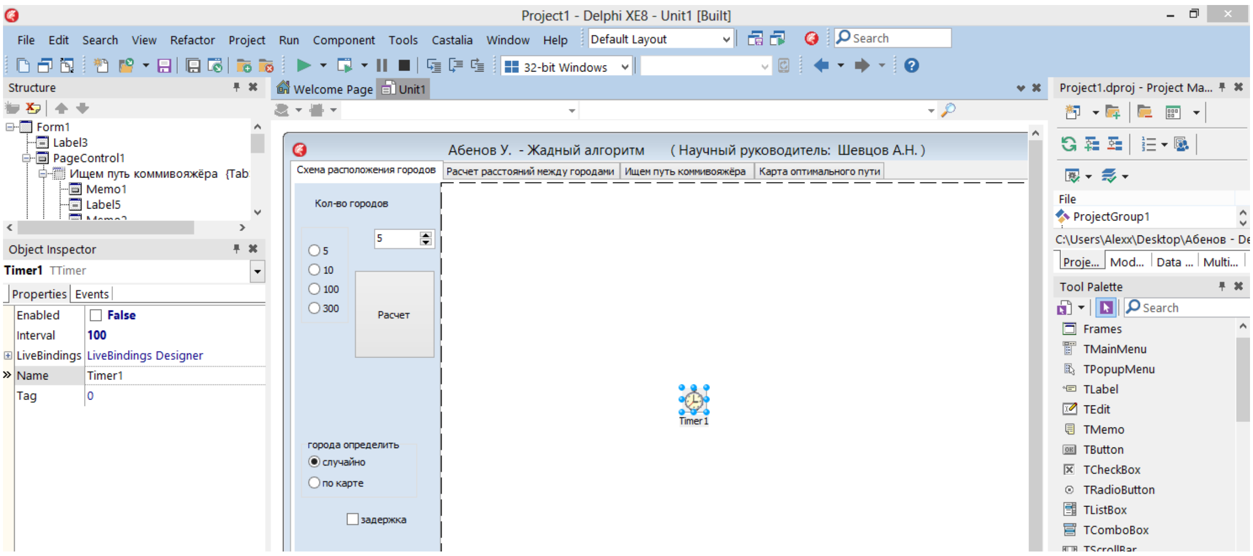


Рисунок 1 – Окно формы программы. Вкладка 1.

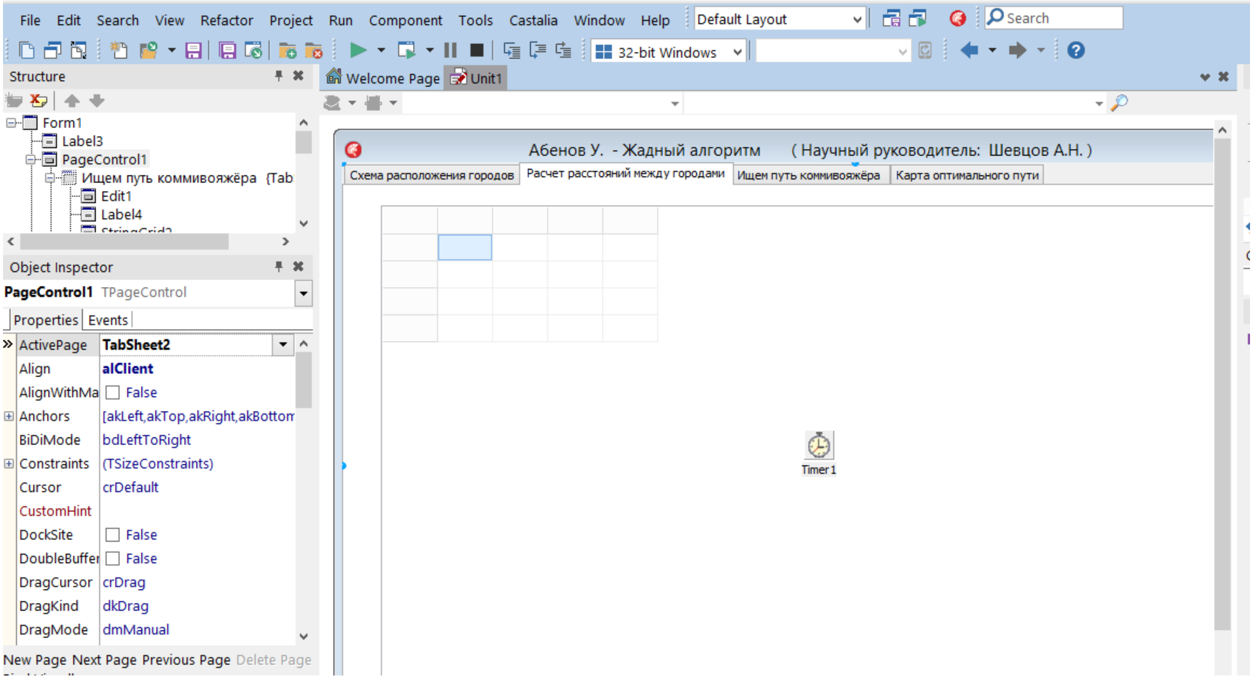


Рисунок 2 – Окно формы программы. Вкладка 2.

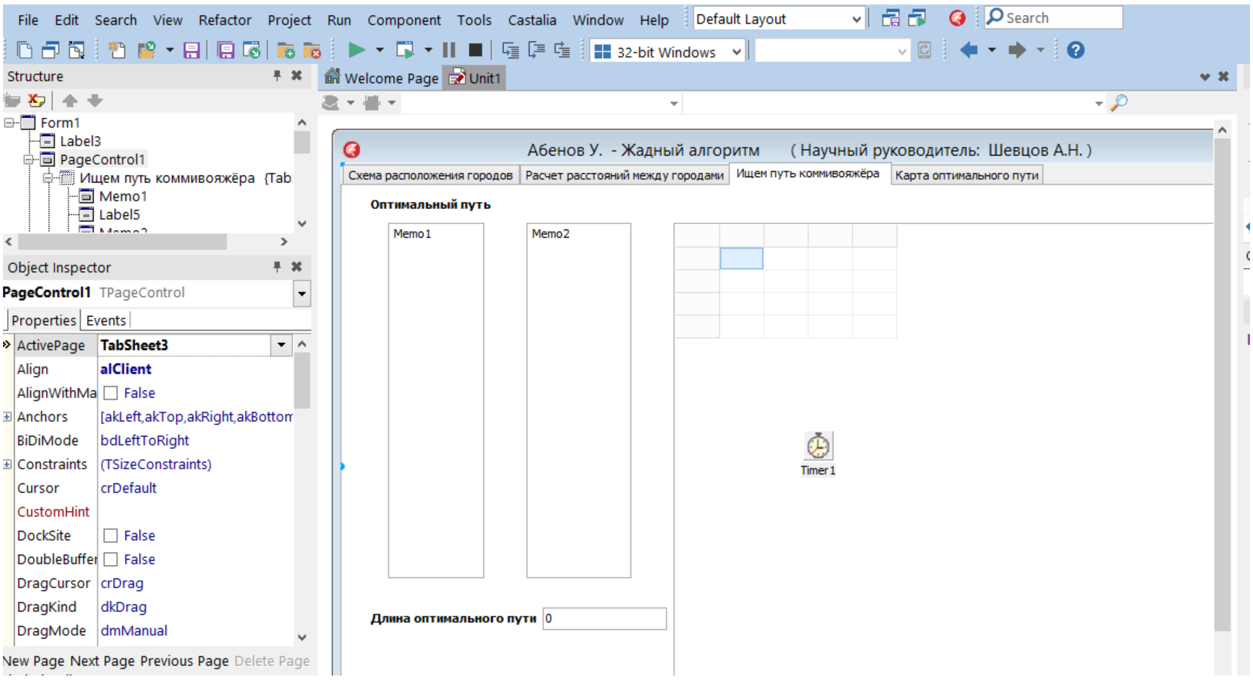


Рисунок 3 – Окно формы программы. Вкладка 3.

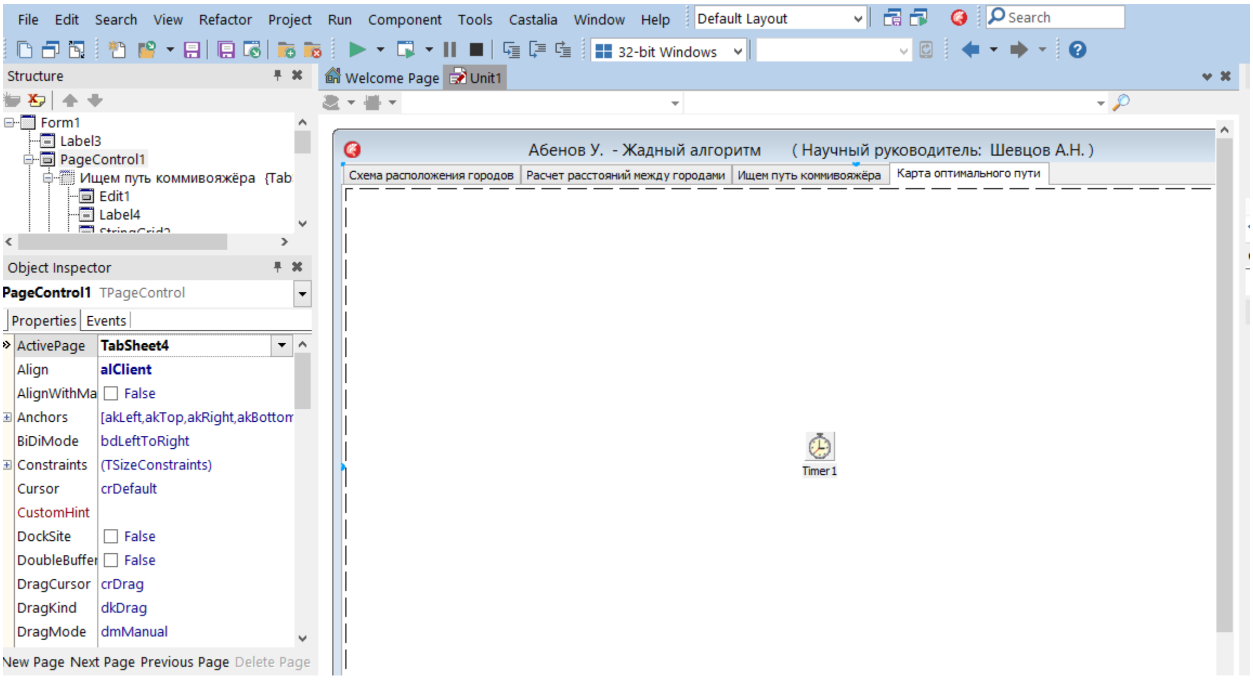


Рисунок 4 – Окно формы программы. Вкладка 4.

Описание алгоритмов «Жадного алгоритма» удобно привести в виде таблицы

Таблица 2

Реализация алгоритма на Delphi

Код Delphi	Подробное описание

procedure TForm1.Button1Click(Sender: TObject);
begin
image1.Canvas.Brush.Color:=clWhite;
Image1.Canvas.FillRect(rect(0,0,1000,1000));
CITY_COUNT:=SpinEdit1.Value;
	Очистка карты городов
	
	Задание кол-ва городов

case RadioGroup2.ItemIndex of
0:begin
for I := 1 to CITY_COUNT do
begin
g[i].X:=random(750);
g[i].Y:=random(500);
image1.Canvas.Brush.Color:=clred;
image1.Canvas.Ellipse(rect(g[i].X,g[i].y,g[i].X+5,g[i].y+5));
image1.Canvas.Brush.Color:=clWhite;
image1.Canvas.TextOut(g[i].X+10,g[i].y-10,inttostr(i));
 	
image2.Canvas.Brush.Color:=clred;
image2.Canvas.Ellipse(rect(g[i].X,g[i].y,g[i].X+5,g[i].y+5));
image2.Canvas.Brush.Color:=clWhite;
image2.Canvas.TextOut(g[i].X+10,g[i].y-10,inttostr(i));
end;
end;
1:begin end ;
 	
end;
	Прорисовка городов на карте
	
	Произвольный выбор города
	
	Нумерация города

stringgrid1.ColCount:=CITY_COUNT+1; stringgrid1.RowCount:=CITY_COUNT+1;	Задание размеров таблицы расстояний между городами Причем расстояние между одинаковыми городами считаем равным -1

for I := 1 to CITY_COUNT do
begin
stringgrid1.Cells[0,i]:=inttostr(i);
stringgrid1.Cells[i,0]:=inttostr(i);
stringgrid1.Cells[i,i]:=inttostr(-1);
Distances[i,i]:=-1;
end;
	Заполнение колонтитулов таблицы и значений между одинаковыми городами

for I := 1 to CITY_COUNT-1 do
for j := i+1 to CITY_COUNT do
begin
x:=g[i].X-g[j].X;
y:=g[i].y-g[j].y;
d:=int(sqrt(x*x+y*y)*100)/100;
stringgrid1.Cells[j,i]:=floattostr(d);
stringgrid1.Cells[i,j]:=floattostr(d);
Distances[i,j]:=d;
Distances[j,i]:=d;
 	
end;
	Расчет расстояний между всеми городами и симметричное заполнение таблицы относительно главной диагонали
	
	Заполнение массива с данными

//ищем путь коммивояжера
memo1.Clear;
memo2.Clear;
im0:=1;
im:=1;
memo1.Lines.Add(inttostr(im));
	Очистка окон вывода данных
	
	Задание начальных параметров

for k := 1 to CITY_COUNT-1 do
begin
dmin:=100000000;
for i := 1 to CITY_COUNT do
begin
d:=Distances[i,im];
if (0<d)and(d<dmin) then
begin
it:=i;
dmin:=d;
end;
end;
	Расчет оптимальной траектории по Жадному алгоритму

im:=it;
for I := 1 to CITY_COUNT do
begin
Distances[i,im0]:=-1;
Distances[im0,i]:=-1;
end;
	Вычеркивание пройденного города из списка городов путем вычеркивания расстояний до других городов

memo1.Lines.Add(inttostr(im));	Вывод очередного города в

memo2.Lines.Add(floattostr(dmin));	оптимальном пути и расстояния до него

im0:=im;
 	
stringgrid2.ColCount:=CITY_COUNT+1;
stringgrid2.RowCount:=CITY_COUNT+1;
for I := 1 to CITY_COUNT do
for j := 1 to CITY_COUNT do
stringgrid2.Cells[i,j]:=floattostr(Distances[i,j]);
Application.ProcessMessages;
 	
if checkbox1.Checked then sleep(trunc(10000/CITY_COUNT));
end;
 	
ii:=1;
timer1.Enabled:=true;
	Обновление таблицы с данными на 3 вкладке
	
	Анимация данных

s:=0;
for i:=0 to memo2.Lines.Count-1 do s:=s+strtofloat(memo2.Lines.Strings[i]);
edit1.Text:=floattostr(s);
 	
end;
	Расчет общей длины оптимального пути

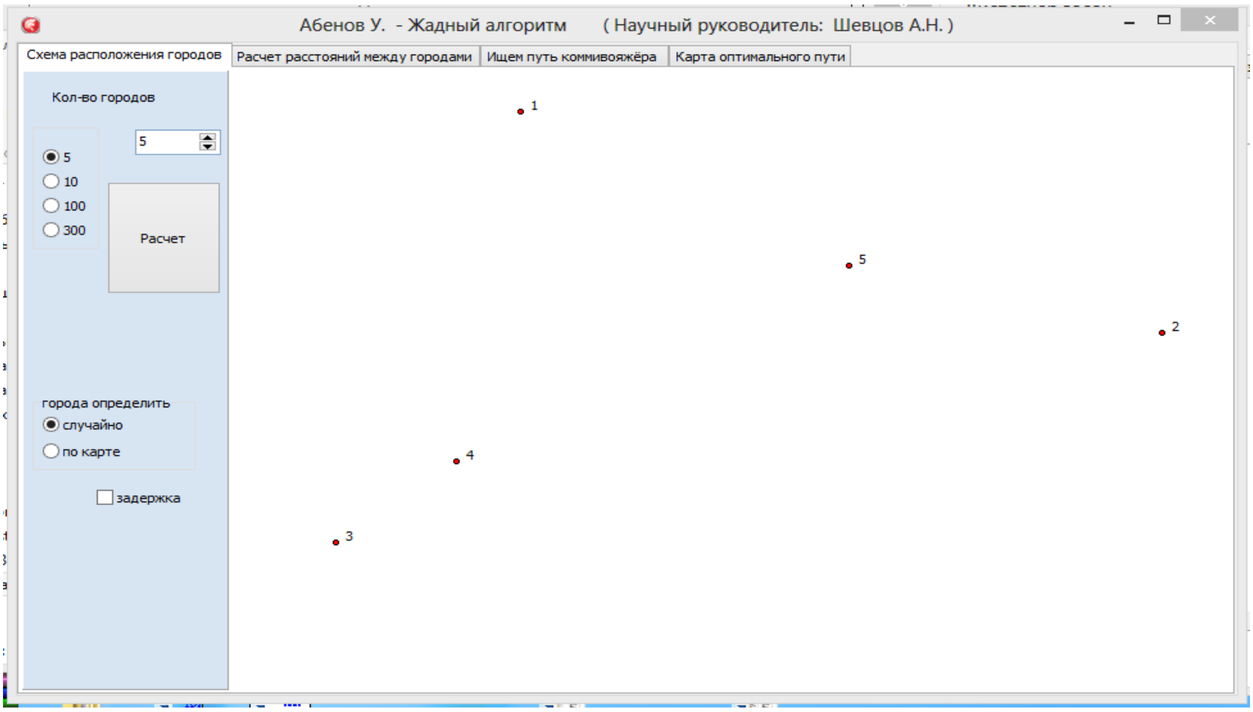


Рисунок 5 – Моделирование 5 городов.

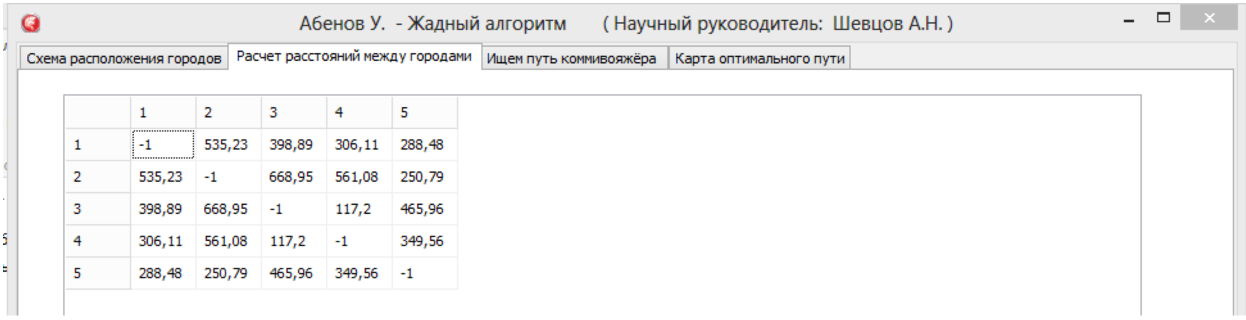


Рисунок 6 – Моделирование 5 городов. Расчет расстояний.

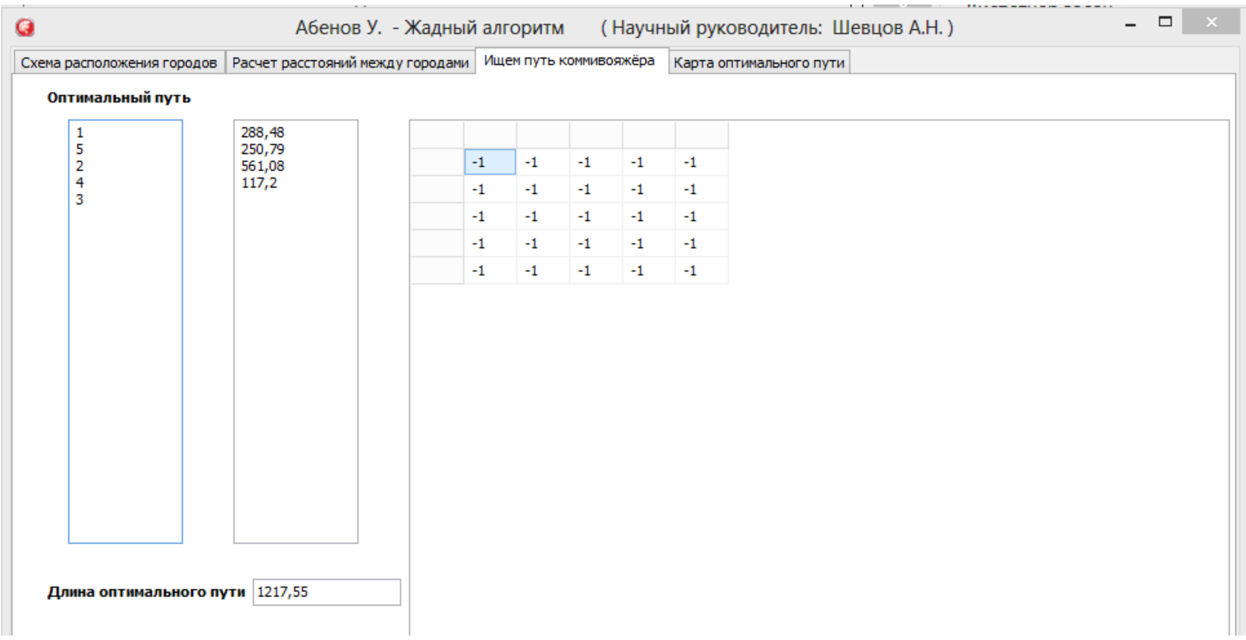


Рисунок 7 – Моделирование 5 городов. Расчет оптимального пути.

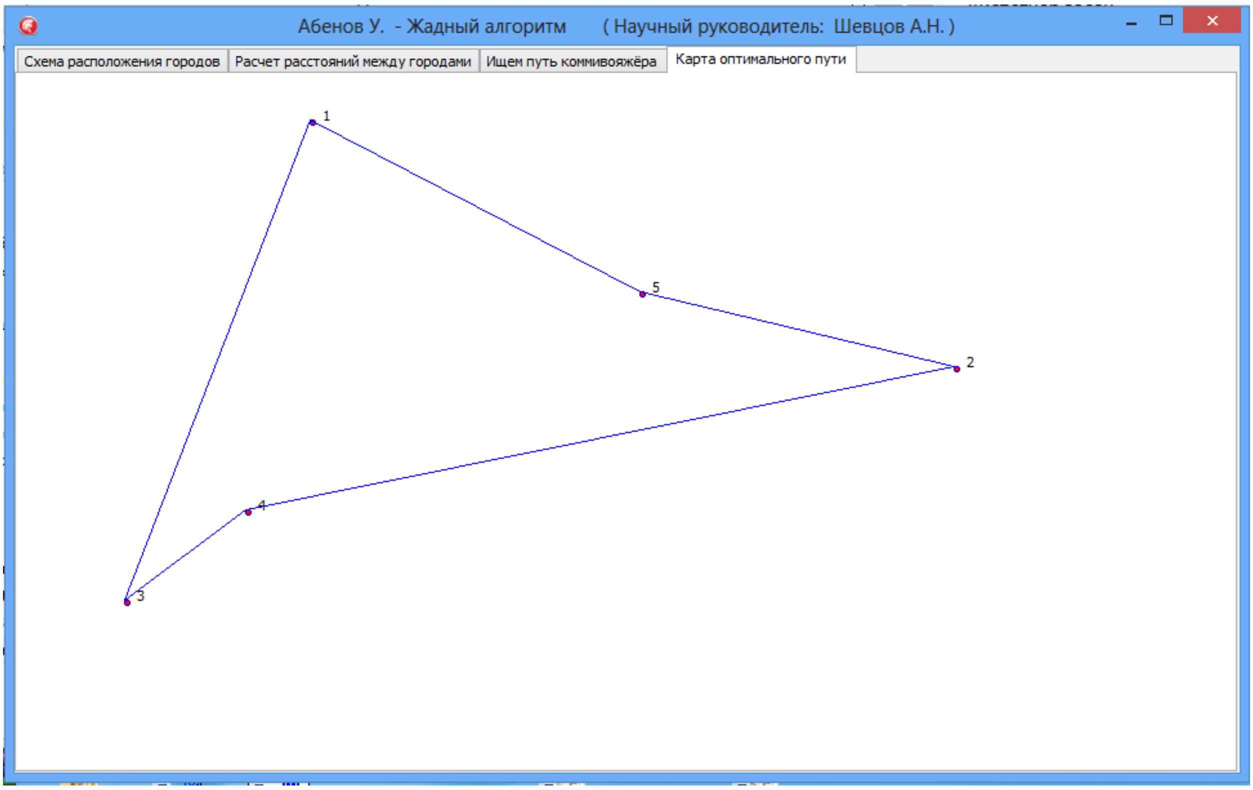


Рисунок 8 – Моделирование 5 городов. Траектория оптимального пути.

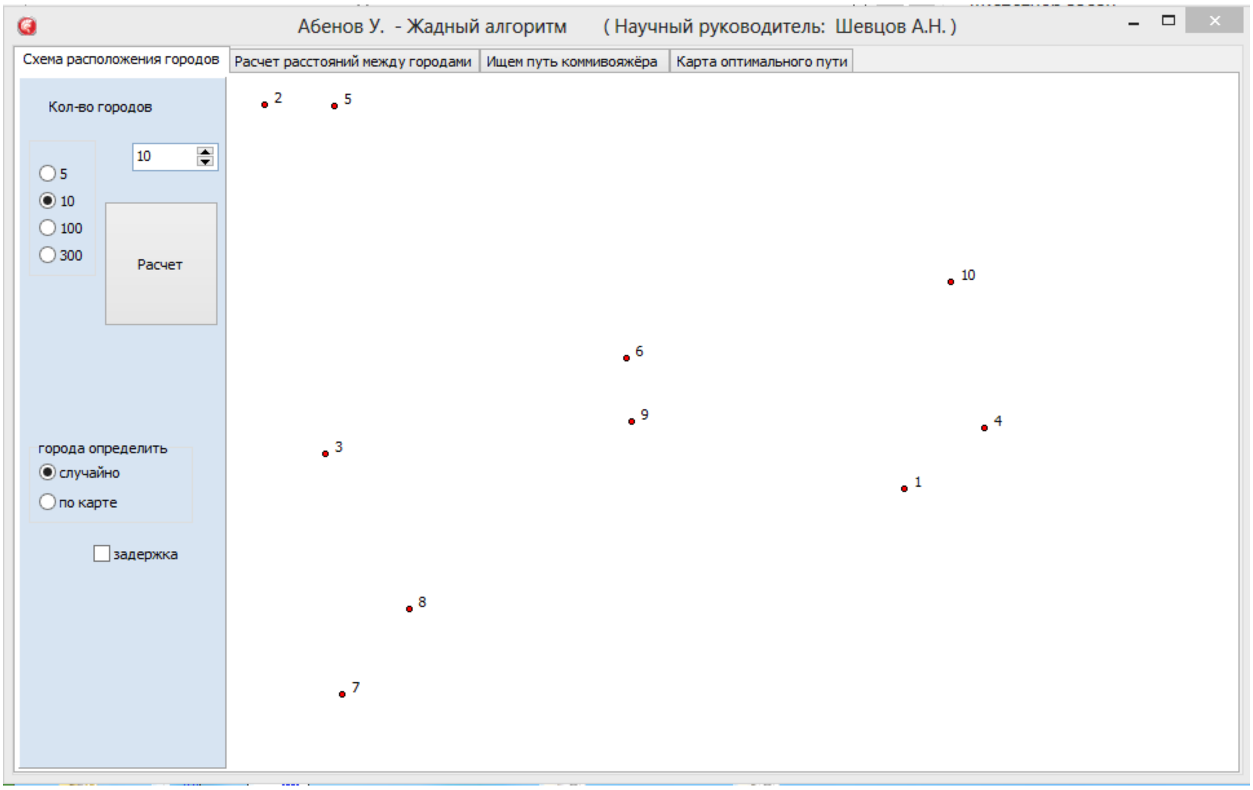
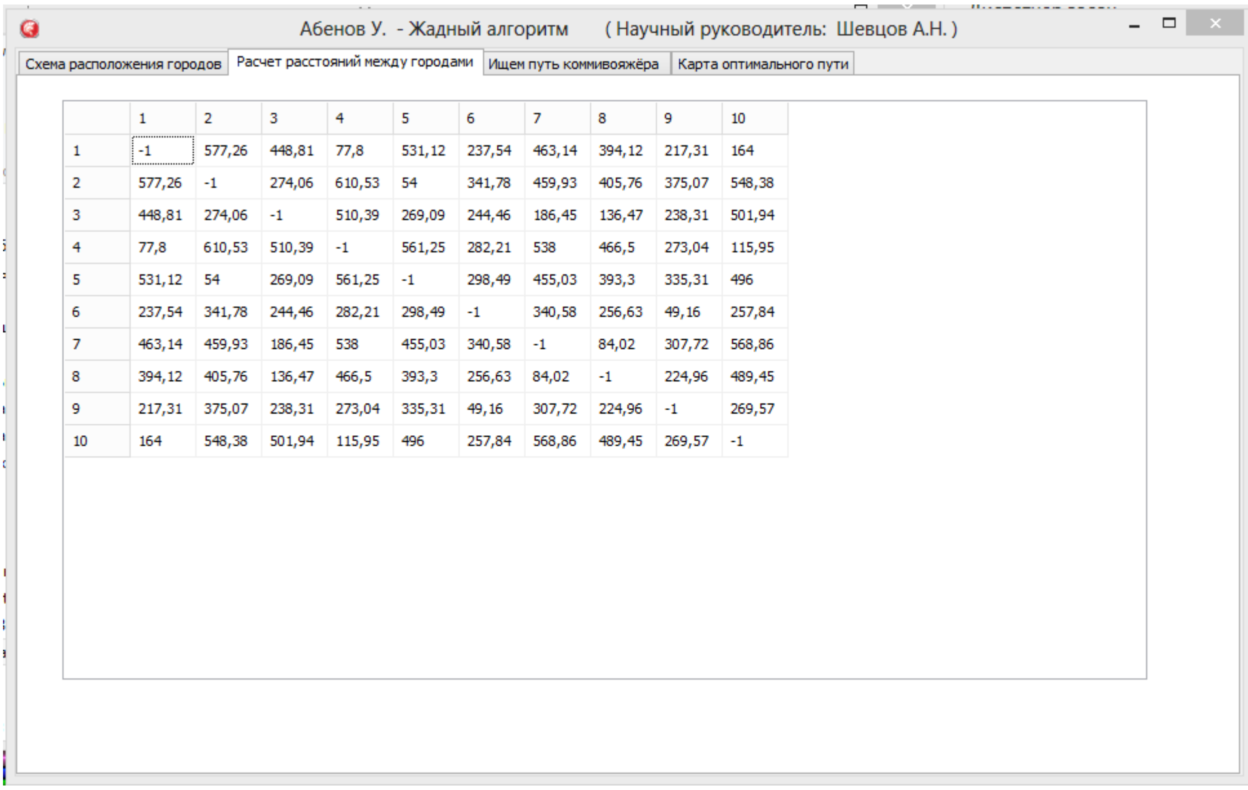
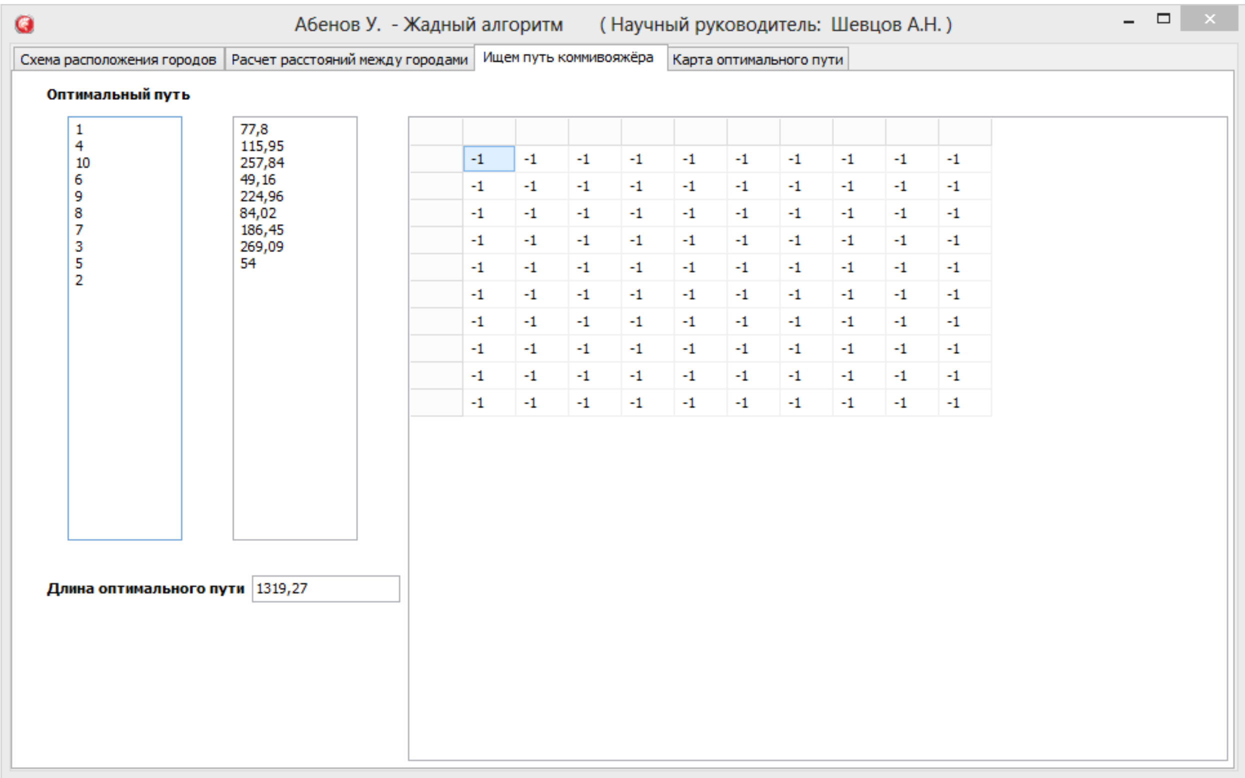


Рисунок 9 – Моделирование 10 городов. Расположение городов.



	1	2	3	4	5	6	7	8	9	10
1	-1	577,26	448,81	77,8	531,12	237,54	463,14	394,12	217,31	164
2	577,26	-1	274,06	610,53	54	341,78	459,93	405,76	375,07	548,38
3	448,81	274,06	-1	510,39	269,09	244,46	186,45	136,47	238,31	501,94
4	77,8	610,53	510,39	-1	561,25	282,21	538	466,5	273,04	115,95
5	531,12	54	269,09	561,25	-1	298,49	455,03	393,3	335,31	496
6	237,54	341,78	244,46	282,21	298,49	-1	340,58	256,63	49,16	257,84
7	463,14	459,93	186,45	538	455,03	340,58	-1	84,02	307,72	568,86
8	394,12	405,76	136,47	466,5	393,3	256,63	84,02	-1	224,96	489,45
9	217,31	375,07	238,31	273,04	335,31	49,16	307,72	224,96	-1	269,57
10	164	548,38	501,94	115,95	496	257,84	568,86	489,45	269,57	-1

Рисунок 10 – Моделирование 5 городов. Расчет расстояний между городами.



	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Рисунок 11 – Моделирование 10 городов. Расчет оптимального пути и его длины.

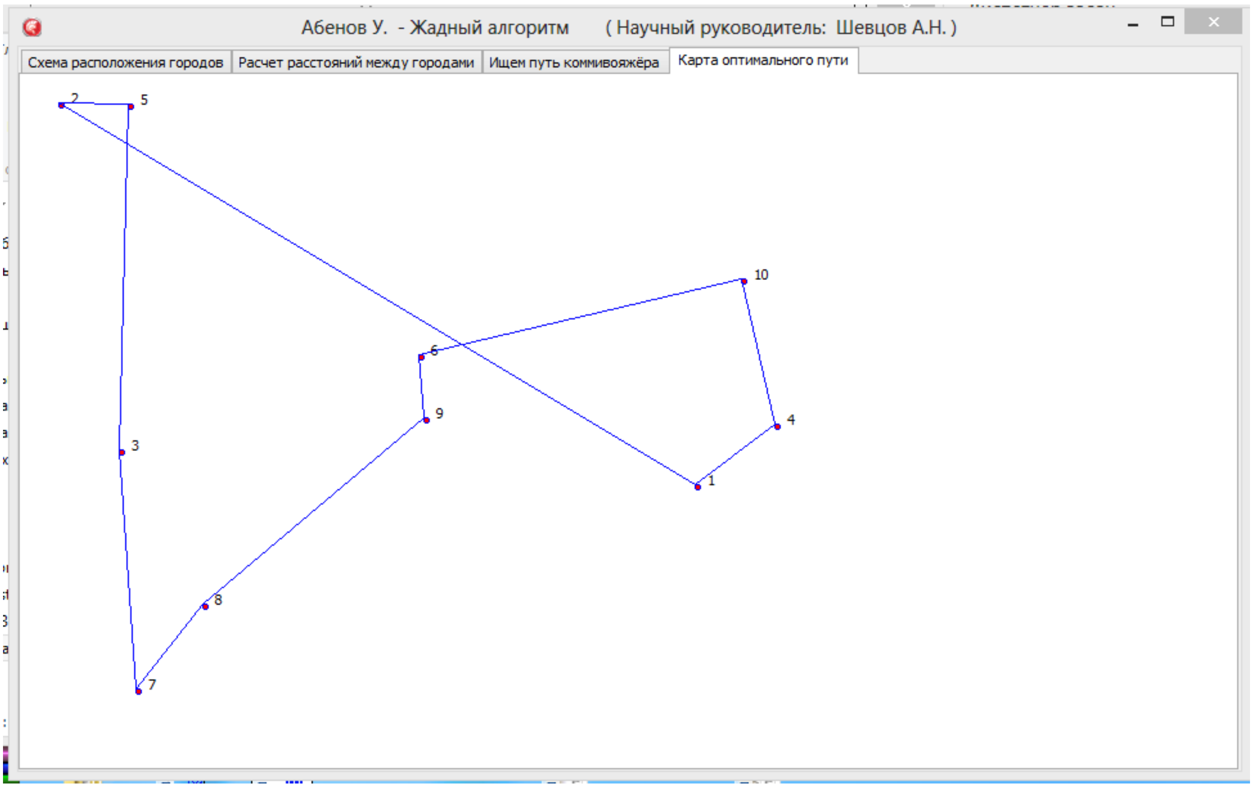


Рисунок 12 – Моделирование 10 городов. Траектория оптимального пути.

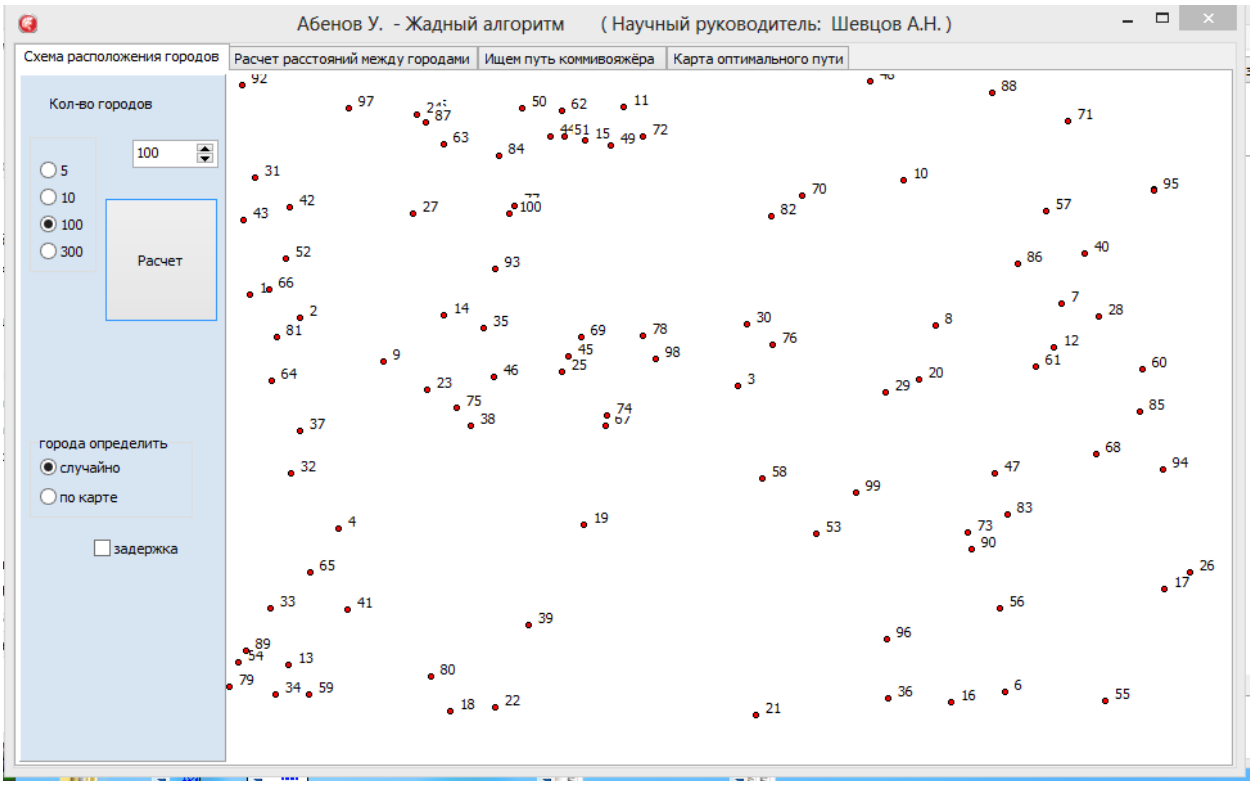
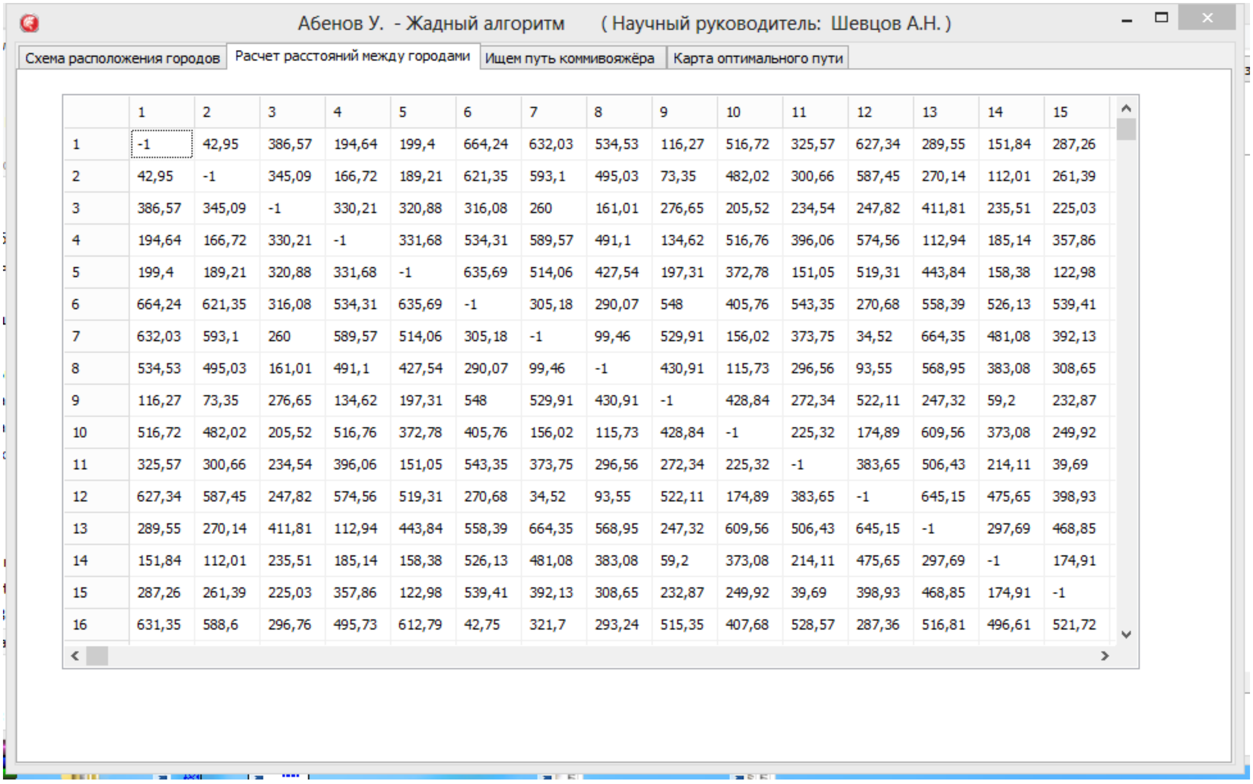
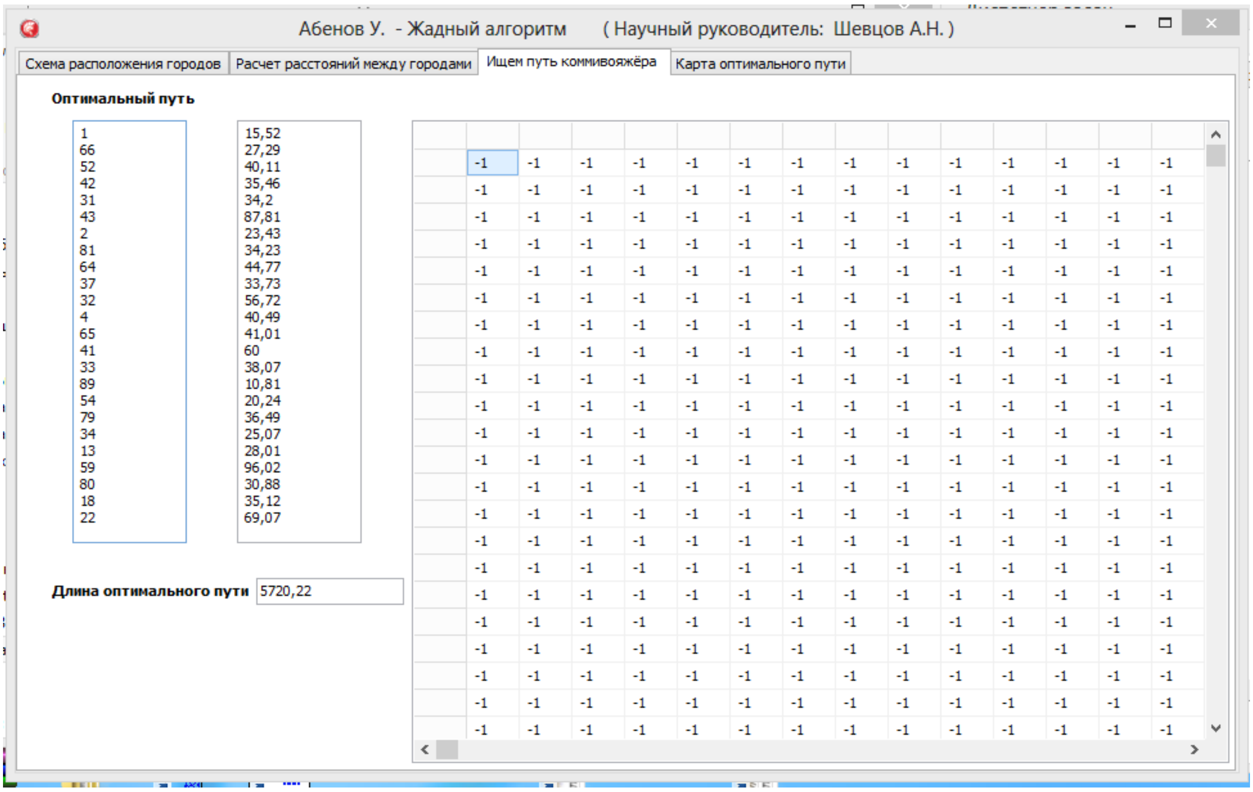


Рисунок 13 – Моделирование 100 городов. Положение на карте.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-1	42,95	386,57	194,64	199,4	664,24	632,03	534,53	116,27	516,72	325,57	627,34	289,55	151,84	287,26
2	42,95	-1	345,09	166,72	189,21	621,35	593,1	495,03	73,35	482,02	300,66	587,45	270,14	112,01	261,39
3	386,57	345,09	-1	330,21	320,88	316,08	260	161,01	276,65	205,52	234,54	247,82	411,81	235,51	225,03
4	194,64	166,72	330,21	-1	331,68	534,31	589,57	491,1	134,62	516,76	396,06	574,56	112,94	185,14	357,86
5	199,4	189,21	320,88	331,68	-1	635,69	514,06	427,54	197,31	372,78	151,05	519,31	443,84	158,38	122,98
6	664,24	621,35	316,08	534,31	635,69	-1	305,18	290,07	548	405,76	543,35	270,68	558,39	526,13	539,41
7	632,03	593,1	260	589,57	514,06	305,18	-1	99,46	529,91	156,02	373,75	34,52	664,35	481,08	392,13
8	534,53	495,03	161,01	491,1	427,54	290,07	99,46	-1	430,91	115,73	296,56	93,55	568,95	383,08	308,65
9	116,27	73,35	276,65	134,62	197,31	548	529,91	430,91	-1	428,84	272,34	522,11	247,32	59,2	232,87
10	516,72	482,02	205,52	516,76	372,78	405,76	156,02	115,73	428,84	-1	225,32	174,89	609,56	373,08	249,92
11	325,57	300,66	234,54	396,06	151,05	543,35	373,75	296,56	272,34	225,32	-1	383,65	506,43	214,11	39,69
12	627,34	587,45	247,82	574,56	519,31	270,68	34,52	93,55	522,11	174,89	383,65	-1	645,15	475,65	398,93
13	289,55	270,14	411,81	112,94	443,84	558,39	664,35	568,95	247,32	609,56	506,43	645,15	-1	297,69	468,85
14	151,84	112,01	235,51	185,14	158,38	526,13	481,08	383,08	59,2	373,08	214,11	475,65	297,69	-1	174,91
15	287,26	261,39	225,03	357,86	122,98	539,41	392,13	308,65	232,87	249,92	39,69	398,93	468,85	174,91	-1
16	631,35	588,6	296,76	495,73	612,79	42,75	321,7	293,24	515,35	407,68	528,57	287,36	516,81	496,61	521,72

Рисунок 14 – Моделирование 100 городов. Таблица расстояний между городами.



-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
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-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

Рисунок 15 – Моделирование 100 городов. Расчет длины оптимального пути.

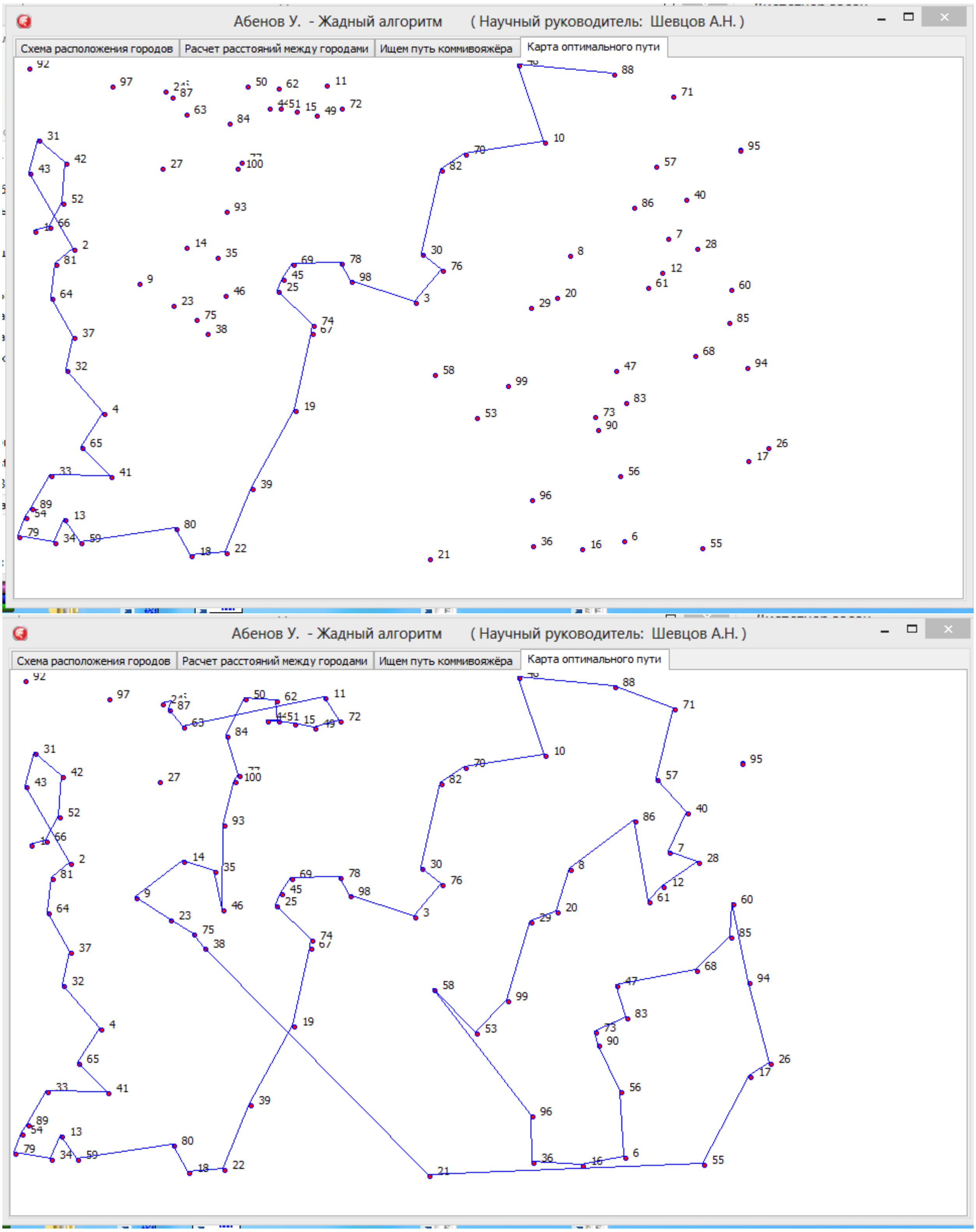

Рисунок 16 – Моделирование 100 городов.

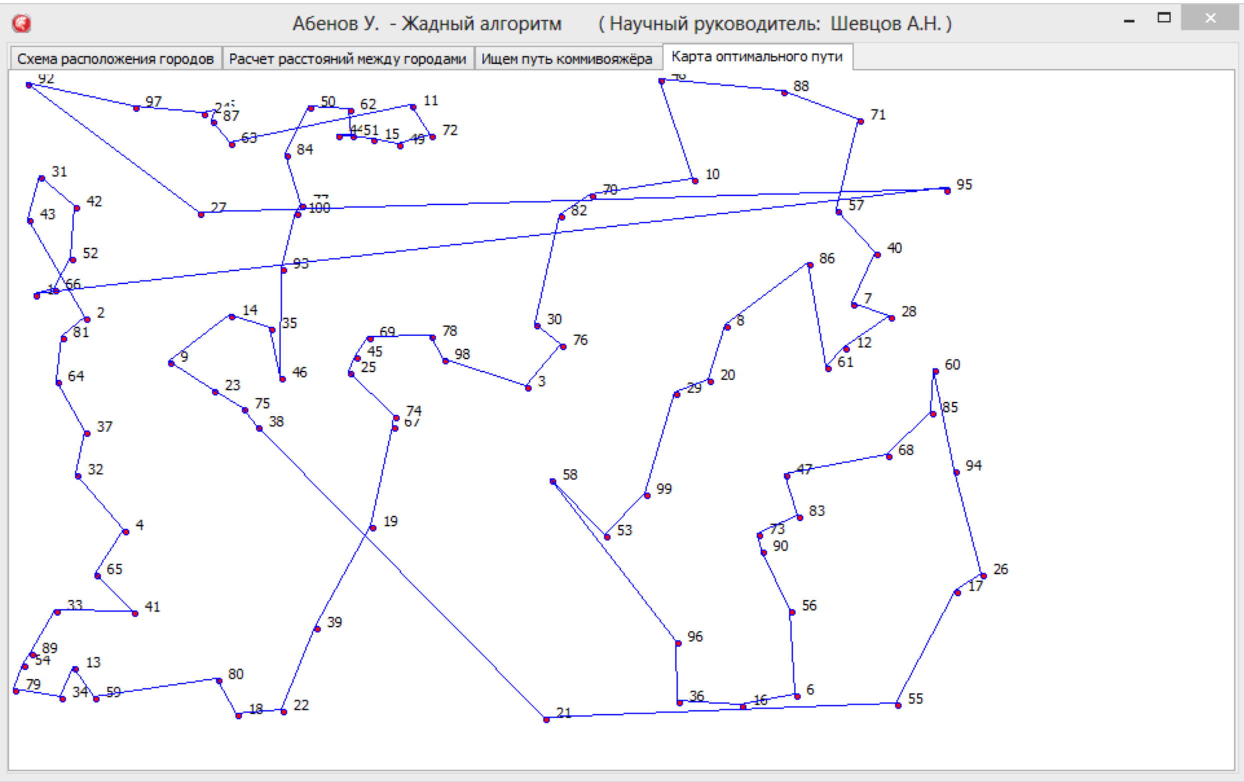

Рисунок 17 – Моделирование 100 городов. Процесс построения траектории оптимального пути.

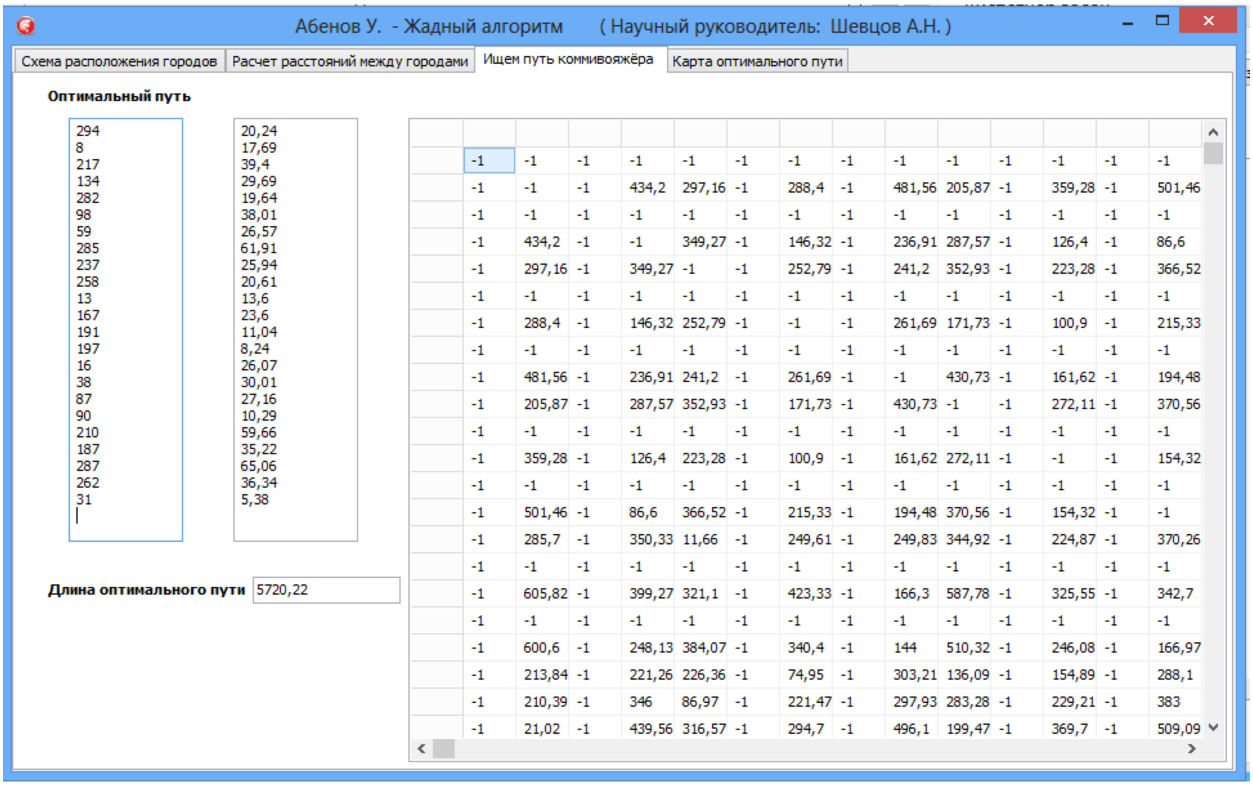

Рисунок 18 – Моделирование 300 городов. Процесс расчета оптимального пути.

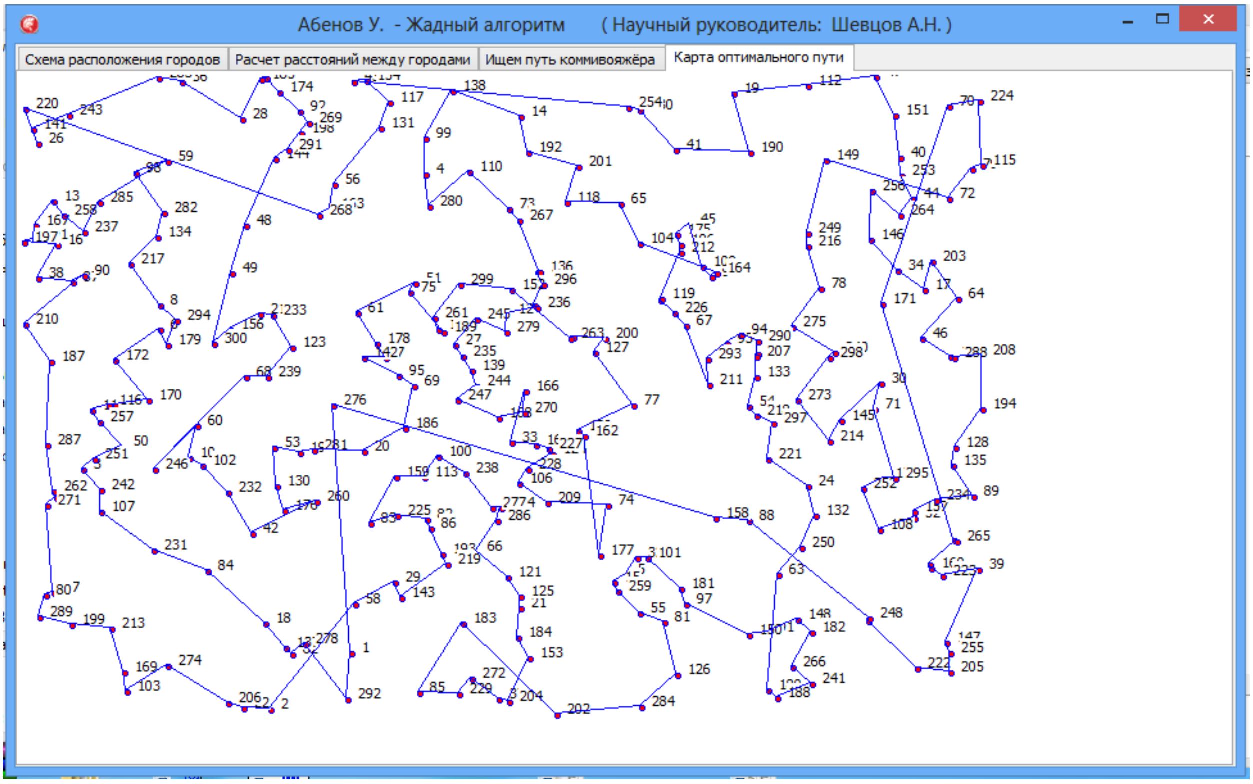

Рисунок 19 – Моделирование 300 городов. Траектория оптимального пути.

Conclusion

В результате проведенного исследования были получены следующие результаты:

- Разработаны алгоритмы и программа для решения задачи поиска оптимального пути на Maple,
- Разработаны алгоритмы и программа для решения задачи поиска оптимального пути на Delphi,
- Разработанные алгоритмы реализованы и аппробированы для различных начальных условий.

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SECTION 2. Applied mathematics. Mathematical modeling.

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THE PRACTICAL ASPECT OF USING GREEDY ALGORITHM

***Abstract**: Initial data for algorithm development are well-known algorithms for the problem of kommivoyazhera, methods of calculation way for Greedy algorithm, known as source data for the task. The justification for the research work is based on the need of commercialization of the algorithm and the creation of methods of calculation capable of implementing the algorithm with the possibility of implementation.*

***Key words**: introduction, greedy algorithm, Delphi.*
***Language**: Russian*
***Citation**: Abenov U, Shevtsov A (2017) THE PRACTICAL ASPECT OF USING GREEDY ALGORITHM. ISJ Theoretical & Applied Science, 05 (49): 120-127.*
***Soi**: http://s-o-i.org/1.1/TAS-05-49-18 **Doi**: crossref https://dx.doi.org/10.15863/TAS.2017.05.49.18*

ПРАКТИЧЕСКИЙ АСПЕКТ ИСПОЛЬЗОВАНИЯ ЖАДНОГО АЛГОРИТМА

***Аннотация**: Исходными данными для разработки алгоритмов являются известные алгоритмы задачи коивояжера, методы расчета пути для «Жадного алгоритма», известные исходные данные для задачи. Обоснование необходимости проведения научно-исследовательской работы опирается на необходимость комерциализации алгоритма и создание методов расчета, способных реализовать алгоритм с возможностью внедрения.*

***Ключевые слова**: внедрение, жадный алгоритм, Delphi.*

Introduction

Актуальность проблемы.

При решении различных технологических задач требуется найти оптимальный путь решения обусловленный малым временем выполнения задачи. Поэтому задача расчета оптимального пути является актуальной для промышленности.

Сведения о планируемом научно-техническом уровне разработки.

Теоретические исследования и математические модели позволяют прогнозировать оптимальный путь с минимальным временем. Результаты исследования могут быть направлены на автоматизацию процессов и сокращение сроков и средств затрачиваемых на их выполнение.

Целью работы является разработка алгоритмов и программ для Delphi и Maple для поиска оптимального пути и возможности их коммерциализации.

Для достижения этой цели в работе решались **следующие задачи:**

- разработка программы для Delphi и ее апробация для различных начальных данных;
- изучение возможности комерциализации данного алгоритма в производстве.

Научная новизна исследований

- разработаны программы на Delphi с возможностью их комерциализации.

Практическая ценность

- разработанные алгоритмы и программное обеспечение позволяет находить оптимальный путь. Результаты имеют возможность комерциализации.

Обоснованность и достоверность полученных результатов -подтверждается тем, что они были получены на основе известных теоретических и апробированных методов дискретной математики.

Materials and Methods

Практический аспект использования

Аппробируем данный алгоритм на 16 городах Казахстана. Для этого необходимо выбрать второй пункт, загрузить карту, и ввести все координаты всех городов.

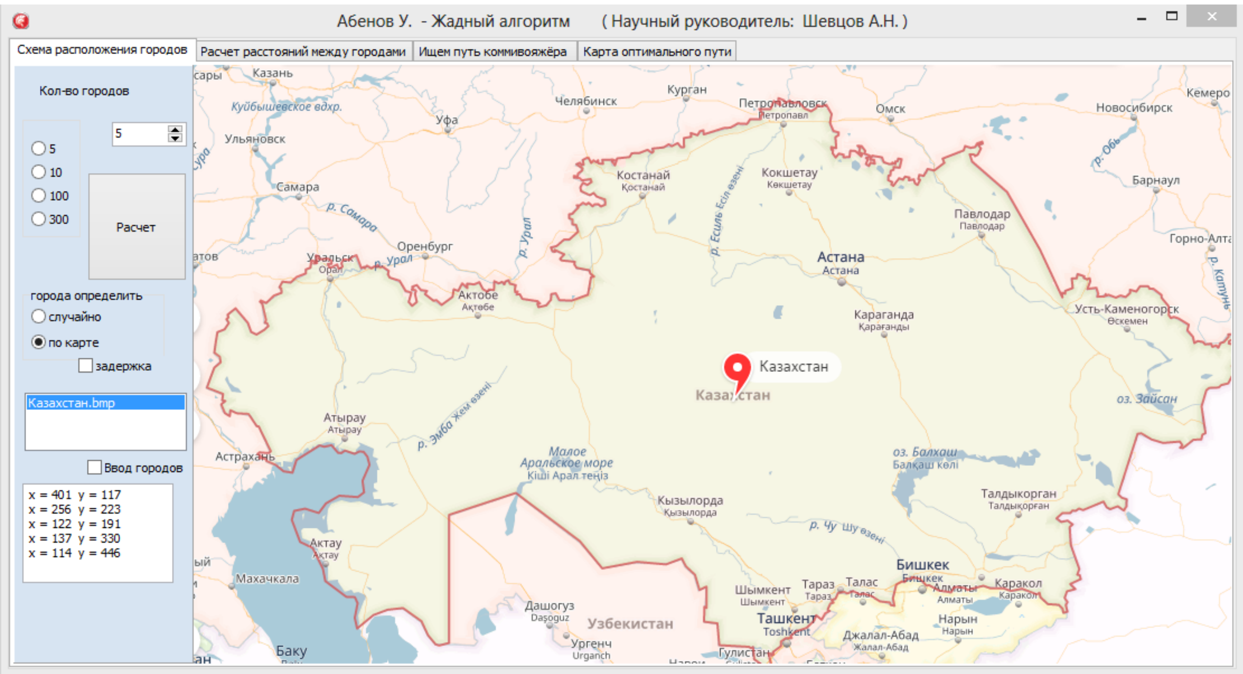
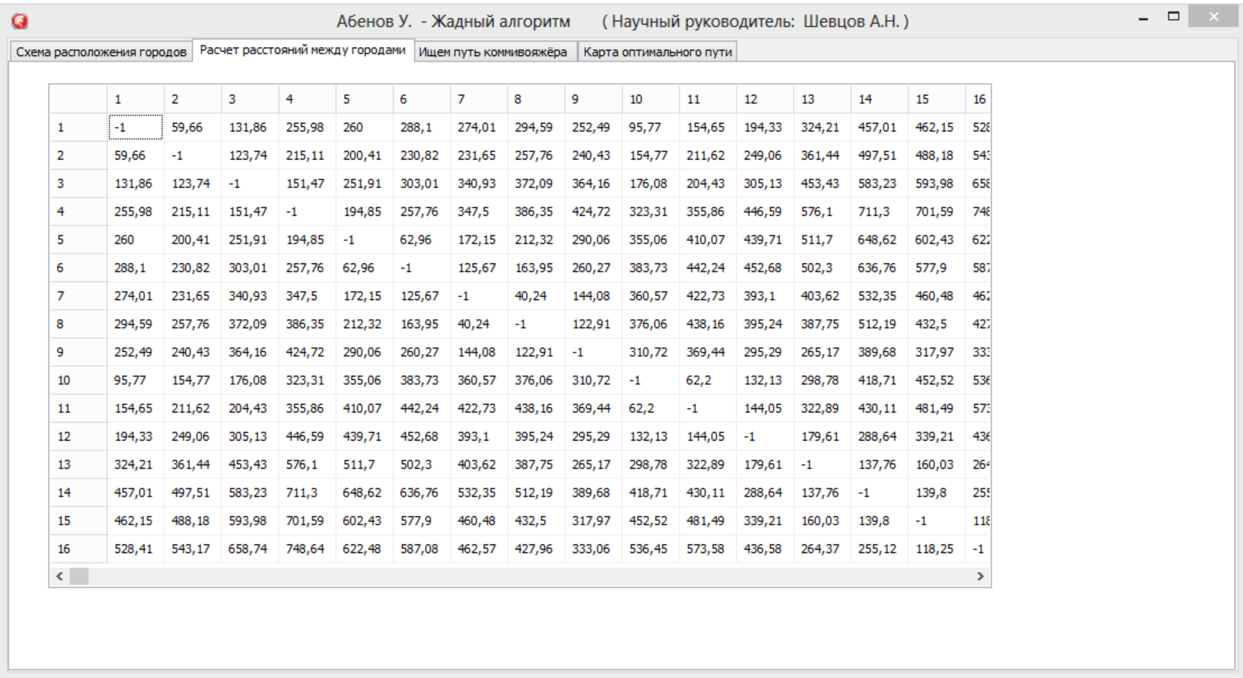


Рисунок 1 – Ввод карты и координат городов.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	-1	59,66	131,86	255,98	260	288,1	274,01	294,59	252,49	95,77	154,65	194,33	324,21	457,01	462,15	528
2	59,66	-1	123,74	215,11	200,41	230,82	231,65	257,76	240,43	154,77	211,62	249,06	361,44	497,51	488,18	54
3	131,86	123,74	-1	151,47	251,91	303,01	340,93	372,09	364,16	176,08	204,43	305,13	453,43	583,23	593,98	658
4	255,98	215,11	151,47	-1	194,85	257,76	347,5	386,35	424,72	323,31	355,86	446,59	576,1	711,3	701,59	748
5	260	200,41	251,91	194,85	-1	62,96	172,15	212,32	290,06	355,06	410,07	439,71	511,7	648,62	602,43	62
6	288,1	230,82	303,01	257,76	62,96	-1	125,67	163,95	260,27	383,73	442,24	452,68	502,3	636,76	577,9	58
7	274,01	231,65	340,93	347,5	172,15	125,67	-1	40,24	144,08	360,57	422,73	393,1	403,62	532,35	460,48	46
8	294,59	257,76	372,09	386,35	212,32	163,95	40,24	-1	122,91	376,06	438,16	395,24	387,75	512,19	432,5	42
9	252,49	240,43	364,16	424,72	290,06	260,27	144,08	122,91	-1	310,72	369,44	295,29	265,17	389,68	317,97	33
10	95,77	154,77	176,08	323,31	355,06	383,73	360,57	376,06	310,72	-1	62,2	132,13	298,78	418,71	452,52	536
11	154,65	211,62	204,43	355,86	410,07	442,24	422,73	438,16	369,44	62,2	-1	144,05	322,89	430,11	481,49	57
12	194,33	249,06	305,13	446,59	439,71	452,68	393,1	395,24	295,29	132,13	144,05	-1	179,61	288,64	339,21	436
13	324,21	361,44	453,43	576,1	511,7	502,3	403,62	387,75	265,17	298,78	322,89	179,61	-1	137,76	160,03	26
14	457,01	497,51	583,23	711,3	648,62	636,76	532,35	512,19	389,68	418,71	430,11	288,64	137,76	-1	139,8	25
15	462,15	488,18	593,98	701,59	602,43	577,9	460,48	432,5	317,97	452,52	481,49	339,21	160,03	139,8	-1	118
16	528,41	543,17	658,74	748,64	622,48	587,08	462,57	427,96	333,06	536,45	573,58	436,58	264,37	255,12	118,25	-1

Рисунок 2 – Расчет расстояний между городами.

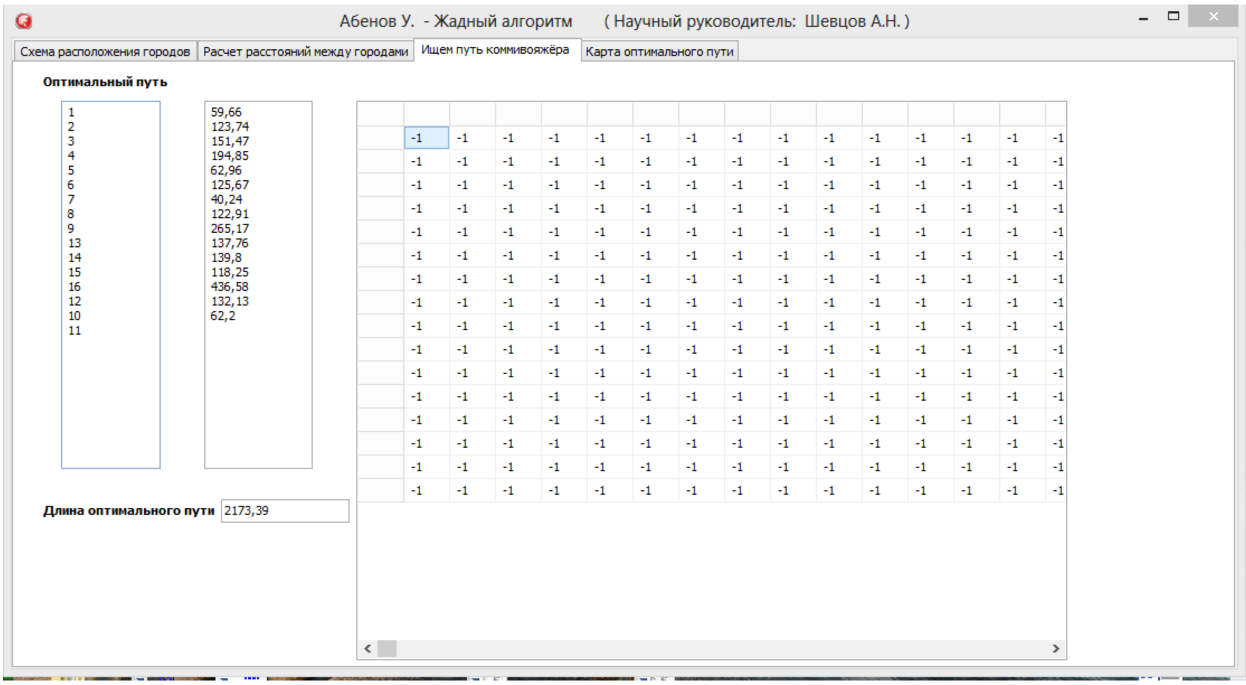


Рисунок 3 – Расчет оптимального пути.

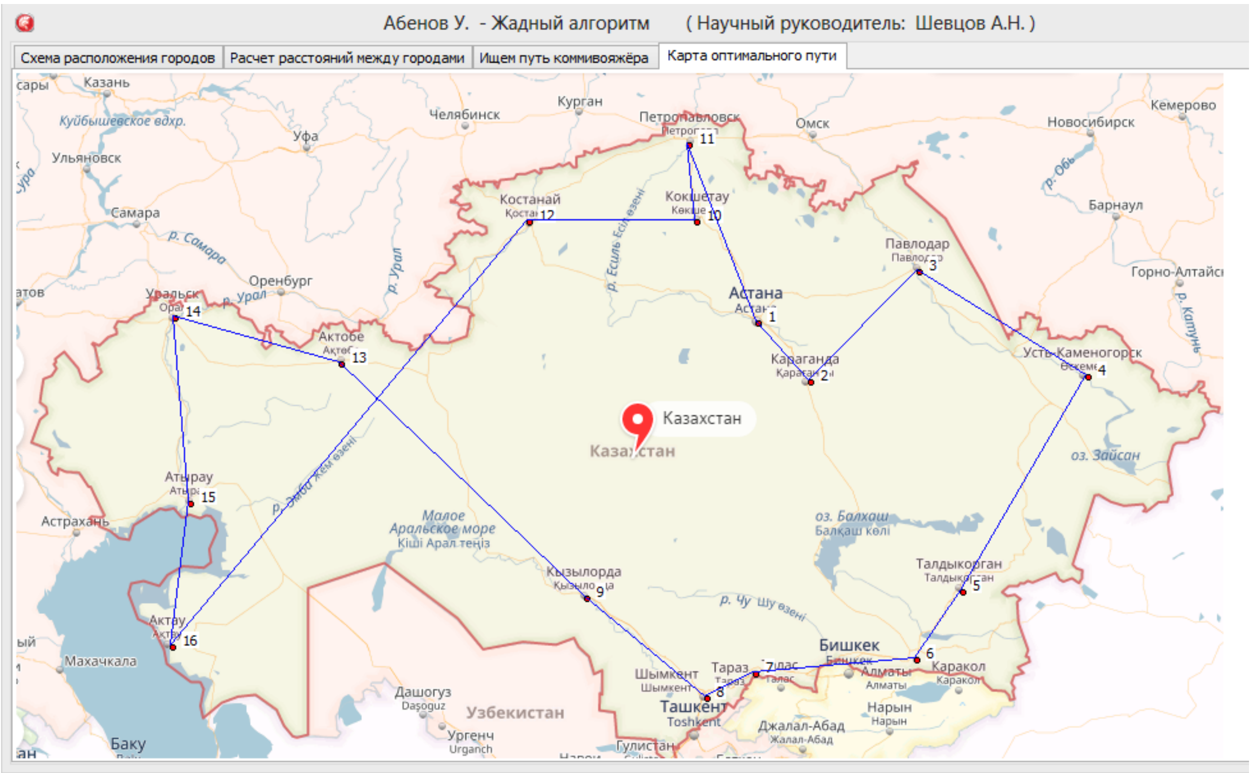


Рисунок 4 – Оптимальный путь.

Как видим применение задачи коммивояжера на практике очень обширно. Ее можно использовать для поиска кратчайшего маршрута при гастролях эстрадной группы по городам, нахождения последовательности технологических операций обеспечивающей наименьшее время выполнения всего производственного цикла и пр.:

- **Задача о путешественнике.** Коммивояжер должен объездить N городов. Для того чтобы уменьшить расходы, он хочет построить такой маршрут, чтобы объездить все города только по одному разу и вернуться в исходный с минимумом затрат. Затраты на перемещение между городами заданы матрицей.

- **Задача о производстве красок.** Имеется цех или производственная линия для производства n красок разного цвета; обозначим эти краски номерами 1,2… n. Всю производственную линию можно считать одним станком. Будем также считать, что единовременно станок производит только одну краску, поэтому краски нужно производить в некотором порядке. Поскольку производство циклическое, то краски надо производить в циклическом порядке. После окончания производства краски i и перед началом производства краски j надо отмыть оборудование от краски i. Для этого требуется время C[i,j]. Очевидно, что C[i,j] зависит как от i, так и от j, и что, вообще говоря,C[i,j]≠C[j,i]. При некотором выбранном порядке придется на цикл производства красок потратить время:

$$f = \sum_{(i,j)\in\pi} C_{i,j} + \sum_{k=1}^{n} t_k$$

где t_k - время производства k-ой краски (не считая очистки). Вторая сумма в правой части постоянна, поэтому полное время на цикл производства минимизируется вместе с общим временем на очистку. Таким образом, задача коммивояжера и задача о минимизации времени очистки – это одна задача, только варианты ее описаны разными словами.

- **Задача о дыропробивном прессе.** Дыропробивной пресс производит большое число одинаковых металлических листов, в которых последовательно по одному пробиваются отверстия разной формы и величины. Схематически пресс можно представить в виде стола, двигающегося независимо по координатам x, y, и вращающегося над столом диска, по периметру которого расположены дыропробивные инструменты разной формы и величины. Каждый инструмент присутствует в одном экземпляре. Диск может вращаться одинаково в двух направлениях (по координате вращения z). Имеется собственно пресс, который надавливает на подвешенный под него инструмент тогда, когда под инструмент подведена нужная точка листа. Теперь, как и в предыдущем случае, задача составления оптимальной программы для дыропробивного пресса сводится к задаче коммивояжера .

В результате проведенной апробации и реализации двух программ на Maple и Delphi можно сделать вывод, что полученные данные свидетельствуют о корректной работе Жадного алгоритма при различных начальных условиях.

Аппробация разработанных алгоритмов

Для аппробации разработанных алгоритмов дискретной математики разработаем устройство состоящее из двух линейных приводов, двух драйверов и платы Ардуино уно.

Подключение к компьютеру будем осуществлять по USB кабелю.

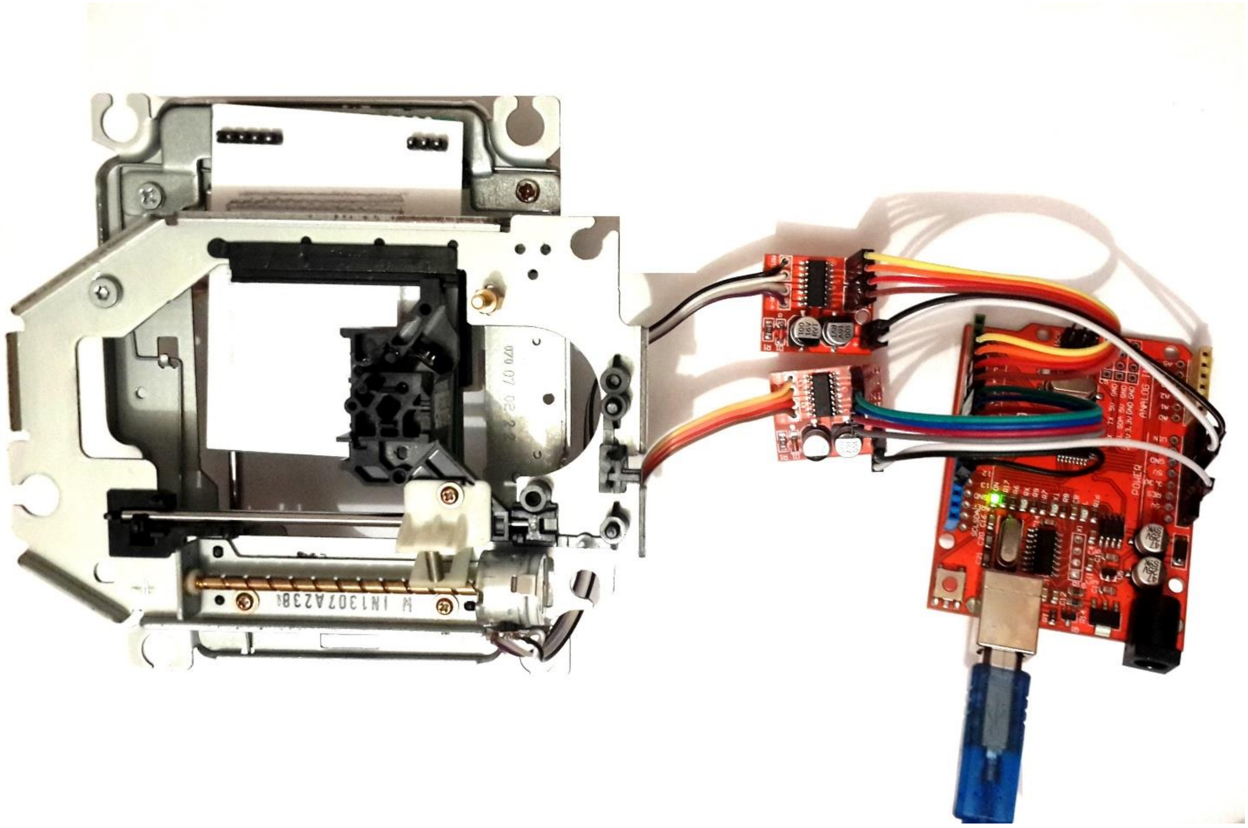


Рисунок 5 – Микроконтроллер и два линейных привода.

Разработаем программу для микроконтроллера:

```
#include <Stepper.h>
// change this to the number of steps on your motor
#define STEPS 100

Stepper s1(STEPS, 11, 10, 9, 8);
Stepper s2(STEPS, 7, 6, 5, 4);

int  s1max = 220;
int  s2max = 160;

int x,y,x0,y0 =0;
char incomingByte;  // входящие данные

void setup() {
    Serial.begin(115200);
  // set the speed of the motor to 30 RPMs
  s1.setSpeed(80);
  s2.setSpeed(60);
  s1.step(-s1max);
  s2.step(-s2max);
}

void loop() {

 if (Serial.available() > 0) {  //если пришли данные
incomingByte = Serial.read(); // считываем байт
```

```
    x:=x0+incomingByte;
    incomingByte = Serial.read(); // считываем байт
    y:=y0+incomingByte;

      s1.step(x);
      s2.step(y);
      x0:=x;
      y0:=y;
    //  delay(5000);
      }
```

Дополним программу на Delphi возможностью подключения к микроконтроллеру:

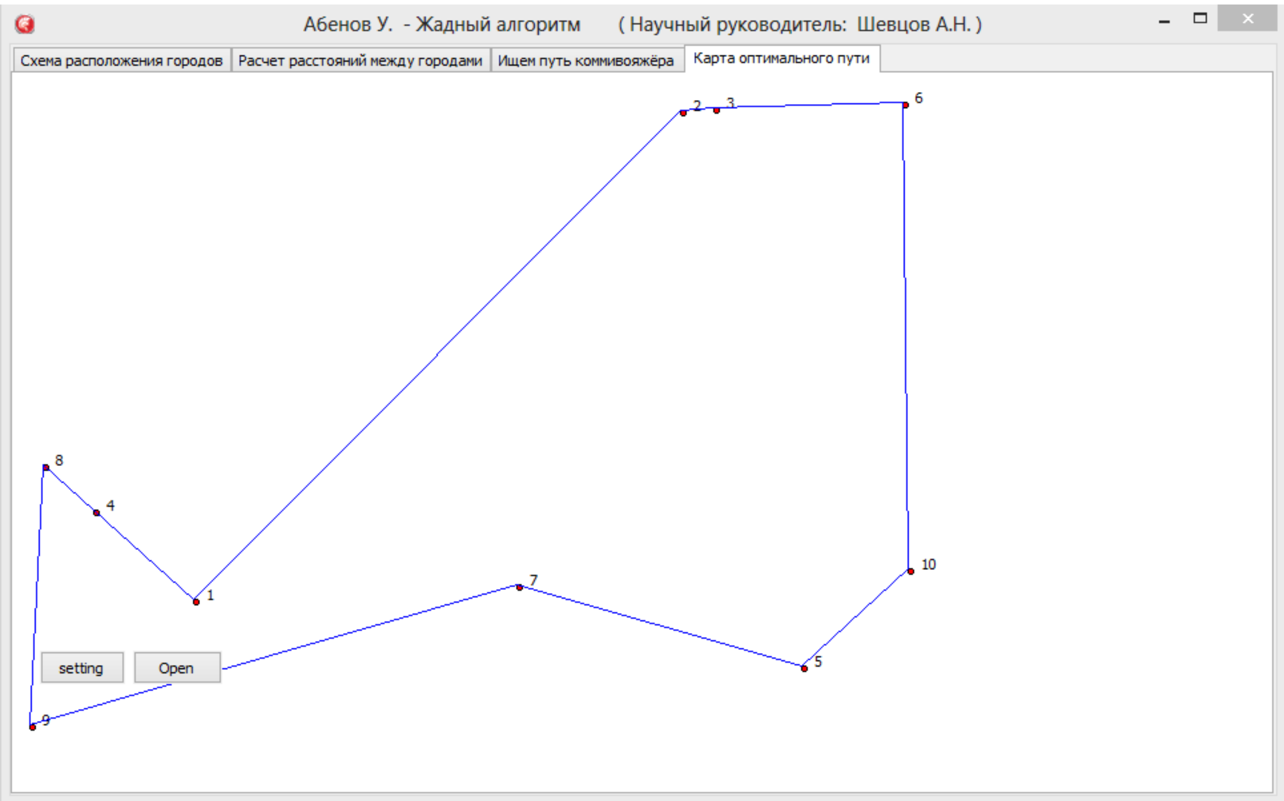


Рисунок 6 – Программа на Delphi с подключением к микроконтроллеру.

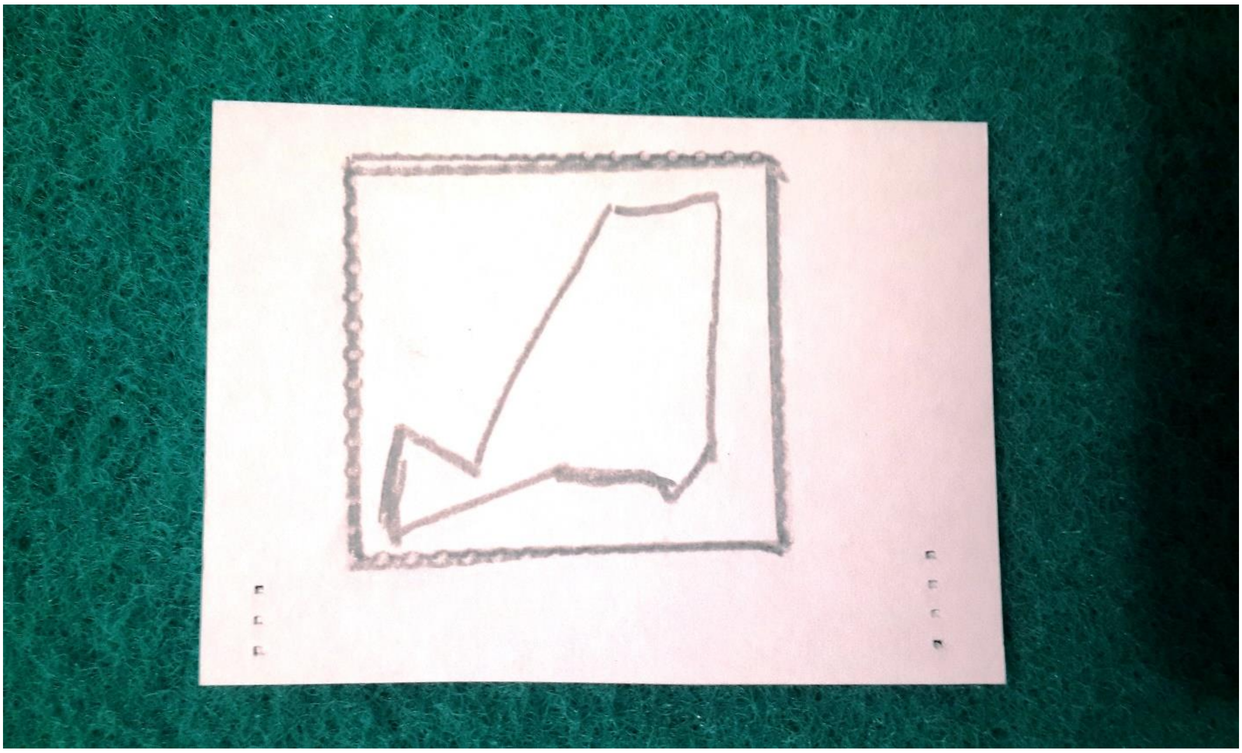


Рисунок 7 – Результат работы устройства.

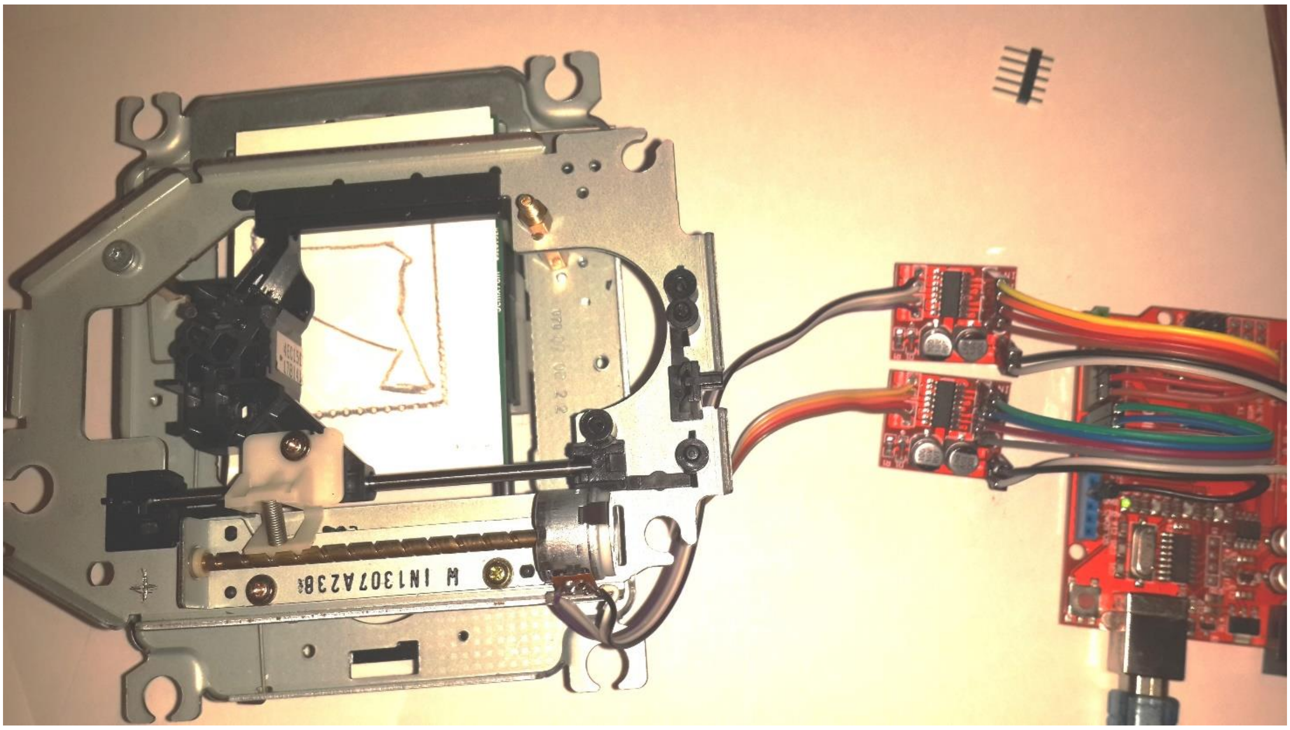


Рисунок 8 – Программа в действии.

Conclusion

В результате проведенного исследования были получены следующие результаты:

Программа на Delphi адаптирована к практическому использованию с картами и может использоваться для решения практических задач,

Имееется возможность комерциализации результатов работы.

Разработано устройство на микроконтроллере реализующее жадный алгоритм.

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BUSINESS-COACHING AS THE MAIN TOOL FOR MANAGING EMPLOYEES OF ORGANIZATIONS

Abstract: *The research is devoted to the problem of cardinal changes in the personnel management of organizations in the recent years. The purpose of this article is to determine the importance of the application of business coaching as a tool for managing employees of organizations in rapidly changing conditions. The article analyzes the development trend of business coaching around the world in terms of: the number of practicing coaches and coach-competent managers of organizations, the total annual income from coaching, the income of coaches around the world, and the importance of using it by the example of big foreign companies. The main results of using coach management in the activities of companies are presented, and its effectiveness are given. The result of the study is the proof of the importance of the application of business coaching as a tool for managing employees of organizations and the importance of its implementation in the activities of each company, the effect of which will lead organizations to a new level of development.*

Key words: *Business-coaching, coaching culture, management, motivation, values.*

Language: *English*

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Introduction

In recent decades, the reality surrounding us has changed significantly. Global changes that occurred in the XXI century, led to the formation of a new way of thinking. At present, the human worldview system has evolved, and for the business world it's time to pay attention not only to the development of technics and technology, but also to the person who works in business. At the moment, values such as the increase in the role of the individual, self-expression of the person, self-actualization, the importance of social partnership between organizations and the public have become priorities.

Researches have shown that modern business reality has become more complex, volatile and unpredictable. IBM conducted a survey of 1,500 executives and found that company executives highlighted the growing complexity of the environment as the main problem in their companies' operations, and most of the interviewed executives noted that their organizations are not ready to overcome this complexity [1].

In connection with the rapid change in external factors, the tasks facing company employees are rapidly changing, which requires conceptually new methods for their solution. Modern managers are increasingly faced with the fact that the old methods of motivating employees no longer work. People need a new management method, more flexible and attentive to everyone [2]. All this implies the need for employees to acquire fundamentally new skills and competencies to continue their successful operations.

In modern conditions of dynamically changing external environment, organizations that focus their attention on the constant development of the social environment of their business and that invest in the development of their employees and in the forms of social interaction between them could pretend to be leaders in their industry.

Currently, the unique technology of working with employees of organizations "Business-coaching" is gaining popularity. This technology is aimed at achieving the goals of a person and/or organizations. Business coaching as the main tool for managing employees of organizations is aimed at organizing the search for the most effective ways to achieve the goals of the company and their implementation by employees. The main result of the application of Business-coaching in personnel management is the ability of employees to independently solve many tasks, take the initiative, make choices, take responsibility and make decisions. Business-coaching allows employees to build a culture of dialogue based on mutual respect and trust, and also helps to unlock the potential of the person, thus helping him to achieve maximum efficiency [3].

Materials and Methods

Coaching as a profession was officially recognized in the United States in 2001 due to the creation and activities of the International Coach Federation (ICF). According to the “2016 ICF Global Coaching Study” conducted by the International Coach Federation with the assistance of the international audit company PricewaterhouseCoopers (PwC), nowadays, there are 53,300 practicing coaches and 10,900 coach-competent managers around the world (table 1).

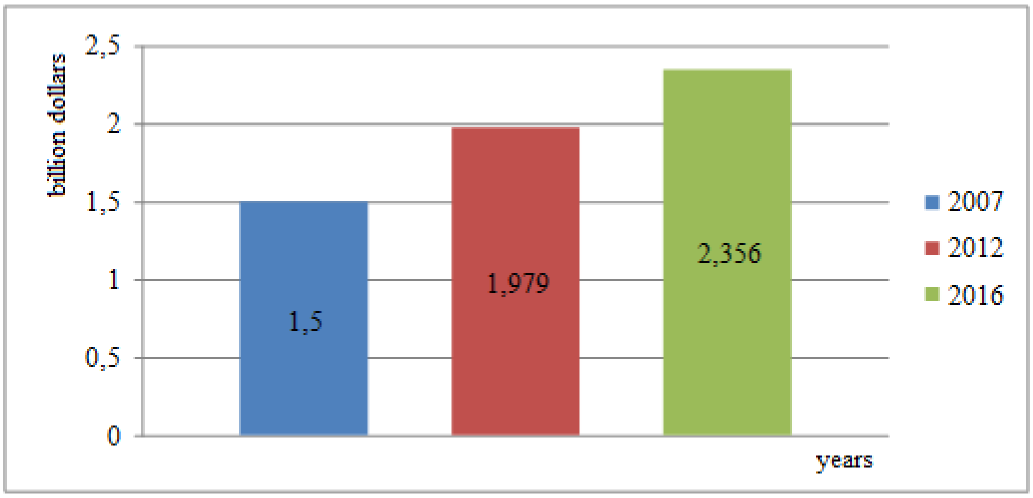
Table 1

Total number of coaches and coach-competent managers in the world, pers. (according to the “ICF Global Coaching Study”)

Region	2012	2016		
	Coaches	Coaches	Coach-competent managers	Total
North America	15 800	17 500	3 100	20 600
Latin America and the Caribbean	2 600	4 000	1 000	5 000
Western Europe	17 800	18 800	2 700	21 400
Eastern Europe	3 500	4 500	1 500	6 000
Middle East and Africa	2 100	2 400	700	3 100
Asia	3 300	3 700	1 500	5200
Oceania	2 400	2 400	400	2 800
Total	47 500	53 300	10 900	64 100

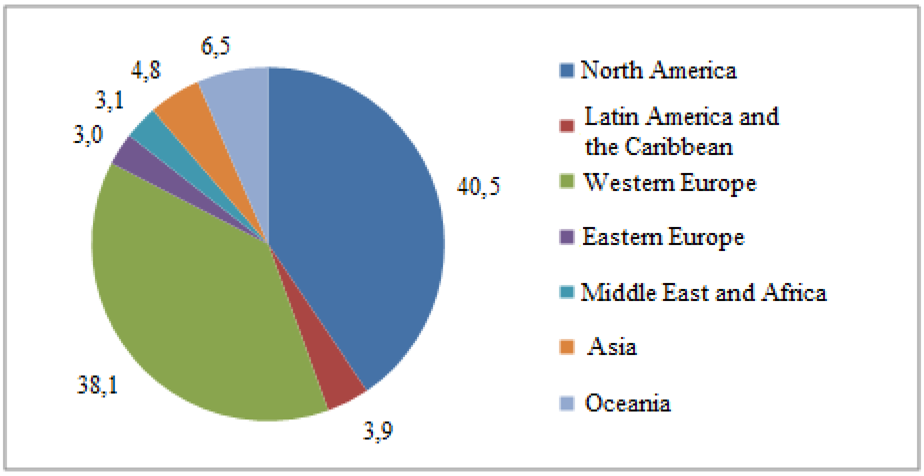
According to the data for the period from 2012 to 2016, the number of coaches in the world increased by the 5,8 thousand people, from 47,5 thousand people to 53,3 thousand people. Of which 35.2% of the total work in Western Europe, 32.8% – work in North America, 8.4% – in Eastern Europe, 7.5% – in Latin America and the Caribbean, 6.9% – in Asia, 4.5% – in the Middle East and Africa and 4.5% – in Oceania. Considering the fact that the analysis of the number of coach-competent managers is considered in ICF studies for the first time, it can be concluded that the importance of using Business-coaching technology in the management of employees of organizations is growing. According to the research, the number of coach-competent managers makes up one fifth of the total number of coaches and will continue to grow in the future.

The world market of coaching is growing rapidly. The ICF research conducted in 2007, 2012, 2016 shows that over 10 years the volume of coaching services has increased by more than 1.5 times (pic. 1).



Picture 1 – Total annual income from coaching in the world, billion dollars (according to the “ICF Global Coaching Study”)

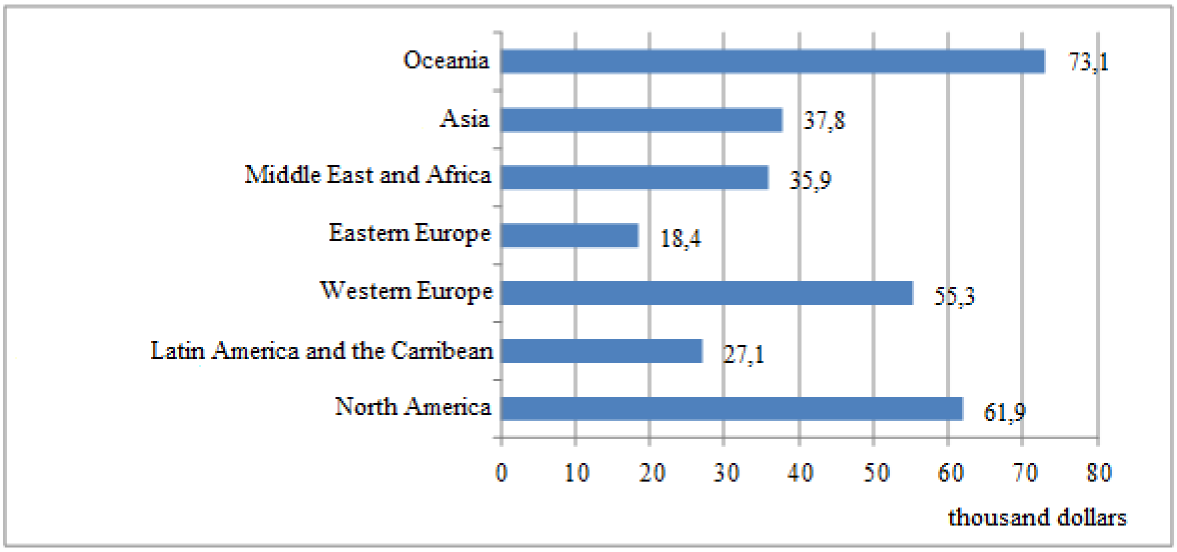
According to the data given, the coaching market in the world from 2007 to 2012 has increased by 32% from $ 1.5 billion and reached a volume of 1.979 billion dollars, from 2012 to 2016 – by 19% from 1.979 billion dollars and reached a volume of 2.356 billion dollars (pic. 2).



**Picture 2 – The share of revenues by regions from the total annual income for 2016, %
(according to the "ICF Global Coaching Study")**

The largest volume of income from the provision of coaching services accounts from the total – 40.6% in North America, 38.1% – in Western Europe, 6.5% – in Oceania, 4.8% – in Asia, and 3.9% – in Latin America America and the Caribbean, 3.1% – the Middle East and Africa, 3.0% – Eastern Europe.

Among coaches with active clients, the average annual income from coaching in 2016 was 51.0 thousand dollars. The highest average annual income of coaches was indicated by the coaches of Oceania – 73.1 thousand dollars, the lowest – coaches in Eastern Europe – 18.4 thousand dollars (pic. 3).

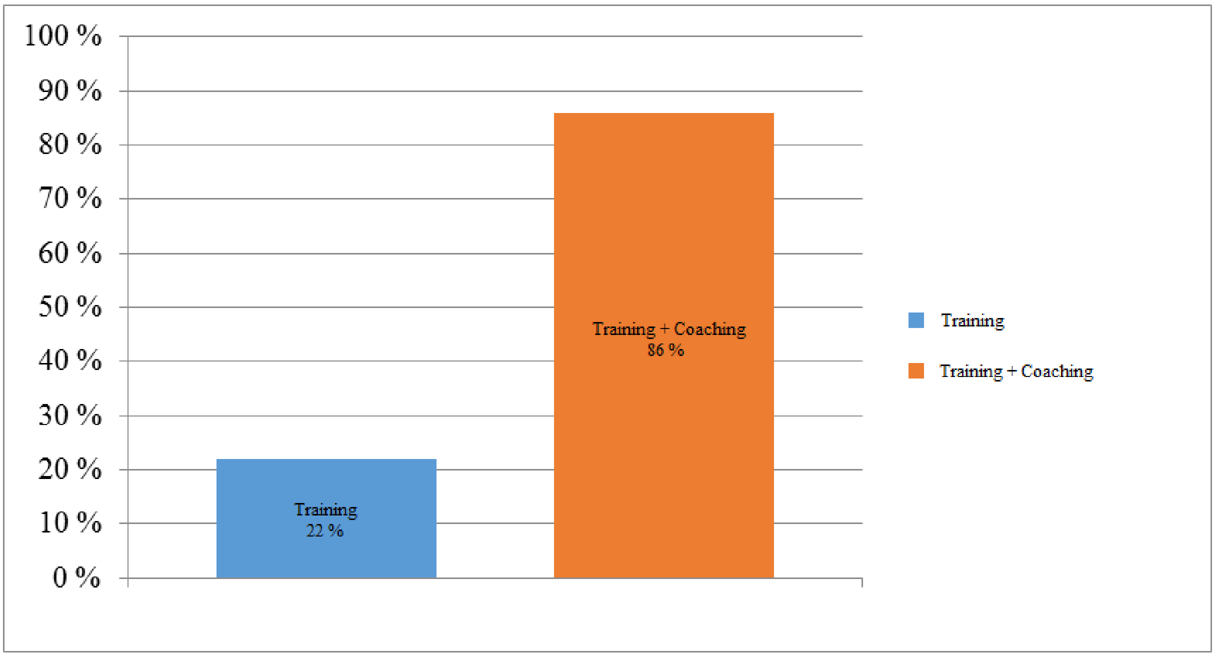


**Picture 3 – The average annual income of coaches in the world, thousand dollars
(according to the "ICF Global Coaching Study")**

According to the above, the development of coaching has a positive growth trend all around the world, as evidenced by a steady increase in the number of practicing coaches, the total annual income from coaching, the income of coaches around the world, and also coach-competent managers who apply coaching technologies in their work.

For the formation of personnel reserve in big organizations, as a rule, is responsible for the department for work with personnel. HR-specialists basically choose such methods of personnel development as training courses, trainings, mentoring, 360 assessment, etc. All the above methods are aimed at transferring knowledge, experience, information, but for a modern experienced worker this is not so important.

According to the statistics of the American Society for Training & Development, companies all over the world invest more than 2 billion dollars a year in training and staff development, but 50-90% of costs are ineffective, since without realizing the importance of applying knowledge gained in practice upgrading of qualifications and passing all kinds of trainings do not give an expected result [4] (pic. 4).



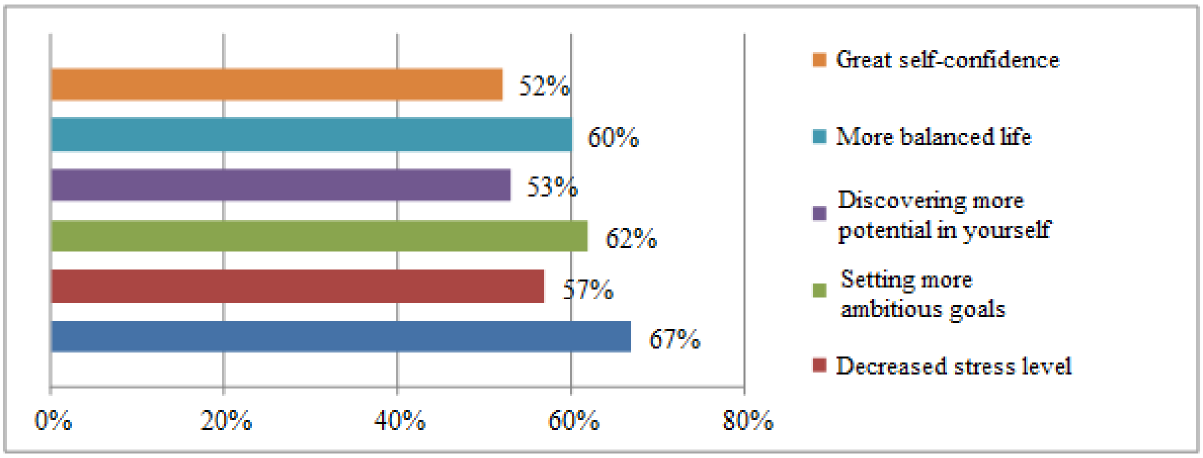
Picture 4 – Effect of coaching and training on the labor productivity, %
(according to the American Society for Training & Development)

According to the statistics of the International Association of Management, it can be noted that in the case of combining trainings with coaching, labor productivity increases to 86 % and only 22 % in cases where only trainings are conducted. Coaching really increases the effectiveness of training by almost 4 times, since coaching is based directly on the personal experience of the employee, and the conscious application of knowledge gained at the training.

Today, there are cardinal changes in the system of personnel management: organizational structure, processes, tools, and most importantly - the managers. Each rapidly developing organization notices these changes and takes specific actions to develop its organization in accordance with current business realities.

Nowadays, Business-coaching as a tool for personnel management is used by more than 500 large and successful foreign companies, including Boeing, American Express, Motorola, IBM, Marriott International, Glaxo Wellcome, that is almost 70 % of "Fortune" companies use Business-coaching in their practice [5]. According to a survey of 100 top-managers of companies "Fortune1000", as a result of coaching, noticeable improvements in motivation, productivity, quality, increasing efficiency of the organization, customer service, stock value of shares, and also in reducing the number of customer complaints and employee turnover [6]. According to Metrix Global statistics, in companies that are members of the "Global500" return on investment (ROI) in coaching is 529%. Coaching really goes into the life of managers and increases the effectiveness of their work. Eight out of ten executives who experienced it themselves claim to have benefited from it, and 96 % say that coaching should be available to employees of all levels.

According to the International Coach Federation (ICF), with the application of Business-coaching in the work with staff, positive results are achieved (pic. 5).



Picture 5 – The results of the application of business coaching in the work with the staff (according to the International Coach Federation, ICF)

These researches confirm that coaching helps to solve the challenge facing employees of organizations in today's business reality. In the practice of Russian companies, Business-coaching is only beginning to prove itself: over the past five years, several large Russian companies have declared Business-coaching the main direction of their development and have begun campaigns to create a coaching culture.

Among foreign companies, cardinal changes in the system of personnel management: organizational structure, processes, tools, and most importantly - the managers themselves, are much more active. Each rapidly developing organization notices these changes and takes concrete actions to develop its organization in accordance with current business realities.

For example, in 2016, General Electric launched one of the largest projects to revise the famous performance management system. The system introduced under Jack Welch ceased to meet the needs of the company and took too much time: the company spent a total of five months on the annual staff assessment. The new system implies the abolition of the rating system and the more frequent interaction between the manager and the employee. The company chose several "pioneering teams" in which such meetings completely replaced the rating system. Also for these teams the evaluation criteria have changed somewhat. More static parameters, such as the level of expertise and clarity of thinking, have been replaced by more dynamic ones. For example, the desire to learn and the ability to adapt. The company began to encourage teams that are committed to change and are able to learn from their mistakes. For some employees, special two-hour meetings are held, where they talk about their mistakes and conclusions. Also, General Electric automated the process of providing feedback through a special mobile application "PD@GE". Each employee can take a feedback on their work or evaluate another employee. If you receive a positive feedback or thanks, the "continue" button is displayed, if there is a negative feedback – "learn".

In 2012 Adobe company instead of the annual evaluation sessions, introduced the "check-ins" system, which includes frequent meetings to discuss the results, encourage successful tasks, and formulate expectations from employees. The result of this innovation was a 30 % reduction in personnel turnover. The "Check-in" system undergoes continuous development, thanks to the constant development of mentoring and coaching skills among managers. Particular attention is paid to those managers whose teams demonstrate the least involvement in the work. In general, according to Adobe HR-managers that changes helped employees and managers make meetings devoted to the evaluation of effectiveness much easier. Staff turnover has decreased, and the level of loyalty to the company has increased.

Deloitte company, having analyzed the effectiveness of its "performance management" system, has also significantly changed the efficiency evaluation process. Instead of asking the opinion of several members of the team about the effectiveness of the employee, as in the evaluation of 360, the company decided to ask only the current leader of the team, changing the nature of the issues and increasing their number. To reduce the subjectivity of answers, leaders are asked not about the skills and qualities of a particular employee, but about what actions the leader is willing to take in relation to this employee. The poll includes four statements:

1. If the company's money were mine, then, taking into account the productivity of this employee, I would provide him with the maximum possible increase in compensation (Measures the overall productivity and uniqueness of the employee).

2. Taking into account the productivity of this

employee, I would much like him to be on my team (The ability to cooperate and teamwork is measured).

3. This employee is at risk because he/she has a poor performance (Potential risks are identified).

4. This employee is ready for improvement today (The potential of the employee is measured).

Analysis of the answers allows to make informed decisions about the future of employees. Using of this technology and the constant collection of feedback, managers at any time can get all the information about the effectiveness of employees, based on the responses of their team leaders. Another innovation was the weekly "Check-in", which allows the leaders to convey to the team members goals and expectations for the next week, prioritize, make the necessary adjustments, give a short feedback on the previous week.

Changes in the system of personnel management in the activities of large companies confirm the need for the development of a new, more flexible, supportive, command-forming personnel management tool, which is called Business-coaching.

At the same time, the majority of Russian organizations still do not mention Business-coaching as an important tool for managing employees, but they are used only as a type of management consulting. Leaders are happy to engage with professional coaches, developing their skills, but continue to interact with subordinates in the traditional directive manner of orders, control of performance and negative feedback, rather than becoming facilitators of their effectiveness. The reasons are both in the absence of coaching competencies, and in outdated mental models of leaders.

In the same moment, the existing complex macroeconomic conditions in the world strengthen the need to overcome the vertical model of interaction between managers and subordinates and move to the model of cooperation, jointly solve complex problems of increasing productivity in conditions of limited resources, growth in a falling economy, motivation at a falling consumption level. At present, managers of organizations are forced to master coaching leadership in order to remain competitive. The main reasons that justify the importance of using business coaching as the main tool for managing employees of organizations are:

1. Ineffectiveness of old systems for evaluating the effectiveness of employees. Analysis of traditional systems for assessing the effectiveness of employees showed that companies use the following tools:

- annual or semi-annual meetings with discussion of the results of the employee's work and setting goals and objectives for the year ahead;
- rating system of employees, based on the estimates for the performance of certain projects during the year;
- various assessment methods, including a survey of team members (ex., assessment 360).

Each of the above tools has recently been subject to increasing criticism due to the large time spent on their implementation, as well as their inefficiency. For example, according to Deloitte's estimates for filling out forms, holding annual meetings and making ratings, the company spent about 2 million hours per year. This implies that such a system does not allow you to quickly respond to changes in the company, and delay the development of employees. Studies in the field of the rating system in assessing the effectiveness of employees have shown that they have a negative impact on the corporate culture and the involvement of staff in the work: assigning an employee a place in the ranking or making a numerical rating causes two possible reactions: euphoria or aggression that have a bad impact on employee involvement. A survey conducted by Globoforce showed that out of 708 interviewed employees of various US companies, more than half do not consider such a system of evaluation effective and motivating, and more than 60% do not agree with the results of annual assessments. Thus, conversations are much more effective, helping the staff to analyze the experience and draw the appropriate conclusions. Today, many companies (Accenture, Adobe, Microsoft, etc.) refuse to rank employees in favor of other methods of performance management.

In the process of coaching, such a tool as feedback is most effective. After all, it is aimed at the result, for certain actions. Feedback in coaching is always supportive. It allows you to see the growth zones and direct efforts in them. The coach gives such feedback, which helps the employee's weak sides to turn into strong, that inspires and gives new opportunities.

In business, for a confident move forward, it is very important to understand on the right person the ways. Or change course if its direction is not true. Therefore, feedback is an obligatory and important component of the coaching process. It provides support and motivation, directs and corrects, gives strength and confidence. All this helps to focus on the results and quickly achieve the goal.

2. Change the values of a new generation of employees. At the moment, the number of the new generation of employees has significantly increased - the generation Y, for which a serious motivating factor is the possibility of constant training and growth. For such employees it is important to often receive feedback in order to continuously improve their effectiveness [7]. For this reason, annual meetings are replaced by more frequent and less formal meetings, during which employees can share their ideas, opinions, suggestions [8]. The ability to express your point of view and be heard is directly related to the level of involvement in the work, while

organizations that pay great attention to maintaining a high level of employee engagement have more effective performance management systems. Also, such a system accustoms employees to independently evaluate their effectiveness [9]. A study conducted by Bersin & Associates found that companies that introduced a continuous staff assessment and feedback system achieved better business performance than companies using the annual assessment. According to the research, financial indicators of 45% of companies, where meetings with employees were held at least four times a year, exceed the average for the market [10].

3. Change in the nature of the tasks facing companies. In a constantly changing environment, the tasks facing employees are becoming less clear, giving them an ever-increasing space for maneuver. Academic studies show that, high uncertainty of tasks requires a transition to a system aimed at maximizing the involvement of employees in the work by creating appropriate conditions [11].

Conclusion

Thus, if the personnel performance management system used to deal primarily with annual or semi-annual meetings and a rating assessment, at the moment it should include a whole range of different tasks: to carry out a continuous assessment of the work of employees, set timely goals and objectives, plan further development of the company And employees, improve the efficiency of employees. In our opinion, business coaching as nothing else is best suited for the implementation of these tasks. Such a cardinal transition from the usual management style to a completely new one is a very difficult stage for any manager. However, the current and extremely difficult situation in the business speaks about the need for changes in the personnel management system. Behavioral approach determines the effectiveness of any organization precisely by the manner in which its managers behave towards employees - an organization cannot be effective if the effectiveness of managers given by the company is low. Sociological research shows that if the success of the business manager's activities is 15% dependent on his professional knowledge, then 85% on the ability to work with people. Thus, the results of labor depend precisely on socio-psychological factors and the ability of the manager to take into account these factors, and with their help to purposefully influence employees, helps the leader to form a team with common goals and objectives.

With a coaching approach, the management of employees creates conditions in which employees make their own decisions, thereby developing professionally and personally. The company is becoming more flexible. In the event of any difficulties, the speed of reaction to non-standard situations increases. Absence of total control and the ability to find different ways to solve the tasks that have been set will also activate creative activity. Conditions are created for innovation, which can provide a breakthrough to business. And the manager finds in the person of employees not executors or "junior comrades", but partners who can make a huge contribution to the development of the case.

Business coaching eliminates internal obstacles and helps to open access to inexhaustible resources - both own - the leader, and his subordinates. The main goal of coaching is to strengthen people's confidence, no matter what task they perform. The application of business coaching, as technology management company employees, is a qualitatively new level of work with employees. It is therefore important for the company's management to know how to change the company's culture at the level of an individual employee, team or whole team. These skills are critical to establishing long-term success. Therefore, the motives to appeal to business coaching and cultivate the coaching culture in the organization are many, which is confirmed by the results of companies already using business coaching in their activities.

It is important for leaders of our time to have coaching competencies, namely, to be guided by the philosophy, principles and methods of business coaching in their work with employees of organizations. It is important for the leader to feel surrounding people, employees, give them the opportunity to think with their own heads, believe in them, while directing and opening in them something new that they themselves did not suspect. Development based on the insight, oriented to the realization of something new by man is the most valuable, because it allows him to see himself and the world from a new angle.

The person has significant opportunities waiting for his time and it is important for the leader to know that people have much greater abilities than those that they show in the workplace, so it is so important to think about the human potential, not its indicators. Faith in the ability of people has a direct effect on their effectiveness and motivation. As the main results of the application of coach management in the activities of companies, we note the following:

- coaching allows to achieve awareness of the employee's actions and responsibility for the result of these actions in individual and team work;
- coaching promotes systematic professional and personal growth;
- coaching allows to maximize the effective labor potential of employees;

 coaching develops the ability for the strategic thinking of the leader, the ability to effectively set goals, develop strategies, prioritize, and effectively complete projects, achieving their goals.

 coaching is a good tool for involving workers in the process of implementing a quality system, allowing them to tap into their knowledge and initiative, overcome resistance to innovation;

 coaching allows you to make full use of the internal resources of the organization, increase the dynamics of the company's development;

 coaching allows to form a specific organizational culture as a basis for constant improvement of quality and innovative development of the company;

 coaching allows you to increase business prospects by more fully revealing the manager's personal potential, which ultimately leads to an improvement in the quality of his work as a "supplier" of management decisions;

 coaching allows you to create a healthy corporate culture in an organization that will match modern business realities.

The conducted research allows drawing a conclusion that coaching is an effective technology for working with employees of organizations, which must be implemented in the activities of each company and the life of each person. The use of this technology will allow companies to enter a qualitatively new level of activity - to improve the interaction of the head-employee, employee-employee, client-employee, as well as increase the motivation and efficiency of people who work in the company.

In summary, business coaching is not just a method that must be strictly followed in certain circumstances, it is a tool that shapes the management style, the attitude towards people, the style of thinking and acting that will allow managers to be more effective in their Work, achieving ever higher results. Companies will be able to achieve great results if they find access to the huge hidden internal reserves and talents of their employees. The person's executive potential will be revealed and will reach a new level, when management will begin to follow the principles of coaching in its activities in all its diversity.

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SECTION 3. Nanotechnology. Physics.

INFLUENCE OF THERMAL TREATMENT ON STRUCTURAL TRANSFORMATIONS IN Ti-Ni ALLOYS

Abstract: *The work includes the experimental results of the study of two groups of alloys of Ti-Ni system with a shape memory effect by electron microscopy and resistometric measurement. A high dislocation density was found after high-temperature treatment. It is established that new precipitations exist only in a certain temperature range.*

Key words: *transition metals, titanium, nickel, alloy, structure, phases, martensitic transformations, shape memory effect.*

Language: *English*

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Introduction

Since olden times the researchers have been very interested in two- and three-component alloys of transition metals that have the ability to restore their shape when heated, as a result of prior deformation. This phenomenon, called the *shape memory effect*, is associated with the martensitic transformation process, occurring in the alloy as a result of heating within a certain temperature range.

Among variety of similar materials Ti-Ni alloys have a number of advantages in comparison with others, where the shape memory effect is determined. These materials have the ability to completely restore the given shape when heated, and also have good plasticity, sufficient heat resistance and improved corrosion resistance. Despite a significant number of studies devoted to these alloys, where the changes in mechanical and physical properties, the influence of thermomechanical treatment on transformation processes, the structural changes in initial and martensitic phases were studied, a clear picture of phase transformations occurring there, and the reasons of changes in various properties were not obtained, and, most importantly, the results reached by different authors were often difficult to compare. The main reason for these failures was the impossibility of alloying under strictly identical conditions. It is known that it is extremely difficult to obtain two fusions of TiNi alloys of the same composition with the same properties. Therefore, it seems appropriate to carry out researches to obtain data on structural and phase transformations in alloys under various external influences and influence of thermal treatment on subsequent martensitic transformation.

Phase transformations in Ti-Ni allows. A general chart of Ti-Ni system state is shown on the figure 1. Three types of compounds are possible in the system: Ti_2Ni, TiNi, $TiNi_3$. The first Ti_2Ni compound is formed in peritectic reaction and has a homogeneity range. At a temperature of 7000°C the homogeneity range is ~ 2 at.% and it slightly narrows under temperature decrease. The TiNi compound crystallizes from the fusion at 1310°C. Under temperature decrease it dissolves a certain amount of Ni in Ti, which leads to the formation of homogeneity range. The maximum homogeneity range of this alloy extends within the range of 49.5 ÷ 57 at.% Ni at a temperature $T = 1118^0C$. It is assumed that at a temperature $T \prec 630^0C$ this alloy eutectoidly dissolved into a compound of two phases, consisting of Ti_2Ni and $TiNi_3$. The $TiNi_3$ compound melts congruently at

13800°C. In Ti-Ni system there are three eutectic, one peritectic and one eutectoid transformations.

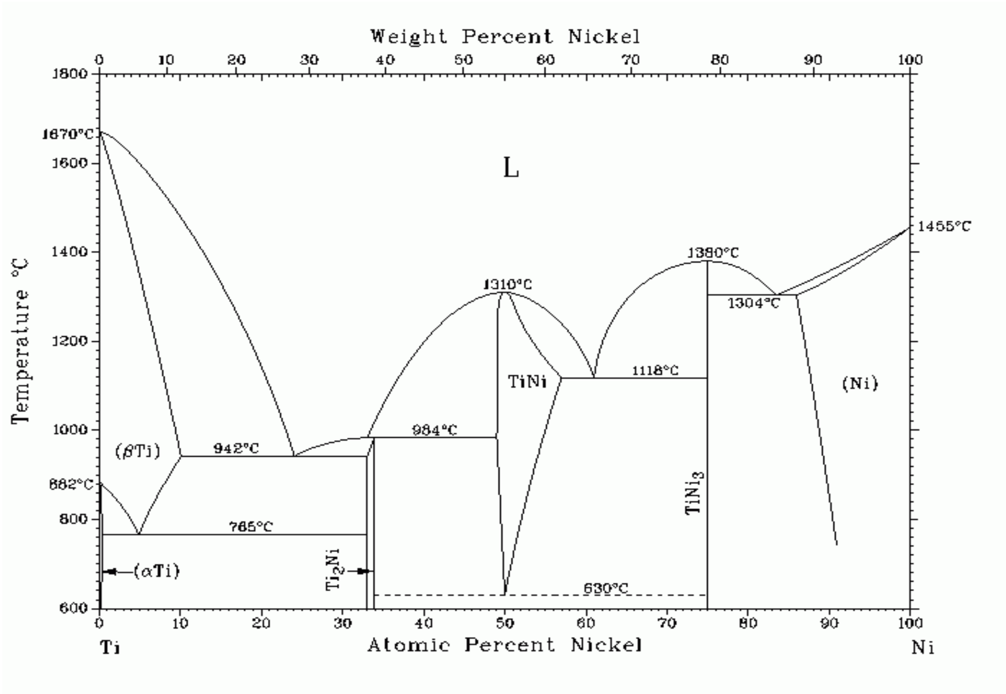

Figure 1 - Chart of Ti-Ni alloys system state.

In Ti-Ni alloys the martensitic transformation occurs in a narrow concentration range near the equiatomic composition of Ti-50 at.% Ni. The high-temperature phase of TiNi (β, BCC, a = 0.302 nm) at a room temperature exists in a narrow concentration range (~ 0.5 at.%) [1]. A compound of two phases Ti_2 Ni + TiNi is formed at lower Ni content (≤ 50 at.%) and at a temperature of 1015°C. A compound of TiNi + $TiNi_3$ is formed under high Ni concentrations (> 50 at.%) at a temperature below 1100°C. Ti_2Ni compound has a complicated face-centered cubic lattice - lattice with the parameter a = 1.131 nm. It contains 96 atoms, whereas $TiNi_3$ has a hexagonal lattice with the parameters a = 0.509 nm and c = 0.831 nm, containing 12 atoms [2].

A large number of works are devoted to the study of the crystal structure of phases arising in TiNi alloys near equiatomic composition at a temperature range of 800°C. And, interestingly, that the results of these studies are interpreted in different ways. For example, the work [2] reports about three phase states in alloys Ti-51 at.% Ni. It is believed that in the temperature range above 700°C there is TiNi phase (I) with BCC structure and the parameter a = 0.3 nm. Within the interval (600 ± 40°C) an ordered phase TiNi (II) appears with the BBC lattice parameter a = 0.9 nm and 54 atoms per cell. This cell is represented as the set of two simple cubic lattices with coordinates of atoms (000) and (½, ½, ½) and the sequence of arrangement of Ti-Ti-Ni-Ti-Ti and Ni-Ni-Ti-Ni-Ni atoms, respectively. The TiNi (II) alloy undergoes a diffusionless pseudomartensitic transition at a temperature of 166°C. At that the work denies possibility of TiNi and $TiNi_3$ phase breaking. The martensitic phase of TiNi (III) is formed at a temperature below 400°C. Another model of the BCC lattice with the parameter a = 0.903 nm was presented in the work [3]. In essence it differs from the previous one only by a different alternation of Ni and Ti atoms. On the basis of electronic and diffraction studies the work [4] proposes to describe this phase by a rhombohedral structure with a parameter a = 0.903 nm at an angle $\alpha_{\min} = 89{,}3^0$. On electron microscopic images, obtained in reflexes [5], located at distances of 1/3 between the main ones, thin domains - *precipitations* are visible. These precipitations are found in samples in annealed and slowly cooled conditions.

The work [6] assumes that the high-temperature TiNi phase decay into Ti_2Ni and $TiNi_3$ occurs in equiatomic alloys under $T = 650^0 C$. According to the authors of the work [6] a plastic-like Ni_3Ti_2 phase with a hexagonal lattice with the parameter a = 0,27 nm, c = 0.44 nm and c/a = 1.63 nm is formed in the hypereutectoid alloy (52 at.% Ni) upon annealing during 1 month at $T = 660^0 C$. This structure is an intermediate one between two types of Ti_3Ni phases: *widmanstatten and equiaxial*.

The crystalline structure of martensite was determined in many works, including [7]. It was found that martensite has a close-packed structure, but the alternation and number of close-packed layers in one period, determined by different authors, is different.

The formation of martensite with a triclinic lattice was reported in the works [8]. Moreover, these works show various values of the lattice parameters. It is most often assumed that martensite in TiNi alloys has a monoclinic structure of β' type. It is also known that martensitic transformation in Ti-Ni alloys is a first-kind transformation and it occurs thermoelastically [9]. In martensitic transformation in TiNi alloys, a relief appears on the polished surface. The martensite crystals grow with lowering of temperature and decrease its size with rising temperature. The thermal hysteresis does not exceed 25-30° C. Such a hysteresis value apparently depends on small volume changes under transformation (0.16%). The dislocation density increases when the reverse transformation occurs in the initial phase.

Martensite is formed in the shape of alternating plates with two orientations with a common boundary along $(\bar{1}1\bar{1})_m$ [10]. The adjacent plates have a width of 100 and 200 nm and differ in the direction of $''c''$ and $''a''$ axes. Three morphological types of martensite were observed in the alloy Ti-50.1 at.% Ni: lamellar, massive and tortuous [11]. A lamellar martensite contains stacking defects located at a distance of 3-6 nm from each other. In addition to stacking defects in martensite there were also found twins of $(\bar{1}1\bar{1})_m$. type.

Methods of research. Hot soaking often leads to a change in the structural state of both the initial martensite phase and the subsequent martensite phase that is formed after cooling. After such treatment the appearance and distribution of dislocation and vacancy defects can be different. At the same time the degree of order and the degree of decomposition of the initial solid solution, as well as the phase composition of the material, can differ. In addition, various physical and mechanical properties can change. In view of this, it follows that it is extremely important to conduct studies on the influence of various thermal and thermomechanical treatments on structural and phase changes in Ti-Ni alloys, obtained under identical conditions.

The studies were carried out on alloys of Ti - (50-60) wt.% Ni. The alloys were melted in vacuum by the arc melting method with a threefold Ti and Ni remelting of 99.99% purity. The obtained ingots were rolled in air at $T \succ 600^0 C$ to the thickness of 0.6÷1.0 mm. The rolled plates were kept at $T = 1000^0 C$ for 15-30 minutes, followed by quenching in NaOH alkali water. Thermal treatment was carried out in argon medium according to the scheme:

a) Quenching at 1000°C, heating and holding in a given temperature range (200-800) 0C for a certain time.

б) Rapid cooling at 1000°C to the given temperature (200-800) 0C and holding for a certain time.

Investigation of structural and phase changes, occurring in the material after various treatments, was carried out by electron microscopy and resistometric measurements.

Discussion of the results. The high dislocation density and elongated subgrains with the dimensions (0.3-0.5) x (3÷5) μm were found in the samples after high-temperature rolling, providing blurring of reflexes on micro-diffraction patterns into rings and arcs. Holding and quenching at 1000°C lead to the removal of defects (dislocations), recrystallization process and growth of new grains. After such treatment large grains of high-temperature β - phase are visible on microstructural images. Inside these grains a «*mottling*» is detected, which is apparently specified by dispersed precipitations of another phase and particles of Ti_2Ni phase, which are located both inside the grains and along the boundaries. The «*mottling»* in β - phase, observed after quenching at 1000°C, becomes much clearer after holding at 200-500°C and cooling to the room temperature. There were no other changes in the microstructure. Probably, such structure is specified by small particles (~ 3-10) nm of the new phase formed during aging.

Certain microstructural changes of the following character become viseable after holding at 300 ÷ 4000 °C: dislocation loops and individual deformation contrast around discrete precipitations are detected. Fine (up to 0.2 μm) particles of the x – phase of $\prec 110 \succ_\beta$ type are clearly visible on dark-field images. Prolonged holding (up to 300 min) leads to an increase of these particles to ~ 0.5 μm in the longitudinal direction. The particles take the form of elongated lenticular (pointed at both ends) plates, coherent with the surrounding matrix. In later stages of growth (~ 5000 ° C), when the particles reach considerable dimensions, they consist of several parts with different orientation, which is detected by alternation of light and dark areas. These areas are often separated by a clear boundary. When they are small (up to 0.5 μm) the particles have a light thickness. This is shown by streaky contrast at the boundaries of x – particle and β - phase.

The particles interact in the process of growth. If one of them strikes upon the other, its growth stops in this direction, but it grows in thickness. At the same time a large particle absorbs small ones without forming new boundaries inside a large particle, whereas old boundaries disappear. Often it is possible to detect 2-3 orientations of x – particles in the neighborhood.

With increase of holding time and temperature (up to 550-650°C) the plates of x – phase grow in length and in thickness (Fig. 2). As a result, a coherence violation occurs, which leads to imperfect dislocations on interphase boundaries (between β - and x – particles), located at a distance of 75-80 nm from each other. Similar structural changes are observed after treatment according to the second scheme, i.e. after heating and holding for quenching and subsequent cooling to a given temperature within the range of 800 ÷ 500°C. It should be noted that x – phase exists up to the temperature of 650-700°C. Above this temperature the particles and the reflections of x – phase disappear. On micro diffraction patterns there are diffuse reflexes of β –phase. The intensity of these phases declines as the temperature rises. Thus, the x – phase exists in a certain temperature range, above and below which it cannot exist. The amount of this phase does not exceed 10-15%.

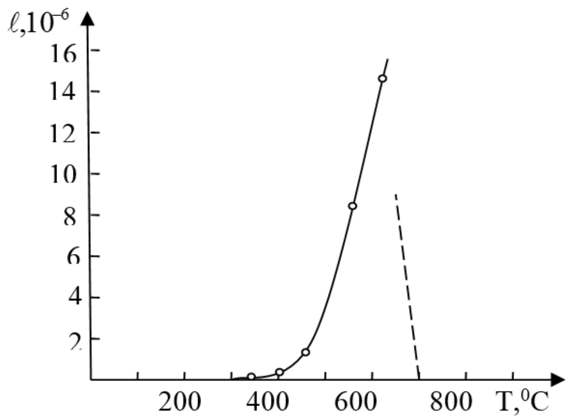

Figure 2 - Dependence of particle size of x -phase in TiNi alloy on the holding temperature

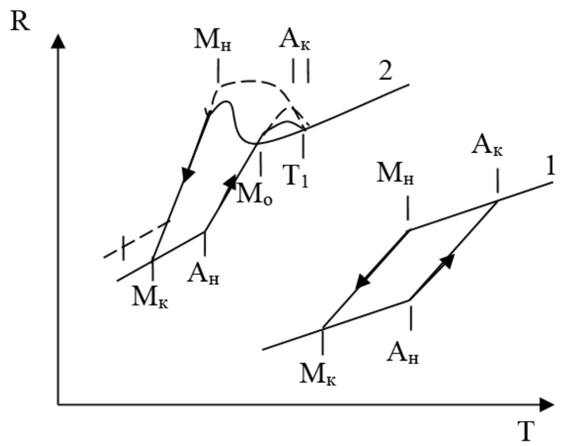

Figure 3 - Temperature dependence on electrical resistivity (ΔR) in TiNi alloy

The electrical resistivity method is often used to record the flow of the martensitic transformation process in the material. This method allows to determine the martensitic points ($M_н$, $M_к$, $A_н$, $A_к$) and thermal hysteresis with high accuracy, and also to monitor the intermediate stages and transformation kinetics. In alloys TiNi, as in the case of martensitic transformation, there is the decrease of electrical resistivity (Fig. 3). However, in the works [9] prior to decrease in electrical resistivity under temperature lowering, a rise was observed, which corresponds to a negative coefficient of electrical resistance. With a temperature cycling in a certain interval, where a partial reverse transformation occurs, the height of the peak increases, and the temperature interval of its appearance shifts to the lower temperature range. Therefore, it is attractive for study of the influence of thermal treatment at elevated temperatures on the magnitude and position of the peak (if it exists), the dependence of its occurrence on concentration of elements in the alloy, and the development of structural changes that cause its occurrence.

It was found that the electrical resistivity dependence on temperature for TiNi alloys is determined by the composition [12]. This dependence is usual in the alloys of A1 group (containing 53.7 ÷ 55.0 wt.% Ni) (Fig. 3 curve 1). Upon cooling and heating the hysteresis loop, specified by martensitic transformation, is observed in the change in electrical resistivity. The value of the electrical resistivity does not practically change after holding for 300 min. in the interval 200-800°C (Fig. 4, curve A).

Under temperature cycling through the martensitic transformation area the shape of curves does not change, but this leads to a slight decrease in the value of M_n point (after 10 cycles).

A different dependence of the electrical resistivity on temperature is observed in the alloys of B1 group (containing 56.4 wt.% Ni) (Fig. 3, curve 2). Prior to the drop in electrical resistivity due to martensitic transformation, there is a rise beginning at a temperature M_0 and ending at a temperature corresponding to M_n point. An ordinary drop in electrical resistivity is observed below this temperature. The ratio of the magnitude of the peak to the change in the electrical resistivity due to martensitic transformation of quenched samples is 5÷10% and depends on the composition of the alloy.

A peak is also observed on $R(T)$ curve when heated, but its value is much smaller and it is shifted to higher temperatures by 0 ÷ 20°C. Temperature cycling leads to decrease in the value of M_n point in samples, held at elevated temperatures, and to increase in the peak by a factor of 2÷3. The peak value is strongly influenced by the holding temperature at a fixed time. As the temperature rises the peak value increases and at 450-500°C it reaches its highest value, and then sharply decreases (Fig. 3c). After holding at 550°C and more the electrical resistivity is the same as in the quenched samples.

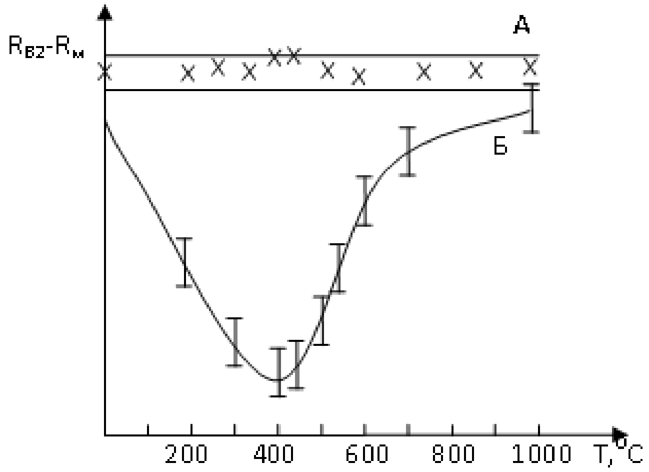

Figure 4 - Influence of holding temperature on the break jump of electrical resistivity in martensitic transformation (RB2-Rm) in TiNi alloys of A and B groups

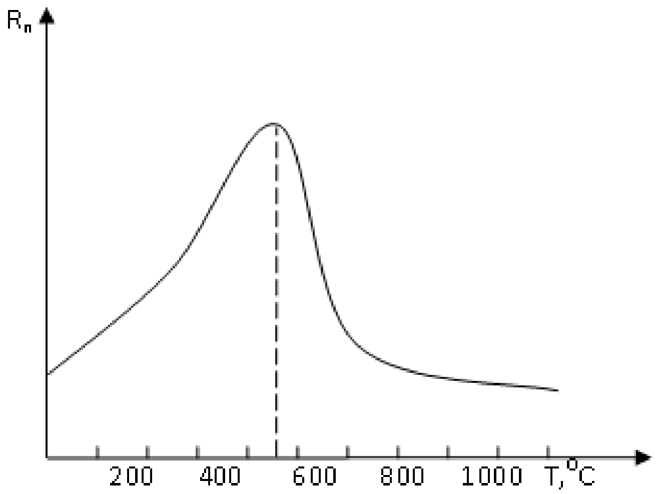

Figure 5 - Temperature dependence of additional peak value of electrical resistivity in TiNi alloy

Conclusions.

The effects found in Ti-Ni alloys are substantiated by premartensitic instability, which

causes vibrations of atoms along certain crystal directions, which near the temperature point of martensitic transformation of M_n leads to the appearance of plane waves. The martensite crystals grow with lowering temperature and decrease with rising temperature. Thermal hysteresis does not exceed 25-30°C. Such hysteresis is probably specified by small volume changes (~ 0.16%).

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SECTION 4. Computer science, computer engineering and automation.

CRYPTOGRAPHIC METHOD OF INFORMATION PROTECTION IN COMPUTER TRAINING SYSTEMS

Abstract: *The article deals with cryptographic protection of information in computer-based learning systems. A cryptographic method based on the principle of the abstract automaton operation is considered.*

Key words: *Information security, cryptography, algorithm, value function.*
Language: *English*
Citation: Borankulova GS, Tungatarova AT (2017) CRYPTOGRAPHIC METHOD OF INFORMATION PROTECTION IN COMPUTER TRAINING SYSTEMS. ISJ Theoretical & Applied Science, 05 (49): 143-145.
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Introduction

In connection with the widespread use of automated training systems, electronic textbooks and tests, the question arose about protecting data from unauthorized access. Currently, there are various methods of protection, use of which depends on the specifics of the information and its carriers, but the cryptographic methods are the most widely used, due to their universality in terms of both the implementation methods and presentation forms.

The proposed cryptographic method is uses the principle of the abstract automaton (AA). The original data stream is divided into fixed-length elements that form a sequence of letters (zf) of the input alphabet of the abstract automation Z={z1, … , zF}. In the process of AA work, a sequence of letters (wg) of the output alphabet W={w1, … , wG}, which is a stream of transformed data from elements of the same length as the elements of the input stream. The automation is specified using the marked transition table. It is necessary that the conditions for the completeness of the transitions and the completeness of the outputs be obeyed. This means that each column of the marked transition table must contain all the letters of the state alphabet A={a1, … , aM} AA. In addition, to ensure the possibility of reverse transformation, all the alphabets of the automation Z, A and W must coincide, and therefore both its transition functions (d) and the output function 1.

Thus, the alphabets Z, W and A can be reduced to a single alphabet like a U={u1, …, uM}. The marked transition table AA can be represented as a square matrix T of size MxM, where M is the number of pairwise distinguishable letters of the alphabet U. Each row and column of the matrix T also each of its elements correspond to the letter of the alphabet U.

The following two algorithms are used to implement the proposed cryptographic method.

The direct conversion algorithm

1. As an initial state AA can be select any state um (for example, u0)
2. From the input sequence of letters AA is read the letter u uf
3. In the column of the matrix whose number corresponds to the current state um, the letter ug is selected at the intersection with the string whose number corresponds to the value of the letter uf.
4. The output sequence of the letters AA is written with the letter uf
5. As the new current state of um AA, is selected uf
6. If the input sequence of letters AA is not exhausted, otherwise the end of the algorithm

The inverse transformation algorithm

1. As the initial state AA, the same state um is chosen, as in the direct conversion algorithm
2. From the input sequence of letters AA is read the letter ug
3. In the column of the matrix whose number corresponds to the current state um, the letter ug
4. In the output sequence of letters AA is written the letter uf, the value of which corresponds

to the number of the line, to the intersection with which the ug letter was found

5. As the new current state um AA, the state is selected ug

6. If the input sequence of letters AA is not exhausted, then the transition will be otherwise end of the algorithm

From the consideration of the two above algorithms, we can conclude that both algorithms use the same encryption matrix T (the marked transition table AA) and are mutually invertible. In this case, the inverse transformation algorithm in general works slower, since it contains a search operation in the matrix column, whereas in the direct conversion algorithm the sampling operation is used. Since the time for administration in author systems does not play a significant role, it is advisable to use the direct conversion algorithm as an algorithm for decryption, and the reverse transformation of the encryption algorithm.

Let's illustrate the work of algorithms using the alphabet of eight letters as an example. (Figure 1) presents one of the options for constructing a marked transition table in a size matrix 8x8.

	A	V	I	M	O	R	T	U
A	M	A	U	V	I	O	R	T
V	O	R	R	A	T	T	M	V
I	U	V	T	I	O	A	U	I
M	V	I	A	M	U	R	T	O
O	I	M	O	T	A	V	I	U
R	R	T	V	R	M	U	O	A
T	A	O	I	O	R	M	V	R
U	T	U	M	U	V	I	A	M

Figure 1 -Work of algorithms using the alphabet of eight letters as an example.

Let's take as an example the words "AVTOMAT" and "MURA". We choose the initial state corresponding to the letter A. Then the encryption process can be presented step-by-step in the form of the following table.

Step number	1	2	3	4	5	6	7	8	9	10	11
Read-out letter ug	A	V	T	O	M	A	T	M	U	R	A
Current state um	A	A	V	T	O	M	A	T	M	U	R
Writable letter	T	M	R	R	R	V	U	V	T	T	I

Let's try to restore the original form of encrypted words:

Step number	1	2	3	4	5	6	7	8	9	10	11
Read-out letter ug	T	M	R	R	R	V	U	V	T	T	I
Current state um	A	A	V	T	O	M	A	T	M	U	R
Writable letter	A	V	T	O	M	A	T	M	U	R	A

As a result received words like a “AVTOMAT” and “MURA”.

The algorithms examined are fairly simple to implement and allow you to quickly and efficiently encrypt data of any type, including those presented in ASCII- format. As the encryption key is the marked transition table, the total number of different variants of construction is (M!)M variants, and its size, the length of the encryption key is MxM letters.

However, this method has a significant drawback, which in some cases can dramatically reduce the quality of encryption. Since the choice of the new state AA depends on the read letter, the same input sequence. This makes the encrypted information weakly resistant to particular analysis. To neutralize this negative effect, you need to add an additional parameter to the transition function d AA, independent of the current state um, neither from a letter uf.

You can suggest the following way to implement this idea. The output sequence of the letters of the first AA is used as the input sequence of the second AA, whose transition function is independent of (uf and ug), and the output sequence of letters and is the resulting output sequence (Figure 2).

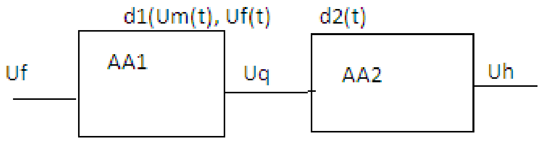

Figure 2 - the output sequence of letters and is the resulting

Conclusion

In the simplest case, the function d2 performs the transition of the automaton from the current state to the state immediately following it. In the reverse transformation of data, the automata should be connected in sequence AA2-AA1. Here it is necessary to take into account that the excessive complexity of the transition function d2(t) or the connection of additional automatic machines will lead to an increase in the time costs for encryption and decryption.

Thus, the proposed solution allows not only to eliminate the identity of encryption of the same data blocks, but also to increase the total number of variants of the encryption key from the viewpoint of the transition function d2.

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SECTION 4. Computer science, computer engineering and automation.

SOFTWARE FOR RESEARCH WORK

***Abstract**: The article discusses the issues of software in the educational process, namely the automation of the examination of the training program by module. The description of the information system "Automation of examination of the training program by module" is given, which is a complex of program modules for the organization of access (authorization) of the examination of the training program.*

***Key words**: module training program, automation, expertise, software.*

***Language**: English*

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Introduction

Software for information systems A set of regular application programs, descriptions and instructions for their use, designed for technical operation of autonomous computers, computer workstations of computer systems and networks, as well as the participation of programmers in the creation and maintenance of software products.The main software in the educational process is the automation of the educational process, which allows you to solve problems in: creating and supporting information resources in the university; Accounting information on the structure of the university and structural units; Accounting and personnel management; Implementation of automated workflow at faculties and departments; Accounting of curricula; Load planning departments; Teacher load planning; Examination of the training program by module; Accounting of information about applicants, the course of entrance examinations at the university; Implementation of automated workflow in the work of the selection committee; Tasks of statistical observation; Various tasks for analytical processing; Accounting of information about students, their academic performance and management of student contingent; and etc.All software modules used in the educational process are informationally connected with the automated data bank and with each other and have functional independence. Work with the software used in the subsystem is organized in an interactive mode and creates conditions for processing information in real time. This allows you to organize access to the information subsystem with a query about the status of the control object at any time and receive operational information.The software requires high reliability, efficient use of computer resources, structural, modularity, cost-effectiveness, friendliness with respect to users, and so on.The software for automation of the educational process ensures the coordinated operation of all PC devices and their interaction with the user. As part of the software allocate common software and application software.Asa common software, various operating systems for local PCs and operating systems of local computer networks are used. The main purpose of the common software is the launch of application programs and the management of their execution.The special software of the automated workplace usually consists of unique programs and functional packages application programs. It is from the functional software that the specific specialization of workplace automation depends. The software must have adaptive and customizable properties for a particular application in accordance with the user's requirements.

Materials and Methods

Basic software tools for creating automated workplaces for the automation of the educational process are software for the preparation of texts, spreadsheets, software for automating the creation and maintenance of databases, finding the required information for the preparation of various documents, accounting programs, specialized processing programs Commercial information. The integrated packages of application programs, which include a text editor, a table processor, a database management system, as well as a specific command file for setting up software for a specific type (mode) of information processing, have become very popular.A special role is assigned to the organization of the user interface. The graphical user interface is the type of screen representation in which the user can select commands, run tasks and view file lists, pointing to icons or items in the menu lists shown on the screen. Actions can, as a rule, be performed with the mouse, or by pressing a key on the keyboard.The key to creating an effective interface is the rapid, as far as possible, development of operators simple conceptual interface model. This is done through consistency. The concept of consistency is that when working with a computer, the user forms a system for waiting for identical reactions to the same actions, which constantly supports the user interface model.Another component of the interface is the property of its concreteness and clarity. This is done by applying the panel plan, using colors and other expressive techniques. Ideas and concepts then acquire a physical expression on the screen with which the user directly communicates.A well-executed interface allows to solve the main task - to ensure the convenience of working with the user application.Before the appearance of the user interface, a splash screen appears, then a dialog box appears asking for the password to gain access, after the correct access is entered, the user interface window appears, if the password is incorrectly entered, a dialog box appears with the message "You have not been authorized"Information system "Automation of examination of the training program by module" is a set of software modules for the organization of access (authorization), viewing and editing the database,editing the base of synonyms, forming the catalogs of the training program, writing to the database, comparing.At the beginning, the access module is launched, which requests a password, after reconciliation, the Data Module connects the database and runs the form to generate the key file to the discipline. Then the main form is launched, which consists of the Exit tab, View and editing of the database, Synonyms, About the program, About the author.The "Keyword Base Formation" form is designed for typing directly from the keyboard in the keyword program window to the discipline. Keywords can be pre-designed and saved as a file with the extension * .keu, which is entered in the form "Identifier".The "Synonyms" form allows you to create a dictionary of synonyms, supplement it or remove unnecessary words from it.The "Keyword Base" form allows you to view the list of information on the discipline, faculty, department entered in the database and to see the list of keywords for discipline. If necessary, you can delete the selected entry from the list.

Technological support - the basis of automated information technology, which implements information processes in automated systems of organizational management, meets information needs of specialists in solving professional problems.Means of information processing - computers form the basis of technical support of an automated workplace network and can include powerful, medium and small computers. A characteristic feature of the practical use of technical means in organizational and economic management is now the transition to decentralized processing on the basis of PC.Delphi 7 is an application development environment based on object-oriented programming. This programming technology is the foundation that allows you to implement all the functionality of Delphi 7. When creating applications based on the finished components using properties, methods and predefined event handlers, you can get by with a small code. For the developer, this means that when developing the user interface of their applications, it can receive significant time savings.A package of visual programming Delphi, allows you to create fairly effective applications for working with databases. The scheme of interaction of program modules is shown in the figure 1.

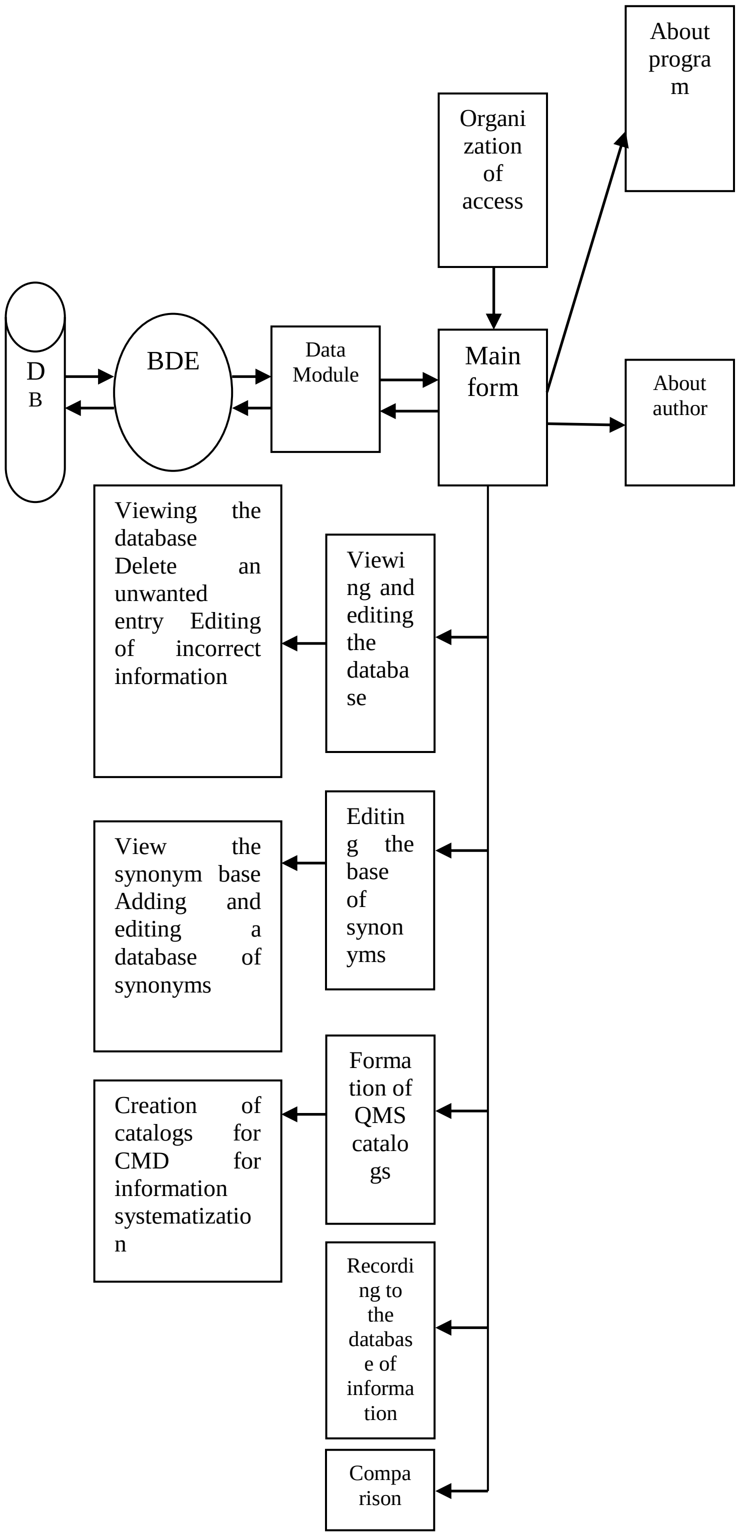

Figure 1 - The inter connection of software module.

Conclusion

Creating applications using Delphi and using them requires certain resources of computer technology.The preference for using Delphi was also based on a number of the following advantages. The language of Pascal is still the best programming language. And the language of Object Pascal, unlike Borland (Turbo) Pascal and other modern application development tools of the same class, has built-in support for a modular methodology for creating applications, because each visual form is automatically placed in accordance with a separate module. Therefore, the creation of Windows applications using visual software development technology does not begin with the simplest operators, but with the ready visual components for which code is automatically generated in the form of much larger syntactic units (classes, properties, methods, modules).Delphi in terms of tools for developing Windows applications includes a high-performance compiler. Therefore, the Delphi compiler from the ObjectPascal language is one of the most productive in the world.The standard software for the design and use of applications for working with the database include operating systems, standard database management systems and modern application design tools.Processing programs include translators, service programs, sorting programs - mergers and utilities; Using them traditionallyin process automation. In addition to translators, the operating system includes service programs: link editor, loader and debugging system.

Databases (Paradox, dBase, FoxPro, Access, etc.) also require fairly decent computer technology for their effective use. For each of them there are minimal volumes of operational and disk memory and minimal computer speed under which the database management system will work effectively.

For stable operation and ensuring the integrity and correctness of reading / writing data from the database, uninterrupted power is required for the computer. The cheapest and most reliable device is suitable: UPS PC-STAR 1400VA.

For the reservation of information, you can use: CD-RW Drive 40/12/40 SAMSUNG SW-240BRNS with Nero software, writing to CDs (CD-R, CD-RW). This backup strategy will protect information from various emergencies that may occur with the computer that stores the database. And also, if necessary, it is possible to restore the information.

For stable and reliable operation of the information system, the computer must have the Windows 2000 Professional operating system installed. The operating system Windows 2000 is the latest version of Microsoft's Windows NT operating system. Identification of the user includes procedures to make sure that the user is exactly who he claims to be. The operating system Windows 2000 provides several different ways to perform this operation. The traditional combination of "user name / password" is time-tested, but human memory, unfortunately, is unreliable.

You also need to install the application package Microsoft Office 2000 Professional or another version.

The program «Automation of examination of the training program by module » is an independent module that operates in the environment of Windows 98 and higher.

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

THE ANALYSIS OF CHEMICAL ANTISEPTIC TANKS FOR THE PURPOSE OF THE CHOICE OF OPTIMUM MEDICINE FOR MODIFYING LINEN RANGE COTTON MATERIALS

Abstract: *The comparative analysis of a wide range of the modern medicines giving antiseptic properties to cotton fabrics is carried out. Primary benefits of silver nanoparticles, such as ecological safety, non-volatility and indifference in relation to resident microflora of the person are provided. Results of cotton fabrics processing by silver hydrosols with the subsequent fixing of a tanidama are shown. It is fixed that the developed technology allows to give to fabrics resistant antiseptic the effect which is remaining after several wet thermal treatments.*

Key words: *antiseptic activity, colloidal silver, stabilizers, tanida, biocidal, bactericidal, bakteriostatic properties of samples.*

Language: *Russian*

Citation: Baranova ON, Mishakov VY, Zolina LI (2017) THE ANALYSIS OF CHEMICAL ANTISEPTIC TANKS FOR THE PURPOSE OF THE CHOICE OF OPTIMUM MEDICINE FOR MODIFYING LINEN RANGE COTTON MATERIALS. ISJ Theoretical & Applied Science, 05 (49): 151-160.

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АНАЛИЗ ХИМИЧЕСКИХ АНТИСЕПТИКОВ С ЦЕЛЬЮ ВЫБОРА ОПТИМАЛЬНОГО ПРЕПАРАТА ДЛЯ МОДИФИЦИРОВАНИЯ ХЛОПЧАТОБУМАЖНЫХ МАТЕРИАЛОВ БЕЛЬЕВОГО АССОРТИМЕНТА

Аннотация: *Проведен сравнительный анализ широкого спектра современных препаратов, придающих антисептические свойства хлопчатобумажным тканям. Представлены основные преимущества наночастиц серебра, такие как экологическая безопасность, нелетучесть и индифферентность по отношению к резидентной микрофлоре человека. Показаны результаты обработки хлопчатобумажных тканей гидрозолями серебра с последующим закреплением танидами. Установлено, что разработанная технология позволяет придать тканям стойкий антисептической эффект, сохраняющийся после нескольких влажно-тепловых обработок.*

Ключевые слова: *относительная деформация, пластическая (остаточная) деформация, упругая деформация пакеты одежды, бикомпонентные волокна. теплофизические свойства, модели структуры, пакеты материала.*

Introduction

Защита людей от воздействия патогенной микрофлоры окружающей среды является важнейшей задачей современной экологической политики государства, решение которой позволит повысить качество жизни человека. Опасность микрофлоры заключается в том, что она содержит не только общеизвестные, патогенные и условно-патогенные бактерии, грибки и вирусы, но и их мутированные формы. В связи, с чем требуется разработка разнообразных мер профилактики, в частности - создание новых эффективно действующих средств на патогенную транзиторную микрофлору и в то же время щадящих резидентную (или постоянную) флору человека.

Одной из профилактических мер снижения риска возникновения инфекционного процесса является изготовление изделий текстильной и лёгкой промышленности из текстильных полотен с антисептическими свойствами, которыми обладают исходные волокна, либо которые придаются им в процессе обработки [1].

В задачи исследования входил анализ биологически активных реагентов, применяемых для модифицирования текстильных материалов, а также определение оптимального состава препарата на основе наночастиц серебра для хлопчатобумажных материалов бельевого ассортимента.

Materials and Methods

Анализ литературных данных показал, что естественные ингибирующие свойства полотен, выработанных из натуральных волокон, таких как целлюлоза (лен), шёлк и шерсть, слабо проявляются в агрессивной патогенной среде. Их можно использовать только в профилактических целях при защите от условно-патогенной флоры [2].

Весь спектр химических антисептиков с микробиологической точки зрения можно разделить на следующие группы:

а) биоциды – для ликвидации бактерий и грибков;

б) бактерициды – для ликвидации бактерий;

в) бактериостатики – для нейтрализации бактерий;

г) фунгициды – против действия грибковой плесени [3, 4].

С химической точки зрения систематизация этих веществ, как органического, так и неорганического происхождения может быть представлена следующим образом [3, 4]:

1. Углеводороды и их, галоген - и нитропроизводные.

2. Спирты, фенолы и их производные.

3. Амины, соли аминов, четвертичные аммониевые соединения и их производные.

4. Гетероциклические соединения.

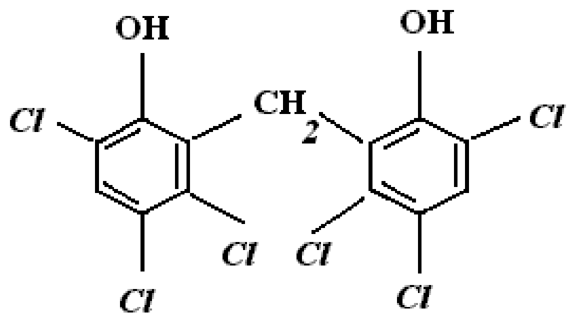
5. Неорганические соединения.

Ниже приведены свойства наиболее распространенных химических антисептиков каждой группы.

1. Ассортимент ***галоген- и нитропроизводных углеводородов,*** используемых в качестве биоцидов достаточно широк и разнообразен. Они могут использоваться не только как контактные биоциды для защиты натуральной кожи, например, бромтан $C_5H_7Br_2Cl_3$, но и как фумиганты (пестициды). Однако, *ткани, обработанные биоцидами этого класса, не сохраняют антисептических свойств после влажных обработок*. Поэтому применение галоген- и нитропроизводных углеводородов не эффективно для модифицирования текстильных материалов [5].

2***.Спирты, фенолы и их производные*** обладают широким спектром биоцидного действия. Биоцидная активность фенолов значительно выше, чем спиртов. Такие соединения, как 2-окси-дифенил применяют при жировании натуральных кож, *п*-нитрофенол – для защиты натуральной кожи [3]. Пентахлорфенол получил широкое распространение для защиты целлюлозных материалов при хранении. Но так как этот *реагент легко растворим в воде, то легко удаляется при стирках и поэтому не рекомендуется для модификации текстильных материалов.*

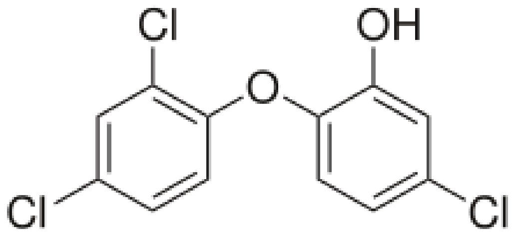
Одним из ***ароматического производного фенола*** для модификации текстильных материалов является *гексахлорофен**:***



(1)

Продукт взаимодействия гексахлорофена с привитым сополимером целлюлозы достаточно устойчив к гидролизу, поэтому текстильные материалы из этого волокна, выдерживают без заметного снижения антимикробных свойств до 30 стирок. Гексахлорофен проявляет высокую активность в отношении грамположительных бактерий и обладает фунгицидным действием, однако *он не воздействует на грамотрицательной бактерии.* [6]. К тому же гексахлорофен в США и Канаде включен в Список опасных веществ. [7]. Поэтому этот реагент имеет ограниченную область применения при модифицировании текстильных материалов.

Известным антибактериальным агентом, который действует на грамположительную и на грамотрицательную флору, а также на грибковые микроорганизмы является ***триклозан*** (2,4,4-трихлор-2-гидроксидифениловый эфир):



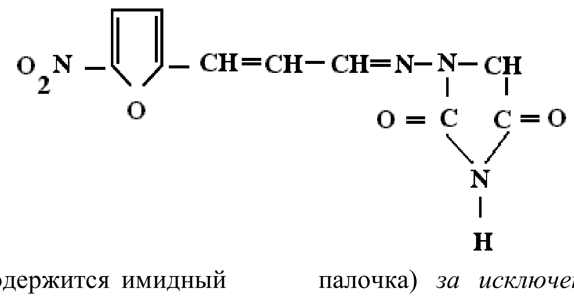
(2)

Триклозан, начиная с 70-х годов XX века, активно применяется в моющих и чистящих средствах, средствах личной гигиены, таких как мыло, зубная паста, дезодоранты. Триклозан входит в состав антимикробного препарата Санитайзед (Коммерческая форма продукта *«Sanitized»* (производитель «*Evonik Goldschmidt»,* Германия). Помимо него эта смесь включает пропиленгликоль – 55% массовых долей и полиоксиэтилен-25-глицерилтриолеат – 35% массовых долей. В рабочих концентрациях триклозан действует как биоцид, при более низких концентрациях обладает бактериостатическим действием, препятствующим синтезу жирных кислот, необходимых для создания и воспроизведения клеточных мембран. Триклозан разрушает фермент ENR, необходимый бактериям для синтеза клеточных мембран. У человека фермент ENR отсутствует, поэтому считается, что триклозан безвреден для людей. Однако в последние годы, учитывая результаты опыта применения, происходит отказ от этого компонента в виду того, что *пропиленгликоль, входящий в состав триклозана, вызывает аллергические реакции.* Начиная с 2000 года в ряде исследований были обнаружены микроорганизмы, устойчивые к триклозану. Появляется доказательства того, что при использовании триклозана развиваются бактерии, устойчивые к лекарственным антибиотикам и антибактериальным препаратам. Исследования показывают, что использование триклозана обеспечивает благоприятные условия для появления антимикробных лекарственно-устойчивых бактерий, даже при низких концентрациях во многих продуктах и косметике [8].

Хлоргексидин, представляющий собой 1,6-ди-N_1, N_1'–*n*-хлор-фенилбигуанидо – N_5, N_5'-гексан, придает бактериальную активность ткани при концентрации 0,025% массовых долей. Этот препарат, проявляет активность в отношении широкого спектра и грамположительных и грамотрицательных бактерий [9]. Однако он *легко удаляется при мокрых обработках*, поэтому применение этого препарата для модификации текстильных материалов неэффективно.

Наряду с гексахлорофеном и хлоргексидином практическое применение находит ***пентахлорофен,*** но этот препарат и *его водорастворимые соли обладают высокой токсичностью и неприятным запахом, что ограничивает его применение* [10].

Широким спектром биоцидного действия и относительно низкой токсичностью обладает соединение нитрофуранового ряда – ***фурагин*** 1 – [b-(5 нитрофурил-2-акрилиденамино) – гидантоин]:



(3)

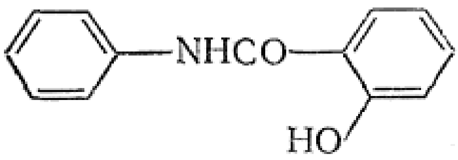
В молекуле фурагина содержится имидный водород, способный замещаться металлами. Такие соединения фурагина мало растворимы в воде, что позволяет придавать текстильным полотнам устойчивые при эксплуатации антимикробные свойства [10 – 13]. Фурагин активен в отношении грамположительных (стафилококки, стрептококки), грамотрицательных микроорганизмов (кишечная палочка) *за исключением синегнойной палочки* [11], помимо болезнетворной флоры *активно подавляет резидентную флору*. Поэтому область применения этого препарата при модифицировании текстильных материалов ограничена.

Соединения, содержащие азот в молекулах углеводородов с характерной структурой:

$$\begin{array}{ccccccccccccccccc} A & - & NH & - & C & - & NH & - & C & - & NH - R - NH & - & C & - & NH & - & C - NH - B \\ & & & & \| & & & & \| & & & & \| & & & & \| \\ & & & & NH & & & & NH & & & & NH & & & & NH \end{array} \qquad (4)$$

где А и В – ароматические ядра (одинаковые или различные), с галогенными, гидроксильными или другими заместителями, а R – углеводородная метиленовая цепочка или диалкоксифенильная группа, которая обуславливает проявление антибактериальных (бактерицидных) и антифунгальных (фунгицидных) свойств, достаточно широко используются для модифицирования текстильных материалов. Однако для синтеза подобных соединений необходимы специальные установки, что *связано с дополнительными финансовыми затратами* [14].

Салициланилид или анилид салициловой кислоты (ширлан; салнид; хемоцид):



(5)

используется в производстве биостойкой упаковочной бумаги и картона, для защиты текстильных материалов. Салициланилид являясь *фунгицидом, воздействует на ограниченный спектр микроорганизмов – грибы*. Применение такого реагента для получения антисептических текстильных материалов является неэффективным [15].

3. Из группы ***аминов, солей аминов, четвертичных аммониевых соединений*** наиболее часто применяется *алкилдиметилбензиламмония хлорид* ***(****Катамин АБ)*, который представляет собой катионное поверхностно-активное вещество с комплексом всех биоцидных свойств [11, 12, 16]:

$$\left[\begin{array}{c} CH_3 \\ | \\ \mathrm{CH_3} - (CH_2)_{2n+1} - N^+ - CH_2C_6H_5 \\ | \\ CH_3 \end{array}\right] \qquad (6)$$

Катамин АБ *используется для дезинфекции тканей, в медицинских целях* (для обработки рук хирурга, операционного поля и раневых поверхностей, а также дезинфекции хирургических инструментов, предметов ухода за больными и помещений) [11, 17]. Но он *относится к 3-му классу опасности умеренно опасных веществ*, в связи, с этим применение Катамина АБ для модификации текстильных материалов непосредственно и длительно контактирующих с кожей человека имеет ограниченный характер [16].

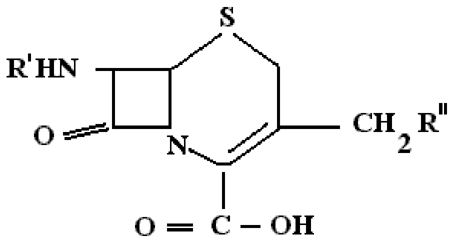
Новые красители (гетарилазо-соединения), производные пиразолона, где диазокомпоненты представлены поли-функциональными ***ароматическими аминами***, применяют для выкраски музейных тканей. Высокое фунгицидное действие отмечено у соединений, где в диазокомпоненте отсутствует сульфогруппа, а нитрогруппа находится в пара-положении (а не в орто-) относительно -ОН группы. При замене нитрогруппы в азокомпоненте на метоксигруппу происходит ослабление фунгицидной активности (ФА). Наличие пиразольного цикла в структуре диазокомпоненты обеспечивает высокую ФА. Замена пиразольного цикла на барбитуровый фрагмент снижает подавляющее действие. Почти все азосоединения, содержащие ОН-группы в орто-, орто′-положениях к азогруппе, оказывали подавляющее действие на тест-культуры, что связано со способностью этих красителей к хелатообразованию [18].

4. Наиболее известным ***гетеро-циклическим соединением***, является *нитро-фурилакролеин*, применяемый при получении синтетического водонерастворимого поли-винилспиртового волокна желтого цвета – «летилана», обладающего широким спектром биоцидного действия.

К гетероциклическим соединениям относятся соли четвертичных аммониевых оснований, производные фенола, нитрофураны, антибиотики, антимикробные красители и другие [19 – 22].

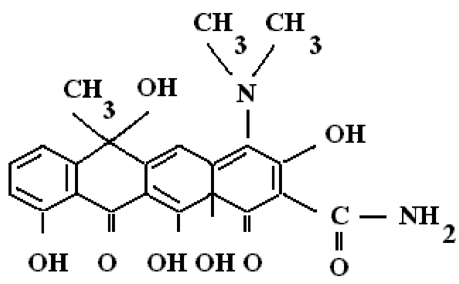
Для придания биоцидных свойств текстильным материалам используют *антибиотики* [12, 13, 17, 23], такие как:

- цефалоспорин



(7)

- тетрациклин



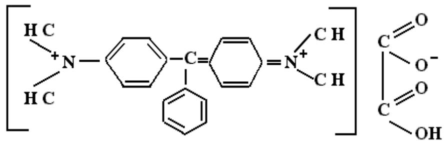
(8)

и др.

Клинические исследования анти-биотиков показали, что к ним чувствительна грамположительная и грамотрицательная микрофлора, в том числе кишечная группа бактерий, протей, синегнойная палочка [13, 23]. Но применение антибиотиков угнетает работу иммунной системы, поэтому применение их в модификации тканей ограничено.

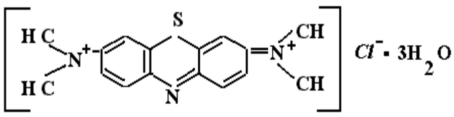
Антимикробные анилиновые красители также применяются в качестве биоцидов для модифицирования тканей, например, такие как [10 - 12, 14, 24]:

- бриллиантовый зеленый



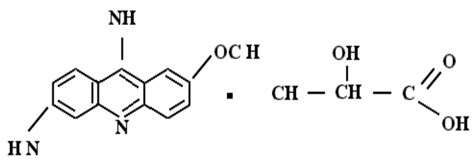
(9)

- метиленовый синий



(10)

- этакридина лактат



(11)

Они обладают невысокой токсичностью и избирательным действием к микроорганизмам [12, 13]. Особенно чувствительны к анилиновым красителям грамположительные бактерии – кокки. Однако их применение с целью модификации ограничено, так как *в белковой среде (раневые поверхности) и поте* *антимикробное действие красителей резко снижается* [17].

5. Ингибирующие свойства ***неорганических биоцидов*** связаны, главным образом, с взаимодействием катионов металлов (Cd^{2+}, $Pb,^{2+}Ag,^{+}$ Cu^{2+}) и некоторых анионов ($S0_4^{2-}$, $Cr0_4^{2-}$, $C1^-_{г}$ F^-, Br^-) с различными функциональными группами пептидогликанов, что приводит к нарушению организации структуры белковой молекулы, денатурации белков, нарушению функции дыхания и гибели клетки.

По интенсивности биоцидного действия ионов металлов на бактерии и грибы их можно разделить на три группы:

наиболее активные – серебро, ртуть, медь;

средней активности – кадмий, хром, свинец, кобальт, цинк;

наименее активные – железо, кальций [3].

Широкое применение для придания антимикробных свойств текстильным материалам получили ***соединения меди,*** благодаря невысокой стоимости, незначительной токсичности и достаточно высокой биологической активности. Материалы, обработанные солями меди, проявляют устойчивый антимикробный эффект, сохраняющийся после многократных стирок, обладают вирулицидным (антивирусным) действием [12, 24].

Купроцин (8-оксихинолят меди) с 1947г. занимает ведущее положение среди фунгицидов для модификации текстильных материалов и защиты красок, древесины, бумаги, пластмасс. Его применяют для обработки тары, помещений, оборудования [3]. Так как *купроцин является только фунгицидом*, применение для модифицирования тканей бельевого назначения ограничено.

Среди солей меди и органических кислот лучшими биоцидами являются стеарат меди (медное мыло) и нафтенат меди. Эти препараты не вымываются при стирке. *Недостатком их является окрашивание ткани в сине-зеленый цвет и снижение стойкости целлюлозных волокон к действию солнечного света.* 8-Оксихинолят меди – также эффективный фунгицид и бактерицид. Однако он окрашивает ткани в желто-зеленый цвет, при этом на свету окраска темнеет до коричневого цвета [24].

Хороший антимикробный эффект достигается при обработке волокнистых материалов соединениями ***производными олова*** с общей формулой R_3SnX или $[R_3Sn]_2O$, (олово) где (R – алкил, циклоалкил, фенил и др., X – остаток любой кислоты), которые характеризуются значительной биоцидной активностью. *Однако они обладают высокой токсичностью* [12, 13]. Хотя за рубежом и используются соли фенилртути: ацетат, олеат, стеарат и другие для *модификации текстильных материалов, применение их в нашей стране в целях безопасности не рекомендуется* [9, 12].

Устойчивость материала к плесневому заражению повышает использование в технологическом цикле отделки тканей комбинированного процесса крашения и обработки растворами солей MeCl × (Co^{2+}, Ni^{2+}, Cu^{2+}, Ca^{2+}, Al^{3+}, Cr^{3+}). Выкраски, обработанные растворами солей кобальта и никеля, становятся более устойчивыми к заражению тест-культур Aspergillus niger и Ulocladium atrum. Наблюдаемая закономерность обусловлена синергическим действием хелатообразующих групп красителя и солей [27].

Из металлов наиболее общепризнанным активным антисептиком является ***серебро***. Препараты серебра чрезвычайно активно уничтожает бактерии. Оно в 1750 раз сильнее действия карболовой кислоты и в 3,5 раза сильнее действия сулемы. Всего 1мг/л серебра в течение 30 минут вызывал полную инактивацию вирусов гриппа А, В, Митре и Сендай (модификации вирусов парагриппа). По антибактериальным свойствам ни один антибиотик не может сравниться с действием серебра. Установлено, что любой из антибиотиков способен подавить не больше 5 – 6 штаммов микробов, а эффективность ионов серебра в коллоидном растворе значительно сильнее проявляется по отношению к 500 штаммам и более [26, 28]. Микроорганизмы, подвергавшиеся воздействию антибиотиков, со временем мутируют, что нельзя сказать о серебре. Согласно таким характеристикам серебро выступает как препарат, обладающий высокими биоцидными свойствами. ***Серебро*** □ металл, практически не изменяющийся под воздействием кислорода воздуха при комнатной температуре. Антибактериальное действие ионов серебра, наблюдающееся даже при концентрации $2{\cdot}10^{-11}$г-ион/л, было открыто в 1893 году V. Naeqeli. [29]. В настоящее время известно, что при концентрации 0,1 мг/л серебро обладает выраженным фунгицидным действием. При микробной нагрузке 100 000 клеток на один литр гибель грибов Candidaalbicans наступает через 30 минут после контакта с серебром [30].

Стабилизировать металлическое серебро в водной среде можно защитными коллоидами, например, водорастворимыми полимерами. Исследования показали, что чувствительность патогенных и непатогенных организмов неодинакова к воздействию ионов серебра. Патогенная микрофлора более восприимчива, чем непатогенная. Поэтому действие серебра является избирательным, в большей степени на более опасные микроорганизмы [31].

На основе наночастиц серебра в начале 2000-х годов появилось новое поколение антисептиков

– коллоидные растворы под маркой AgBion. Препараты AgБион-1 и AgБион-2 обладают бактерицидными, вирулентными, фунгицидными свойствами, а также активны по отношению к плесени и сине-зеленым водорослям. Препарат AgБион-2 в разбавленном виде может использоваться для дезинфекции помещений, предметов обстановки, оборудования в лечебно-профилактических, пенитенциарных учреждениях, на объектах коммунального хозяйства [32]. AgБион-1 предназначен, главным образом, для модификации наночастицами серебра различных материалов. Введение наноразмерных частиц серебра в количестве от 0,01% до 0,1% от объема модифицируемого материала приводят к появлению стойкого биоцидного эффекта, однако *этот препарат вымывается водой* [33].

Таким образом, анализ существующих в настоящее время биоцидных препаратов, показывает, что их применение для модификации текстильных хлопчатобумажных материалов бельевого ассортимента может быть ограничено по следующим причинам:

-*нестойкость к влажно-тепловым обработкам*: углеводороды, их галоген-и нитропроизводные, спирты, фенолы и их производные;

- *токсичность в различной степени:* пентахлорофен, элементорганические соединения ртути, олова, мышьяка, триклозан; растворы цитрата серебра, катамина АБ и лимонной кислоты;

-*необходимость наличия специального оборудования* при производстве азотсодержащих углеводородов;

- *значительное окрашивание ткани:* стеарат меди, нафтенат меди и 8-оксихинолят меди;

-*ограниченный спектр антисептического действия:* гексохлорофен и анилиновые красители (не воздействует на грамотрицательной бактерии), фурагин (не уничтожает синегнойную палочку), анимид салициловой кислоты и купроцин (являются только фунгицидами);

-*угнетение работы иммунной* системы: антибиотики.

Этих недостатков лишены препараты на основе наночастиц *серебра.* Их несомненными достоинствами являются:

- высокая антимикробная активность, в т. ч. способность подавлять наиболее адаптированные к внешним воздействиям микроорганизмы (или их видоизмененные формы);

- полный спектр антимикробного действия (бактерии, вирусы, грибы) и подавления патогенной микрофлоры (споры);

- отсутствие деструктирующего влияния на материалы обрабатываемых изделий;

- отсутствие в составе хлорсодержащих компонентов;

- экологическая безопасность [34].

К недостаткам практического применения наночастиц серебра можно отнести достаточно высокую стоимость и коричневатые оттенки модифицированных образцов, а также недостаточную прочность закрепления его в структуре ткани.

Серовато-коричневая гамма модифицированных проб, обусловлена характерным избирательным поглощением светового излучения наноразмерными частицами серебра в области 406 нм [13, 19].

Однако на практике используют гидрозоли с достаточно низкой концентрацией серебра, что значительно снижает их стоимость. Кроме того, возможно изменение цветовой гаммы модифицированных образцов при сохранении бактерицидных свойств.

Решение проблемы недостаточной прочности закрепления наночастиц серебра в структуре ткани возможно путем осаждения защитных коллоидов полипептидой природы с образованием нерастворимых соединений на поверхности волокон. С этой целью можно применять экологически безопасные растительные дубители – танниды, которые содержатся в коре, древесине, листьях и плодах многих растений. Такие танниды как *квебрахо и мимоза* используются при дублении кожи, танниды *коры ели, каштана, дуба, акации* – для придания различным напиткам терпкого и вяжущего вкуса и как пищевой краситель (Е 181). В медицине *танниды* коры дуба находят применение как вяжущие лекарственные кровоостанавливающие и общеукрепляющие средства. Они способны самостоятельно подавлять рост патогенных микроорганизмов. В воде танниды образуют коллоидные растворы, имеющие кислую реакцию и обладающие сильным дубильным действием, которое основано на способности взаимодействия отрицательно заряженных групп фенольного характера с положительно заряженными аминогруппами белка [35, 36].

Проведенный анализ выявил очевидные преимущества наночастиц серебра. Поэтому для модификации хлопчатобумажных тканей бельевого ассортимента были использованы гидрозоли серебра, созданные в ЗАО «ЦНТБ» [37]. При этом использовали два разных стабилизатора: *сополимер акриловой кислоты с акриламидом и желатин.* Содержание защитного коллоида в композициях составляло от 0,5 до 0,05 % (масс.) Композиция, стабилизированная сополимером акриловой кислоты с акриламидом, проста в изготовлении, использовании и стабильна при хранении. Пищевой желатин в качестве защитного коллоида применялся с целью повышения экологической безопасности системы и повышения её адсорбционной способности. Желатин, являясь полиамфолитом с большей молекулярной массой, чем сополимер акриловой кислоты с акриламидом, прочнее удерживает частицы серебра на поверхности волокон ткани.

Методика обработки тканей была зарегистрированный патентом РФ [38].

Образцы бязи обрабатывали *композицией при различном содержании атомарного серебра в гидрозоле*: от 0,0216 до 0,0018 % (масс.). Уменьшение концентрации серебра в растворе проводили для снижения затрат и коррекции цвета образцов при сохранении антисептических свойств.

Для фиксации частиц серебра в структуре текстильного полотна применили два растительных дубителя: *квебрахо и мимозу.* После обработки композициями на основе гидрозоля серебра проводили закрепление на одних образцах ткани в 1,5%-ном растворе таннидов квебрахо и на других - в 1,5%-ном растворе таннидов мимозы. После обработки в растворе квебрахо образцы приобретали более эстетичный светло – желтый тон, а мимоза предавала ткани персиковый оттенок.

Модифицированные образцы повергали пяти влажно-тепловым обработкам и последующему автоклавированию.

Для исследования антисептической устойчивости модифицированных образцов ткани были выбраны штаммы бактерий, чаще всего встречающиеся в транзитной микрофлоре: Bacilluc cereus sp. или Bacilluc licheniformis, Staphylococcus aureus и Escherichia`coli.

Биоцидные свойства образцов были определены методом «зон», бактерицидные свойства - аэрозольным методом, а бактериостатические свойства устанавливали по высеву микроорганизмов на плотные питательные среды из растущей жидкой культуры.

Было установлено, что после первой стирки содержание серебра в образцах, как и антисептические свойства, несколько уменьшились, однако после второй и последующих стирок показатели стабилизировались: образцы сохраняли высокие бактерицидные и бактериостатические свойства.

Conclusion

Таким образом, проведенное исследование показало высокую эффективность композиций, созданных на основе коллоидного серебра, а последующее применение таннидов, придало тканям эффект «невымываемости» с синергическим бактерицидным эффектом самих таннидов. В результате модифицированные материалы приобрели высокие потребительские антисептические свойства пролонгированного действия [39].

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

COMMUNICATIVE SELF-EFFICACY AS THE MOST IMPORTANT QUALITY OF THE FUTURE SPECIALIST

Abstract: *The author of the article pays attention to the relevance of "self-efficacy" among students in the educational activities in connection with the new realities of life. It emphasizes the importance of the work on communicative self-efficacy formation.*

Key words: *self-efficacy, communication self-efficacy, self-efficacy structure.*
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Introduction.

At present, society is gradually moving from the commodity economy to the intellectual-creative economy. In this context, the mastering of Internet technologies, nano-technologies, and robotics by students is considered as a very important aspect of their professional training and determines their willingness to achieve real success in their future activities. However, this does not mean that there is no need to develop abilities which are inaccessible to robots: creativity, imagination, initiative, communication, leadership qualities. Active life position, serious motivation for the profession, tendency to self-development, stress resistance, business negotiations skills, providing psychological help, conflict resolution, ability to act independently, actively and creatively, ability to navigate in situations of uncertainty in activities and communication, readiness for team work, etc. - these are the main market competencies that currently make university graduates attractive candidates for the proposed positions.

Whatever a person does, he must have a creative approach to everything, a lively imagination, the ability to quickly navigate in changing circumstances and there must be a well-developed intuition.

In this regard, there is a special interest in searching for internal resources, which actualization will lead to the increasing of success and productivity in the process of self-realization of the individual. And, first of all, the belief in the effectiveness of one's own actions and the expectation of success from their realization is very important, that is self-efficacy of the individual.

The main text

The term "self-efficacy" is one of the main terms in the social-cognitive theory of Albert Bandura. According to the scientist, self-efficacy, or belief in effectiveness, means a person's conviction that in a difficult situation he will be able to demonstrate good behavior [1].

As A. Bandura and other researchers have shown, self-efficacy can influence a wide range of aspects of our life - from the psychological state to behavior and motivation. The scientist also found out that the individual's self-efficacy plays an important role in choosing the ways of achievement of goals, of solution of problems. People with a high level of self-efficacy view complex problems as tasks that will necessarily be resolved; they show a deep interest in the activities they are engaged in; and they recover from failure faster than the others. People with a low level of self-efficacy tend to avoid complex tasks; they are sure that they are not able to cope with them; they focus on their own shortcomings and past failures.

Many foreign and domestic psychologists and educators have been researching the self-efficacy. They've proved that the influence of self-efficacy extends to any human activity. Thus, S.N. Gonchar correlates self-efficacy with ideas about one's own behavior and the results that this behavior gives (self-efficacy in activity), and also with ideas about one's own abilities to successfully communicate with others (self-efficacy in communication) [4]. M.I. Gaidar, in turn, identifies three types of self-efficacy: *activity self-efficacy* - the subject's conviction in the possession of knowledge, skills for meaningful implementation of activities, productive mastery of new forms of behavior; *communicative self-efficacy* - the subject's conviction in the ability to effectively and qualitatively implement communication with the others, as well as in the possession of a wide range of means of communication; *personal self-efficacy* is an integrative psychological characteristic, a combination of ideas in a human being about the existence of personally important qualities and the belief that the subject can skillfully apply them in different situations, achieving the desired result [3, p.11-12]. J. Maddux and M. Scheer singled out *self-efficacy in the subject-matter activity* as a confidence that the existing experience, knowledge and skills in a particular activity can be successfully applied in future activity, and *self-efficacy in communication* - as a confidence that interaction with other members of society can have a positive effect on the final result of the activity [6, p.38]. In the T.O. Gordeeva's opinion self-efficacy is "the belief of a subject in his own ability to cope with a certain activity" [5, p. 80]. In this definition, there is a clear connection between the individual's self-efficacy and the practical activity carried out by the individual, through which this quality manifests itself, that is why a scientific study of self-efficacy must take place within the framework of a certain organized activity of the subject.

First of all, we are interested in the question of the formation of communicative competence among students at a university and, as a consequence, the question of orienting future specialists to communicative self-efficacy.

Therefore, we organized a special study among the one-two-year cadets of the Siberian Fire Rescue Academy of the Ministry for Emergency Situations of Russia (specialty "Fire Safety"). The purpose of this study was to explore the self-efficacy of cadets, including communicative self-efficacy.

Observations of cadets in the classes showed that many of them prefer to work independently, rather than cooperate in pairs or groups. They often hesitate to speak in front of their group, some refuse to speak or communicate, making reports (even in Russian) many of them very often cannot take eyes off the text, the information which has been found by cadets is not often structured, and it's hard to listen to them. But the most important conclusion arising from observation is that they do not try to change the situation, they seem even to "hesitate their own self-efficacy."

In order to determine the cadets' level of self-efficacy a special test was done (authors: Maddux and Scheer, modification by L. Boyarintseva, R. Krichevsky) [6, c.38-41], 69 people took part in testing. An analysis of the results showed that overconfidence in the potential for organizing and conducting their own activities necessary to achieve a specific goal was demonstrated by 29% of cadets, over 46% of cadets showed excessive confidence in their potential abilities to organize and carry out their own activities necessary to achieve a certain goal; moderately expressed confidence (the average level of self-efficacy) in the subject activity was manifested by 68% of cadets, in interpersonal communication - 30%; uncertainty in their own strengths, a weak belief in the availability of potential abilities to organize and carry out their own activities was demonstrated by 3% of cadets, in the field of interpersonal communication - 23%.

At the same time, we were interested to know the opinion of cadets about what competencies they considered to be the most important for themselves, and whether the mastery of these competencies affected their communicative self-efficacy. The one-two-year students were offered a list of general cultural competences and general professional competencies, considered in the Federal State Educational Standard of Higher Education in this specialty (20.05.01. "Fire Safety").

The results of the conducted survey are reflected in Table 1.

Table 1

The results of the survey of cadets

№	Competence	Significance level	Influence on communicative self-efficacy	
			Direct	Indirect
1	the ability to abstract thinking, analysis, synthesis	4	+	
2	the ability to use the basics of philosophical knowledge to form a worldview position .	12		+
3	the ability to analyze the main stages and patterns of historical development of society for the formation of a civil position .	11		+
4	the ability to use the basics of economic knowledge in various spheres of life.	9	+	
5	the ability to use the basics of legal knowledge in various	6	+	

	spheres of life.			
6	the readiness to act in non-standard situations, to bear social and ethical responsibility for the decisions.	1	+	
7	the readiness to self-development, self-realization, using creative potential.	8	+	
8	the ability to use methods and means of physical culture to ensure full social and professional activities .	3		+
9	the ability to use first-aid techniques, methods of protection in emergency situations.	2	+	
10	the ability to solve problems of professional activity on the basis of information and bibliographic culture using information and communication technologies and taking into account the basic information security requirements .	7	+	
11	the readiness for communication in oral and written forms in Russian and foreign languages to decide different tasks of professional activities.	5	+	
12	the readiness to lead the team in the sphere of their professional activity, tolerate social, ethnic, confessional and cultural differences.	10	+	

Analysis of the results of the survey shows that the competence considered by cadets as the most important are connected with the willingness to act in unusual situations, as well as with the willingness to communicate in various forms to solve problems of professional activity. Moreover, in the opinion of cadets, most of the general cultural and general professional competences of the future specialist are directly related to such quality as communicative self-effectiveness.

Thus, based on the analysis of the results of observation, testing and the survey, as well as in the process of joint discussion with cadets, we came to the conclusion that self-efficacy, including communicative self-efficacy, is a super quality of a person, which is necessary for a modern graduate of the university as it determines person competitiveness.

Therefore, it is important to organize a purposeful work on the development of communicative self-efficacy of cadets. We believe that orienting the students to communicative self-efficacy is the most optimal pedagogical strategy in this case, since it involves a set of pedagogical activities of an introductory, recommendatory, supportive nature that help to give a value to the work being done [7, p.16].

As S.V. Bogomazov puts it, self-efficacy can be measured quantitatively and changed due to external or internal influence [2, p.30]. Therefore, talking about the change, the impact on the self-efficacy of a person, one must clearly understand its structure.

We've studied the literature on this issue and singled out the following components of communicative self-efficacy:

- value-motivational component (as I refer to my own communicative self-efficacy): the need to master the communication culture; understanding of the value of effective communication, orientation to the forthcoming communicative activity and mastering of communicative experience;

- cognitive-reflective component (what I know about my own communicative self-efficacy): ideas about the essence of communicative self-efficacy and how to build my communicative activity; reflection on the subject of what I can, what I do not know, how to work on, the ability to carry out an independent search for necessary information in situations of uncertainty;

- the activity-regulative component (which communication strategies I choose to solve problems in situations of uncertainty): demonstration of my own achievements, competence in the field of communication; verbal self-hypnosis, conviction in the upcoming success, evaluation of one's own communicative behavior and changing it to more effective according to the situation.

Summary and Conclusions.

We considered self-efficacy including communicative self-efficacy as a super quality of a person, which is necessary for a modern graduate of the university as it determines person competitiveness. Having studied special literature we can conclude that self-efficacy means the ability of a person to cope with specific and complex situations and to influence the effectiveness of their own activities. A person who has realized his own self-efficacy, i.e. a person focused on self-efficacy in communicative activity, makes more efforts to solve complex problems than that person who doubts about his capabilities.

Obviously, for full-fledged orientation of students to communicative self-efficacy in the educational process in university, it is necessary to create conditions of a strategic nature, each of which, according to the logic of the pedagogical process, corresponds to the named components. The impact on each component of the structure of communicative self-efficacy through the creation of strategic conditions in the educational acquisition process of the university will facilitate to getting by students of new meanings of communicative self-efficacy; to formation of attitude to the change of its qualitative and quantitative characteristics; to manifestation, enrichment of personal experience of communicative self-efficacy and other.

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SECTION 6. Metallurgy and energy.

STRESS FIELDS IN A STEEL CASTING

Abstract: *The article are presented the calculated stress fields and displacements arising in the cooling process (solidification) of the steel ingot in the mould.*

Key words: *a casting, stress, solidification, deformation.*
Language: *English*
Citation: Chemezov D (2017) STRESS FIELDS IN A STEEL CASTING. ISJ Theoretical & Applied Science, 05 (49): 165-172.
Soi: http://s-o-i.org/1.1/TAS-05-49-25 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2017.05.49.25

Introduction

25 % of all castings in engineering are making of steel. Using a modern equipment and the special moulding technologies [1] with the subsequent necessary thermal treatment, it is possible to obtain the complex configurations of the steel castings with the high mechanical properties.

Due to the low castability of steel (this is caused by the high viscosity and the surface tension in the liquid state), solidification of the casting occurs uneven throughout the volume. This process is especially pronounced in the thick-walled steel castings. It promotes the formation of hot tears and internal stresses in the casting material [2]. In conjunction with the other defects (change of the shape and the linear dimensions), the casting will be considered defective [3].

Since cast occurs in a closed mould without the possibility of a tracking process, then a mathematical calculation in the special computer programs allows with high accuracy to obtain a complete picture of the mould filling by melt, cooling of an alloy and to make the analysis of the hidden defects after solidification of the low carbon steel casting of the simple configuration.

Materials and methods

The calculation of the stress-strain state of the steel casting during cooling was performed according to the elasto-plastic model in the computer program LVMFlow [4]. As the casting it was taken an ingot from chrome-manganese steel of the grade 16MnCr5 of length 100 mm, width 50 mm and height 50 mm.

Steel contains 0.15 % carbon, 0.45 % silicon, 0.9 % manganese, 0.15 % chromium, 0.03 % phosphorus, 0.03 % sulfur, 0.23 % copper, 0.01 % nickel, 0.05 % molybdenum and 98 % iron. The liquidus temperature [5] for the alloy is 1512.221 °C, the solidus temperature is 1476.787 °C, the eutectic temperature [6] is 1142.306 °C, CLF up (the proportion of the liquid phase in which the formed crystals freely flow together with melt) is 70 %, CLF down (the proportion of the liquid phase below which there is no stream in the absence of plastic deformation) is 70 %, compressibility (parameter which is depended from the material properties, for example, the content of gas in melt) is 30 1/Mbar, CLFpres. (the parameter which equal to CLF down multiplied by 0.8) is 56 %, CLF Niyama (the criterion which is used for the prediction of shrinkage porosity in the casting material) is 3 %, the specific heat of crystallization is 172.6 kJ/kg and the specific heat of formation of the eutectic is 130 kJ/kg.

The temperature data for Young's modulus and Poisson's ratio for steel of the grade 16MnCr5 are linearly extrapolated by the temperature points introduced in the solid phase until the liquidus temperature. The cooling process is characterized by the increased value of Young's modulus and shear modulus of the material casting. At a temperature of 22 °C the value of Young's modulus of steel is 211 GPa, bulk modulus is 164 GPa, shear modulus is 82 GPa and Poisson's ratio is 0.285. The mechanical properties of chrome-manganese steel at the change temperature are presented in Fig. 1 – 4.

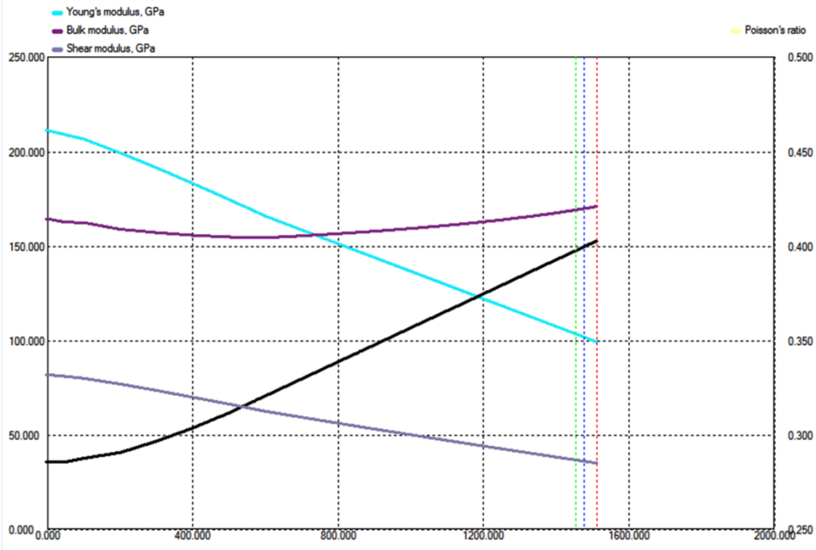


Figure 1 – The dependencies of Young's modulus, bulk modulus, shear modulus and Poisson's ratio of steel of the grade 16MnCr5 from the temperature.

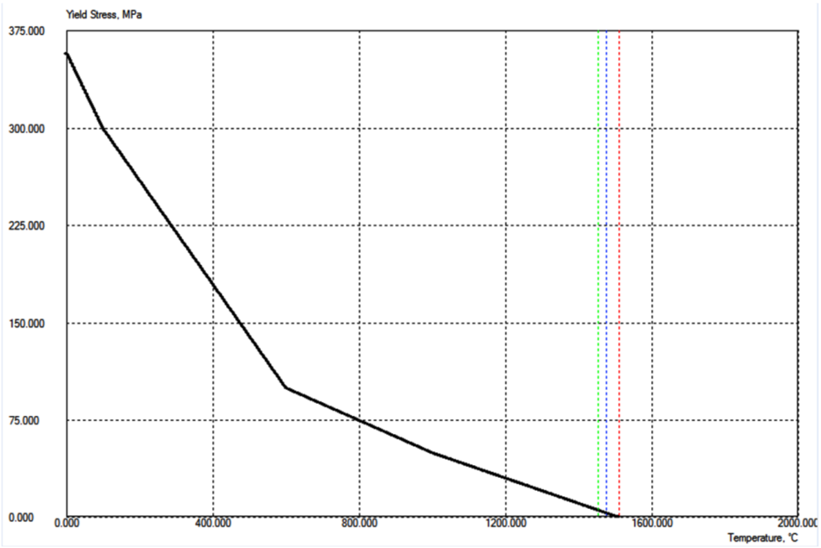


Figure 2 – The dependence of yield stress of steel of the grade 16MnCr5 from the temperature.

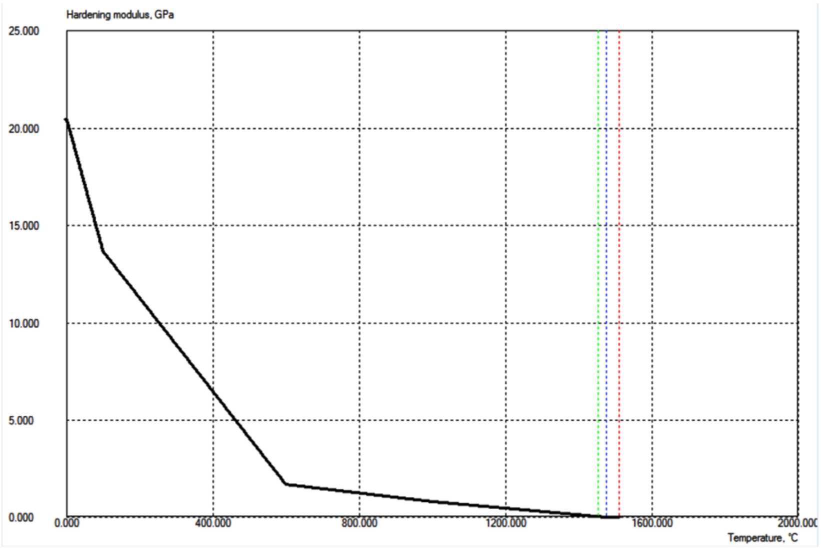


Figure 3 – The dependence of hardening modulus of steel of the grade 16MnCr5 from the temperature.

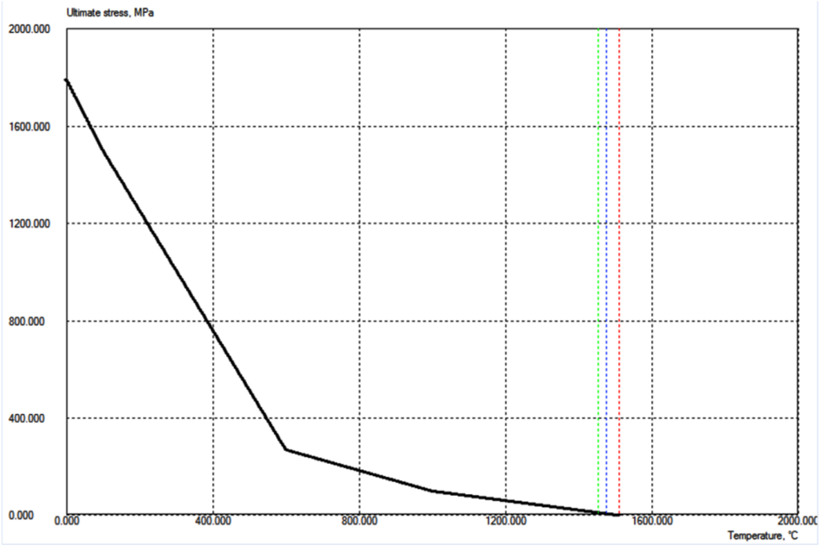


Figure 4 – The dependence of ultimate stress of steel of the grade 16MnCr5 from the temperature.

In the temperature range 600 – 22 °C a rapid increase of yield stress, ultimate stress and hardening modulus of steel is occurred [7]. The black line on the chart (Fig. 1) is the dependence of Poisson's ratio from the temperature.

Steel has a high heat conduction, which decreases with the increasing temperature. The alloy density in the liquid and solid phases decreases with the increasing temperature.

The simulation is consisted in the mould filling of melt at the initial temperature of 1610 °C and subsequent cooling (solidification) of the casting. Mould was a model, which is simulated the casting process. The internal cavity of the mould was a shape of the casting after solidification. The flow of melt into the mould was carried out through the feeder.

The diagram of the casting process of the steel ingot is presented in Fig. 5.

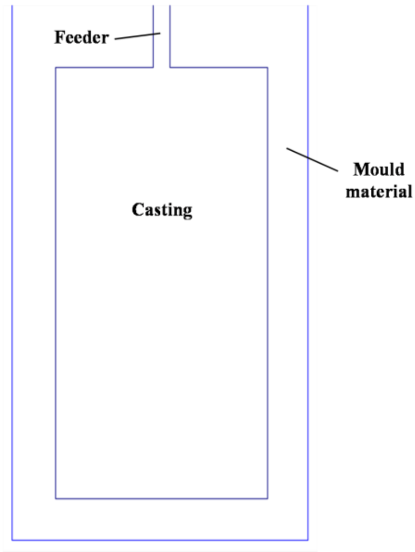


Figure 5 – Problem statement.

The maximum calculation step for solidification of the casting is adopted of 64.65 s.

Results and discussion

The calculated solidification time of the casting amounts to 261.039 s. The temperature of the casting after the process simulation of solidification amounts to 180.031 °C.

The following calculated fields were obtained:

1. The resultant displacement of the casting from the initial position.
2. Maximal principal stress in the casting material (i.e. the most principal value of the stress tensor) represents maximum stress of a normal uniaxial tension at the point of a solid body.
3. Median principal stress in the casting material, i.e. the average principal value of the stress tensor.

4. Minimal principal stress in the casting material. Stress acts perpendicular to the plane on which shear stress equals zero.

5. Yield stress in the casting material represents yield stress in the conditions of the uniaxial tension at the solidus temperature.

6. Von Mises stress in the casting material. The parameter characterizes the value of shear stresses in the solid body.

7. Pressure in the casting material. The parameter characterizes the isotropic part of tensile stresses in the solid body.

8. Effective plastic strain of the casting, i.e. the value of the tensor accumulated plastic strain at the point of the solid body.

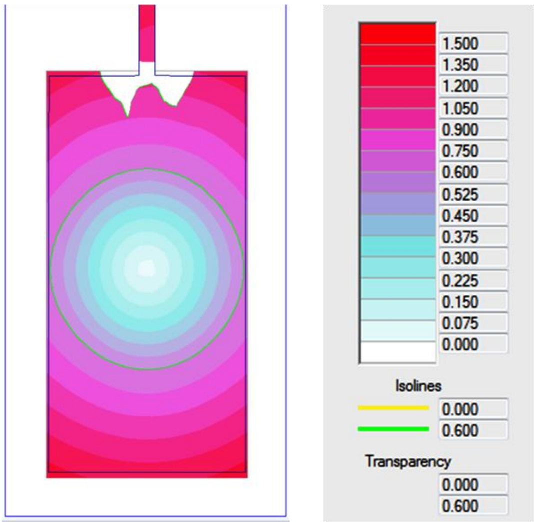
9. The plastic deforming work represents the volume density of work stresses by the plastic deforming of the point of the solid body.

10. Hot tears in the casting material. The threshold value for the formation of hot tears in the material.

The calculated fields of the stress-strain state of the casting material after solidification are presented in Fig. 6 – 15.

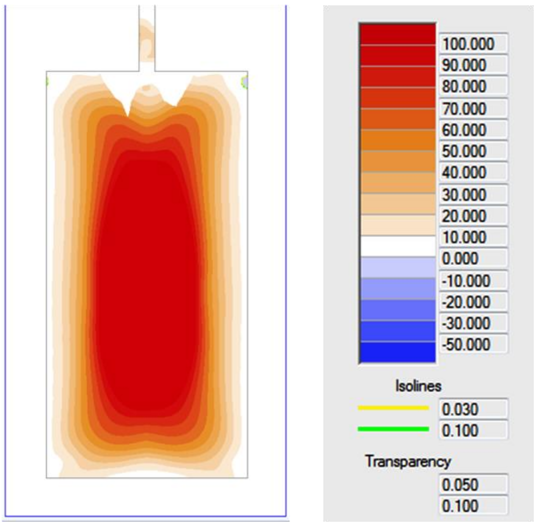
The inner layers of the casting material are cooled down in the last turn, therefore they are exposed to highest deformations and stresses. This is caused by the change of the specific volume alloy with the change of the temperature. The simultaneous tensile and compression of the alloy leads to the combined inhibition of shrinkage. As the result a discontinuity of the casting material occurs.

In the case when there is no exceeding of ultimate stress of the material, internal stresses remain, leading in the process of operation to the change of the shape and dimensions of the casting.



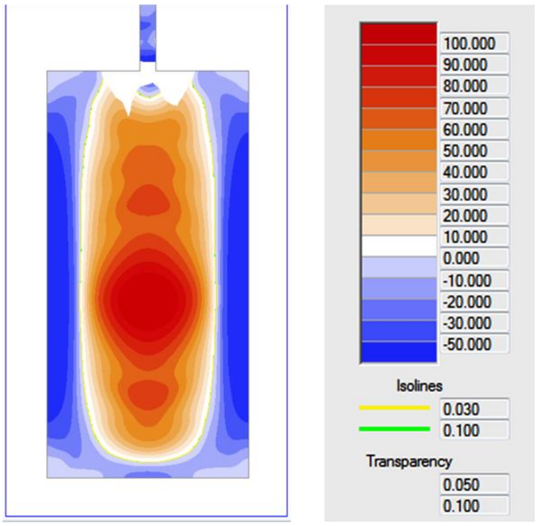
Displacements, mm

Figure 6 – Displacements in the casting on 261.039 second of the solidification process.



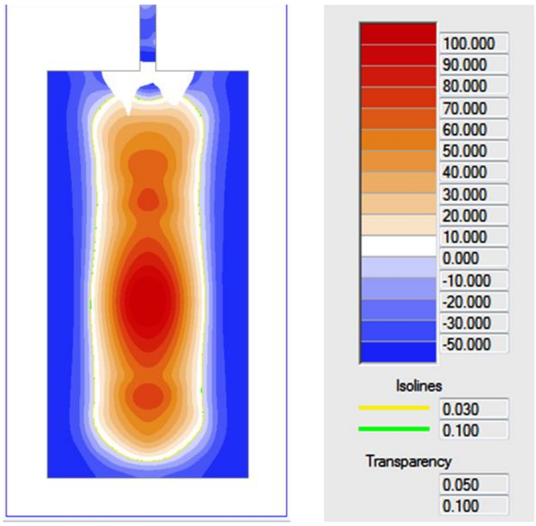
Maximal principal stress, MPa

Figure 7 – Maximal principal stress in the casting on 261.039 second of the solidification process.



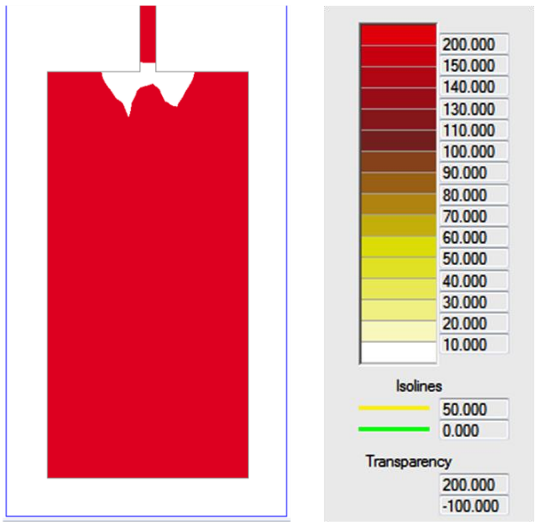
Median principal stress, MPa

Figure 8 – Median principal stress in the casting on 261.039 second of the solidification process.



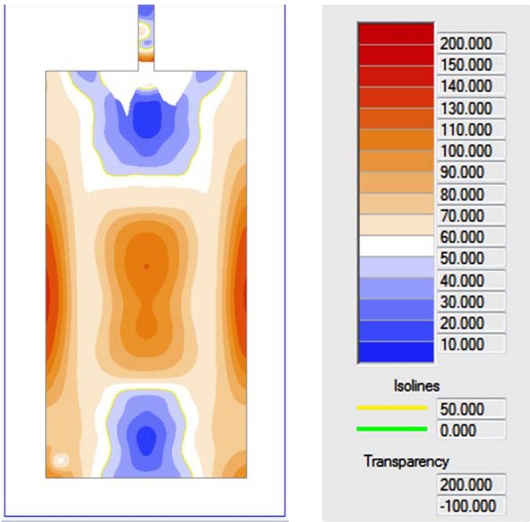
Minimal principal stress, MPa

Figure 9 – Minimal principal stress in the casting on 261.039 second of the solidification process.



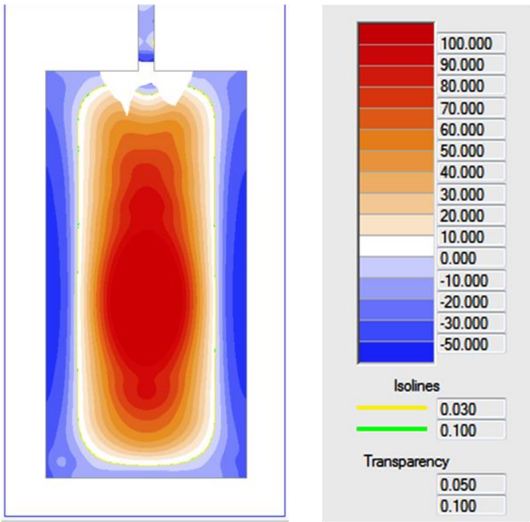
Yield stress, MPa

Figure 10 – Yield stress in the casting on 261.039 second of the solidification process.



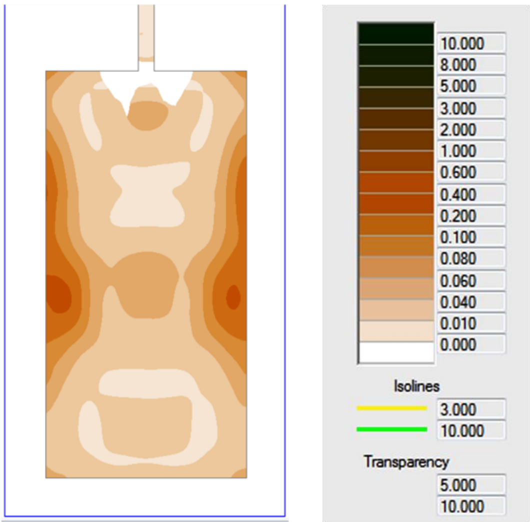
Von Mises stress, MPa

Figure 11 – Von Mises stress in the casting on 261.039 second of the solidification process.



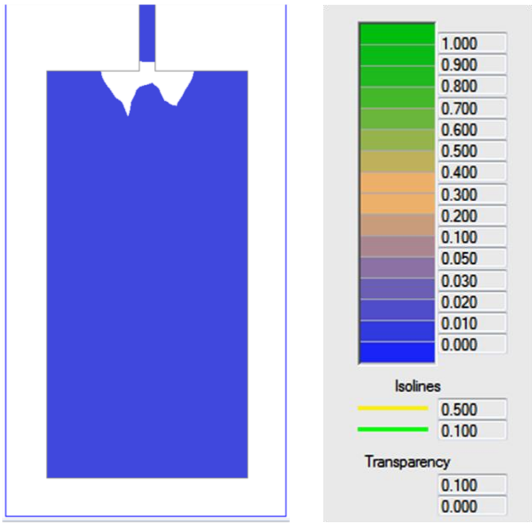
Pressure, MPa

Figure 12 – Pressure in the casting on 261.039 second of the solidification process.



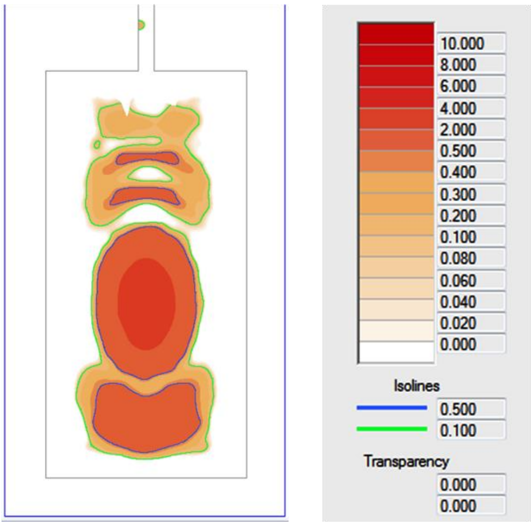
Effective plastic strain, *0.01

Figure 13 – Effective plastic strain of the casting on 261.039 second of the solidification process.



The plastic deforming work, MPa

Figure 14 – The plastic deforming work of the casting on 261.039 second of the solidification process.



Hot tears

Figure 15 – Hot tears in the casting on 261.039 second of the solidification process.

The predicted elongation of the casting amounts 1 – 1.35 mm from the initial length. By the width of the casting, the displacement amounts 0.5 mm. Deviation from the required dimensions of the castings amounts 1 %.

Maximal principal stress is concentrated at the center of the casting. The highest value of stress amounts 110 MPa. Maximal principal stress of the casting material has the positive value, i.e. it corresponds to the maximum possible for the value of normal stress of the tensile at the point.

The type of deformation of the casting material is determined by median and minimal principal stresses. The surface layers of the casting material are exposed by normal compressive stress (negative values). The inner layers of the casting material are exposed by tensile stress (positive values).

Yield stress is distributed throughout the volume of the casting material. Calculated yield stress of the casting material amounts not more than 200 MPa. This means that residual deformation in the material is absent, because calculated yield stress is less than allowable yield stress for steel of the grade 16MnCr5.

Highest von Mises stress of the material is distributed in the center and by the side surfaces of the casting. From the side of the feeder, the casting material is deformed less.

The positive values on the calculated field of pressure correspond by the tensile isotropic part, the negative values correspond by the compressive isotropic part. The character of pressure of the casting material is similar by to principal stresses.

After solidification of steel, the shape casting slightly changes (the surface layers of the material).

This is confirmed on the calculated field of the plastic deforming work of the casting material (value of the plastic deforming work amounts not more than 0.01 MPa).

Intensity of the formation of hot tears in the casting material depends on the value of maximal normal tensile stress, which during crystallization in the conditions of achievement of the full solidus is acts [8]. Since maximal principal stress in the area of the formation of hot tears has the positive values, it is possible the fracture of the crystal skeleton of the casting. With the increase of the value of normal tensile stresses, the probability of this fracture increases.

Conclusion

Thus, on the basis of the performed simulation several conclusions can be drawn:

1. Time of cooling (solidification) of the steel ingot when the specified dimensions is approximately of 261 s. Full crystallization of chrome-manganese steel with the formation of maximal residual stresses occurs at the temperature of 180 °C.
2. The solidification process is accompanied by deformation of tension and compression of the material in the inner and outer layers, respectively.
3. Dimensional change of the casting by 1% after solidification is allowed for this method of the workpiece manufacture.
4. Hot tears in the casting material are concentrated in the inner layers.

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SECTION 8. Architecture and construction.

THE INFLUENCE OF PRELIMINARY CYCLIC LOADING ON DEFORMATION AND STRENGTH OF SANDY SOILS

Abstract: *The article presents the results and experimental data on the study of deformation and strength of sandy soil considering influence of preliminary cyclic exposure.*

Key words: *soil, sand, loading, deformation, cyclic effect.*
Language: *Russian*
Citation: Azbergen MI, Inkarbek NM (2017) THE INFLUENCE OF PRELIMINARY CYCLIC LOADING ON DEFORMATION AND STRENGTH OF SANDY SOILS. ISJ Theoretical & Applied Science, 05 (49): 173-176.
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УДК 624.13

ВЛИЯНИЕ ПРЕДВАРИТЕЛЬНОГО ЦИКЛИЧЕСКОГО НАГРУЖЕНИЯ НА ДЕФОРМИРУЕМОСТЬ И ПРОЧНОСТЬ ПЕСЧАНЫХ ГРУНТОВ

Аннотация: *В статье представлены результаты и экспериментальные данные по исследованию деформируемости и прочности песчаных грунтов с учетом влияния предварительного циклического воздействия.*

Ключевые слова: *грунт, песок, нагруженцие, деформация, циклическое воздействие.*

Introduction

Для зданий и сооружений, работающих в квазистатическом режиме и претерпевающих на определенном этапе действие циклических воздействий, важным является оценка влияния последних на деформируемость и прочность грунтов их оснований.

С этой целью выполнены четыре серии испытаний. Эксперименты проведены в приборах трехосного сжатия конструкции Э.И.Воронцова-М.И.Азберген [3,5-8]. Исследованы песчаные грунты двух типов: песок мелкий и песок средней крупности. Грунты однородны, средней плотности сложения.

Materials and Methods

Первая и вторая серии экспериментов посвящены изучению прочности и деформируемости грунтов при статическом (однократном) нагружении. В испытаниях использованы грунты обеих типов. На первом этапе грунты подвергались изотропному обжатию с заданным давлением, на втором этапе проводилось девиаторное нагружение с возрастающим средним нормальным напряжением до разрушения образца грунта.

В третьей и четвертой серии экспериментов изучались влияние предварительного циклического воздействия на прочность и деформируемость грунтов. Испытания проведены с песком мелким в воздушно-сухом состоянии и песком средней крупности при двух состояниях по влажности (воздушно-сухом и влажности 0,04). На первом этапе грунты подвергались изотропному обжатию с заданным давлением, на втором этапе при достижении девиаторного нагружения заданного уровня напряжений σ_i / σ_i^* производилась частичная разгрузка на величину $n = \sigma^{ц} / \sigma^{cm}$ и квазистатическое циклическое воздействие с заданной амплитудой n до стабилизации приращений деформаций, после чего приложением статической нагрузки образец грунта доводился до разрушения по траектории «раздавливания» (рис.1, траектория П).

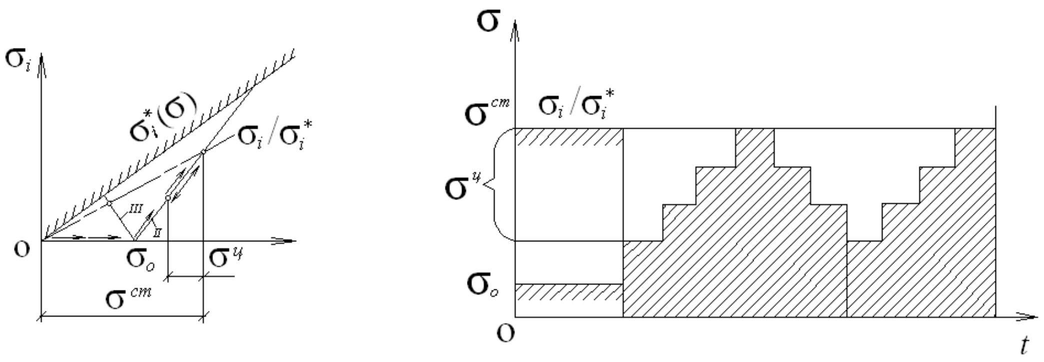

Рисунок 1 – Траектории и режимы циклической нагрузки.

С методикой проведения таких испытаний более подробно можно ознакомиться в работах [4-8].

Как показывают результаты испытания грунтов при статических (однократных) нагружениях по траектории П (рис.2-3, кривые 1), характер объемного и сдвигового деформирования песков мелкого и средней крупности в воздушно-сухом состоянии идентичен. Однако, песок средней крупности имеет гораздо большую, чем песок мелкий, склонность к уплотнению.

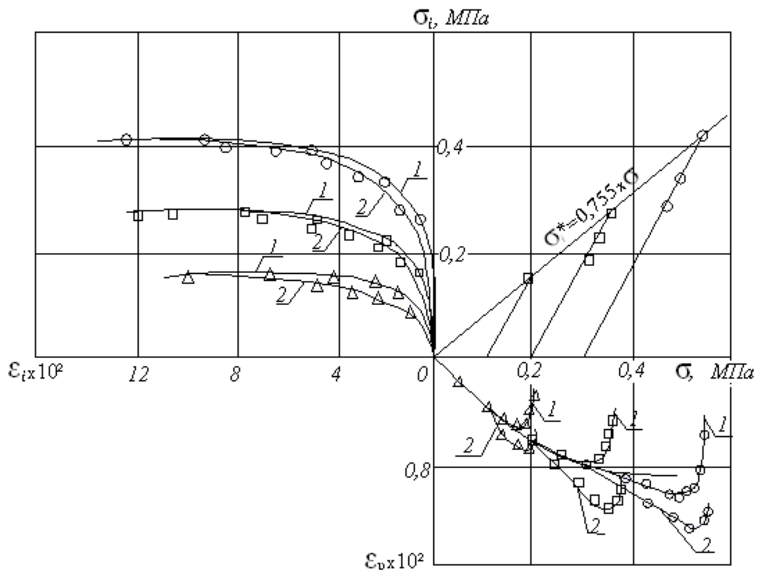

Рисунок 2 – Паспорт испытания грунта.
Мелкий песок, в воздушно-сухом состоянии: 1-статика; 2-циклика

Влияние предварительного циклического воздействия на деформируемость грунтов характеризуется развитием дополнительных как объемных, так и сдвиговых деформаций по сравнению с однократным нагружением (кривые 2 на рис.2-3). В области статистического девиаторного уплотнения объемная деформируемость характеризуется доуплотнением по сравнению с однократным нагружением [1,2]. Величина этого доуплотнения, при прочих равных условиях, зависит от типа и состояния грунта. В области статистического девиаторного разрыхления исследованные грунты имеют меньшую тенденцию к разрыхлению, чем при однократном нагружении.

Прочностные характеристики, определенные статистической обработкой экспериментальных данных, показывают, что в общем случае параметры прочности исследованных грунтов в различной степени зависят от типа и состояния грунта (таблица 1).

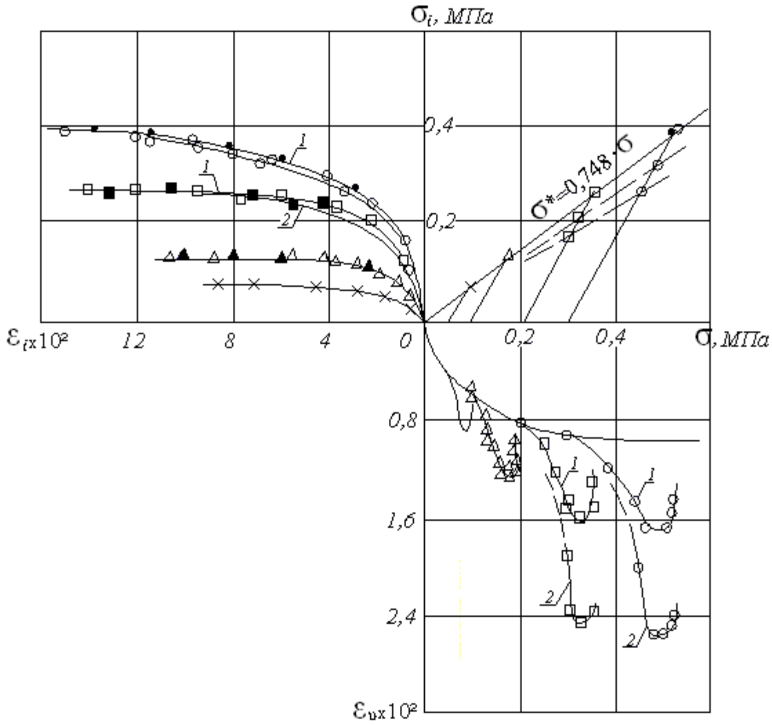

Рисунок 3 - Паспорт испытания грунта.

Песок средней крупности, в воздушно-сухом состоянии: 1-статика; 2-циклика

Таблица 1

Величин предельных интенсивностей касательных напряжений при однократном нагружении и предварительном циклическом воздействии.

Наименование грунта	Плотность сухого грунта	Влажность	Напряжения, МПа			Отклонения %
			σ_o	σ_i^*	$\sigma_{i(N)}^*$	
Песок мелкий	1,56	0,02	0,20	0,260 / 0,258	0,256 / 0,262	+1,54 / -1,55
			0,30	0,396 / 0,400	0,398 / 0,393	-0,50 / +1,75
Песок средней крупности	1,63	0,01	0,20	0,262 / 0,257	0,259 / 0,261	+1,14 / -1,55
			0,30	0,391 / 0,387	0,386 / 0,390	+1,28 / -0,77
		0,04	0,20	0,238 / 0,242	0,243 / 0,239	-2,10 / +2,24
			0,30	0,355 / 0,352	0,352 / 0,353	+1,12 / -0,28

Примечание: в числителе и знаменателе приведены результаты двух повторностей.

Conclusion

Сравнение величин предельных интенсивностей касательных напряжений для соответствующих значений напряжений гидростатического обжатия, полученных при однократном нагружении и предварительном циклическом воздействии песчаных грунтов (табл.1), свидетельствуют о том, что отклонения их не превышают ±3%. В связи с этим отсутствие закономерности в отклонениях позволяет отнести их за счет разбросов, обусловленных точностями подготовки образцов и измерения в приборах.

Таким образом, в общем случае, предварительное циклическое воздействие оказывает существенное влияние на деформируемость грунтов, тогда как влияния их на прочность не установлено, и это согласуется с результатами [1,2,9,10].

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SECTION 13. Geography. History. Oceanology. Meteorology.

FOREIGN LAWS TO PREVENT ENVIRONMENTAL PROBLEMS

Abstract: *Currently, the national security of the Republic of Uzbekistan's domestic and foreign political life of the most important issues to be solved. Concern for the preservation of national security laws to protect the public and to avoid social and environmental problems will serve as an important criterion.*

Key words: *society, state, national security, the environment, criminal code, a person, fine, nature.*
Language: *English*
Citation: Rakhimova GS, Azimov A, Mamadaliyev A (2017) FOREIGN LAWS TO PREVENT ENVIRONMENTAL PROBLEMS. ISJ Theoretical & Applied Science, 05 (49): 177-179.
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Introduction

In recent years, endangering of human life from environmental factors is becoming the world problem. In preventing problems, in the first place is to receive laws and international legal documents in cooperation in all countries in order to protect national ecological environmental. The international standards of the world emphasized: "The nations of the world must work together to restore ecosystem and maintain the health. States are responsible for not materializing global environmental problems in their ecosystems and environments. The development of the state must be obliged to be provided on the basis of international rules, to provide with technology and financial resources to prevent environmental issues" [1]. Therefore, the legal system of criminal must be required to keep a high level of each state in accordance with the present day. The protection of human dignity in the field of criminal law of the countries of the world was systemized, on the basis of international laws. Sometimes, evidences on a great many of the negative effects of basic criminal liabilities to environmental pollution, global environment are given [2]. As M.D.Bergenevani said: "The issue is that duty for pollution of environment is paid by the oil companies during the transportation of the oil to the other countries. However, can the duty to prevent environmental damage justify itself financially? [3]

Materials and Methods

Not being superior of economic development from the environmental life for valuing in society, coming first of environmental fields from all spheres of the state, laws concerning with ecological purity among the population, rights on environmental issues did not give a clear assessment to the situation. Law on the criminal field of many countries only connected with humanity. Animals and environmental pollution were only reserved with environmental rights. Even if environment was disastrous damaged, it will be punished based on environmental legal norms. This means to cause that the damaging to environment of people in production is not significant factor and the ecological problems have originated among society. Using criminal penalties can achieve great results in environment protection. For example, Kazakhstan state according to Bergenevani: Environmental protection laws in Kazakhstan are more with agricultural production facilities and recorded of administrative penalties and fines by the state to enterprises which were treated improper to environmental norms. Reasons for causing to environmental problems were not taken severe punishment cases" [4].

Even if administrative penalties warn to the population, state authorities don't do in practice. It should be noted that the abandoned waste in different places isn't controlled and isn't undergone administrative liability.

As a result, damaging of the human ecology remain relating to emergence of new diseases recently. This shows the lack of attention to environmental policy paid to environmental preservation.

Perhaps, criminal violation of environment does not affect to social sectors negatively, but statistics show the expansion of environmentally dangerous areas in countries. Some articles of RIO about "criminal prosecutions to some serious reasons which may danger to environment "were adopted. On the basis of this declaration, running consideration of laws and decisions on environment in every country intensify measures on preventing environmental problems little in country" [5].

The laws on the preservation of the environment of the former Soviet Union were not reflected in 1991.

As a result, the violation and issues of environment in a number of related republics are deteriorating. After the disintegration of the former Soviet republics, environmental policy of countries grew. Environmental policy in some economically developed republics began to resolve problems quickly and easily. Environmental policy was implemented with using tested methods in countries close to Europe countries. But ecological processes in Central Asia were implemented slowly with difficulties.

In February 1992, states in accordance with the rules of cooperation of the Commonwealth of Independent States signed agreement to cooperate with each other on "protection of human health and the environment" ecological tragedy and prevent them. The main objective of this agreement is protection of ecology and environmental (preservation of the soil in cultivating, not breaking national legislation in using soil, forest, water, air, plants and animals, natural resources, economic zones, basins of water.

The Agreement vas controlled with the policy of ecology and environmental protection in 1992. the legitimate certificates of environmental protection were organized in the agreement and environmental norms and standards were taken into account. Interstate act also included in the fight against to chemical, and nuclear weapons, wastes of toxic and radioactive substances on the environmental, ecological security. In 1992, controlling agreement by the Interstate Environmental Alliance, the Environment Fund was agreed. DEI as a controller of the agreement makes measures and decisions on finding solutions in emergency [6]. Moreover, it helps countries that signed the agreement in emerged dangerous situations, makes concrete measures and represents the direct participation. Some articles on damage of other states to environmental were adopted in Criminal Code of the Russian Federation. Also, harsh punishments were given in China's criminal code for environmental damages. For example: "Jail punishment from 3 years till 10 years or high fine for damaging environment was indicated".

The protection of ecology and environment is being controlled according to the degrees of dangerousness for human life in developed countries of Europe.

In the criminal legislation of the republic of Bulgaria (Criminal code, 5th section, 11th chapter) criminal punishments are established for using atomic energy illegally. Followed by this code, several criminal cases were opened in the tragedy of Chernobel in 1986. The criminal code of the Poland: "A person who damages natural environment and its territory is fined: according to the amount of damage they are imprisoned for 2 years" [7]. More specifically, nature and its creatures, whether they are inanimate or animate, are protected by the law. It is concrete that damage to nature, in any case, naturally leads to changes in the ecology. For example: There is a significant difference between the attention given to their agricultural land and the land of the state in agricultural sector. However, they are related to each other with the land and the soil changes.

In article 266 of Chapter XXVI of the Criminal Code of the Kyrgyz Republic such given that environment, human health and life are harmed in the cases of not applying to arrangement during transportation of chemicals, bacteriological, radioactive waste, a high level of fines and imprisonment up to 2 years are used. In addition, if the death of human and animals are come as a result of pollution and large-scale poisoning of the environment, criminal proceedings will be risen and from 3 years to 5 years imprisonment will be sentenced.

Russian lawyer researcher O.L.Dubovinki said: "there is no any factual factors to environmental lesions caused to the death of the human, but there are some specific facts caused to diseases and it is certain that serious consequences can cause to the death of human" [8].

Such conditions can be seen in society that poisoning of water is being reason for the death of human. The laws on " Using water resources", "Environment preservation", " Using nature resources in agriculture" were made in Australia, Great Britain and Belgium [9].

So, if we analyze the criminal codes of foreign states, law breaking in preservation of environment is carried out in the level of criminality.

Conclusion

To make equal Environmental protection with the criminal, impacts positively the civil on the prevention of offenses identified with environment;

- Specific environmental laws related to environmental protection must be developed in legislation institutes

- Show more monitoring advertisements related to environmental legislation among population
- To impose penalties for damage to the environment and to implement it in practice by state

If ecological rights in the international community make environmental damage among countries, large fines will lead to a political settlement. But in the inner regions of the state, penalties, fines to its citizens are not how much money. Citizens' attention to the environment is carried out by means of legislation will lead to the rebirth of a sense of responsibility.

Using execution of eco-fines in protection of environment and the application of taxes or fines that can fill environmental damages will serve as a material to improve the environment.

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ACCORDING TO THE CALCULATION OF REINFORCED CONCRETE CEILINGS TAKING INTO ACCOUNT THE CHANGE IN TORSIONAL STIFFNESS OF PREFABRICATED PLATES AGAINST THE FORMATION OF NORMAL CRACKS

Abstract*: The article shows the influence of torsional rigidity of reinforced concrete elements on the spatial work of bridges, overlappings, building frames and other complex statically indeterminate systems. It is shown that the determination of torsional stiffnesses by the existing methods assumes the obligatory presence of spatial spiral cracks, and torsional stiffness in the presence of normal cracks is not investigated. A method for determining the torsional rigidity of reinforced concrete elements is described in the presence of normal cracks in them. It is shown that this approach allows calculating the torsion of reinforced concrete elements of any cross-section, and also taking into account the nonlinear properties of concrete. The article also describes the use of approximation methods, in particular, the apparatus of the best Chebyshev approximation.*

Key words*: Torsional stiffness, spiral cracks, reinforced concrete elements, approximation, concrete.*
Language*: English*
Citation: Azizov TN, Melnyk AS, Vakal LP, Kalenchuk-Porkhanova AA, Orlova OM (2017) ACCORDING TO THE CALCULATION OF REINFORCED CONCRETE CEILINGS TAKING INTO ACCOUNT THE CHANGE IN TORSIONAL STIFFNESS OF PREFABRICATED PLATES AGAINST THE FORMATION OF NORMAL CRACKS. ISJ Theoretical & Applied Science, 05 (49): 180-189.
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Introduction.

It is known that the torsional rigidity of their elements exerts a significant influence on the spatial work of the plate-ribbed systems. In reinforced concrete slab-ribbed systems (bridges, ribbed monolithic and prefabricated ceilings), flexural and torsional rigidity is affected by various cracks [1, 2, 9, 10, 13, 16, 20].

When local loads are applied to prefabricated or monolithic reinforced concrete floors, cracks may appear in individual beams or slabs, in others they may be absent. In this case, the torsional and flexural rigidity in the beams without cracks and with cracks will differ. It was shown in [2, 16, 20] that the redistribution of the local load depends in practically the same manner on both the flexural and torsional stiffnesses of the individual elements. This dependence is significant. Consequently, the definition of bending and torsion stiffness is an important and urgent task. Despite this, most calculations for the design of various structures, including well-known powerful software complexes, such as Ansys, Nastran, Lira, are carried out without taking into account the change in torsional stiffness resulting from the formation of normal cracks.

The torsional stiffness of individual elements with normal cracks can be taken into account in the program complexes mentioned above, when using volumetric finite elements. However, when calculating, for example, the skeleton of a multi-storey building, a bridge structure or an overlap consisting of many elements, modeling

Each element (column, beam, plate, etc.) from volumetric finite elements with the inclusion of reinforcement elements is very, very laborious and practically impracticable.

To date, there is a large number of studies on the flexural rigidity of reinforced concrete elements with cracks and a very small number of studies of the torsional stiffness of such elements. Most of the studies relating to torsion in reinforced concrete are devoted to the study of the strength of such elements. The existing methods for determining torsional stiffness [14, 22, 25, 26] relate mainly to reinforced concrete elements with spiral cracks under the action of torsional bending, although experimental studies have established a significant effect of normal cracks on the torsional stiffness of reinforced concrete elements [9, 13] . In addition, in these works we consider simple types of sections: a rectangle with a symmetric reinforcement, a ring, cylindrical elements. Considering the fact that in practice there are a variety of types of sections: T-waves, I-beams, hollow triangles, box-shaped, etc., some studies have been carried out in this direction at the Odessa State Academy of Construction [3, 5, 21]. However, these works are only at the initial stage of research. The works devoted to the investigation of the torsional stiffness of reinforced concrete elements with normal cracks [3, 5, 19, 21] have an approximate and particular character.

In connection with the foregoing, the **purpose of this article** is to develop methods for determining the torsional stiffnesses of reinforced concrete elements with normal cracks using algorithms and software complexes for processing and compressing arrays of experimental data by replacing them with a certain analytical expression (approximant) with a small number of coefficient parameters using known approximation methods.

Qualitatively new approach when performing such a replacement is the use of intellectualized methods of approximation of the function by the best Chebyshev (uniform) approximation, which is much more effective and universal than the interpolation and rms approximation methods.

The main advantage of the Chebyshev method of approximation in comparison with other methods of approximation is to ensure the accuracy of the approximation obtained at a certain set of points of the approximation interval at all points of this interval.

The advantages of the Chebyshev approximation allow us to solve with high accuracy not only the obtaining of an approximant and, as a result, the compression with large (several orders of magnitude) data compression coefficients of a discretely given functional dependence (the direct approximation problem), but also the task of restoring the values of the dependence on "unlit" (Inverse approximation problem).

Developed for the first time in the Institute of Cybernetics named after VM. Glushkov Institute of National Academy of Sciences of Ukraine the apparatus of the best Chebyshev approximation has been used for many years to solve a large number of problems and has repeatedly confirmed high efficiency in comparison with other methods of approximation (for more details, see [12c, 12d]).

The article also substantiates the significant influence of the change in the torsional rigidity of the elements of the structure of the overlap on the redistribution of forces in individual elements.

Statement of the problem and the algorithm for its solution. In view of the foregoing, it is important to develop methods for determining torsional rigidity that would have general hypotheses for any type of cross-section, and also include methods for calculating elements with the presence of both spatial and inclined and normal cracks.

Consider a reinforced concrete element with a normal crack, subject to the action of torque (Figure 1).

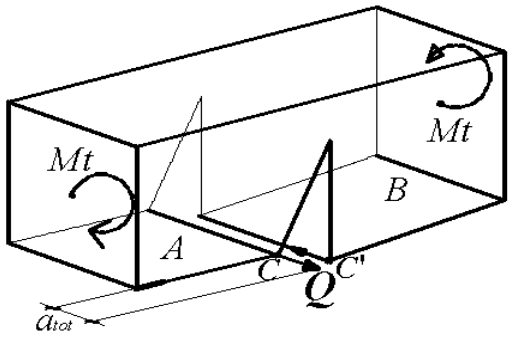

Figure 1 - Scheme of a reinforced concrete element with a normal crack subjected to torsion.

After the mental dissection of the longitudinal reinforcement, the nail strength Q in it is determined from the compatibility condition of the deformations at the point of dissection of the reinforcement.

Define the deformations of the element in the crack according to the procedure [2]. The discrepancy between the points C and CI (see Figure 1) should be zero at the section of the reinforcement:

$$\Delta_C = \Delta_{Mt} - \Delta_Q - \Delta_{sm} = 0$$

Where is Δ_{Mt} the divergence of points from the action of the external moment M_t; Δ_Q - divergence of points from torsion of the rod by an unknown nagel force Q; Δ_{sm} - the divergence of points from the crushing of concrete by the nagal force Q. Since the concrete is crumpled in both blocks separated by a crack, the value Δ_{sm} should be multiplied by 2. If we denote the discrepancies of the points as a result of the action of the unit nadal force $\overline{Q} = 1$ against torsion and on the wrinkling, respectively Δ_{Qed} , $\Delta_{sm,ed}$ (1) with the above note in mind Δ_{sm}, we get the value of the nagel force:

$$Q = \frac{\Delta_{Mt}}{\Delta_{Qed} + 2 \cdot \Delta_{sm,ed}}$$

The components Δ_{Mt} and Δ_{Qed} are determined using software packages, as will be discussed below. In this case, use the volumetric finite elements. The component $\Delta_{sm,ed}$ of crushing by a single nagel force $\overline{Q}$ can be determined using empirical data [18]:

$$\Delta_{sm,ed} = \varphi_{cc}\left(1000\frac{\overline{Q}^2}{d_s^3 E_b^2} + \frac{\overline{Q}}{d_s E_b}\right)$$

Where (3) $\varphi_{cc} = 1$ for short-term load action; ds - is the diameter of the reinforcing bar; E_b is the modulus of elasticity of concrete. In expression (3), in contrast to [18], we do not take into account force of pressing a mortgage to the concrete because of its absence. The determination of the amount of displacement from the crushing $\Delta_{sm,ed}$ can be obtained by any other known theoretical or experimental method. The essence of the calculation does not change from this.

Expression (2) differs from expression (6.59) [2] by the absence of a term containing the displacement from the shear of the reinforcing bar in the fracture. This is done because the displacement from the shear of the reinforcing bar in the fracture turns out to be much smaller (by an order or more) displacement from the crushing of concrete and it can be neglected.

After calculating the unknown value of *Q*, it is easy to determine the total displacement in the fracture a_{tot} (see Figure 1):

$$a_{tot} = 2 \cdot \Delta_{sm,ed} \cdot Q$$

Further, a coefficient k_t is determined, which is the ratio of the deformation of an element with a normal crack to the deformation of an element without cracks:

$$k_t = \frac{a_{tot} + a_e}{a_e}$$

Where a_e is the displacement from the torsion of the element without cracks, which is determined by the formula:

$$a_e = R \cdot \varphi_e;$$

R is the radius of the turn to the point of definition of displacement (for a rectangular section it is almost half the height of the total cross section of the beam); φ_e - the angle of rotation of an elastic (without cracks) element length l_{crc} equal to the distance between cracks, determined by the known formula of the resistance of materials:

$$\varphi_e = \frac{M_t \cdot l_{crc}}{GJ_t}$$

Where GJ_t is the torsional stiffness of the element without cracks.

The value k_t is the ratio of the torsional stiffness of the element without cracks to the rigidity of the element with cracks, i.e. How many times the rigidity of an element with normal cracks is less than its initial stiffness. As can be seen from the above formulas, it depends on the distance between the cracks, the diameter of the reinforcement and the depth of the crack (since the values Δ_{Mt} Δ_{Qed} of u depend on the latter).

The advantage of the described approach is its generality for calculating the rigidity of elements with normal cracks in any form of cross-section (rectangular, T-shaped, box-like, etc.), because the initial data for the calculation are the values Δ_{Mt} Δ_{Qed}, determined from the calculation of the FEM. In this case, the values Δ_{Mt} Δ_{Qed}, determined once for a particular section and the height of the compressed zone, will allow us to determine the rigidity of an element with different diameters of the reinforcement.

Let us consider in more detail the definition of the quantities Δ_{Mt} Δ_{Qed} and the expression (2).

In the works of the authors of [5, 6, 7, 17], a series of studies of the torsional stiffness of reinforced concrete elements of rectangular and T-sections with normal cracks was carried out. In these works it was shown that the main part of the problem of determining the torsional stiffness of a reinforced concrete element with normal cracks is the determination of mutual displacement of the crack edges. This problem can be solved both by an approximate method [6, 19], and using the finite element method. One of the disadvantages of solving this problem, as mentioned above, is the condition of using a large number of volumetric finite elements, which complicates both the creation of the calculation scheme and analysis of the calculation results, especially since this is only part of the solution of the general problem of the stress-strain state Reinforced concrete element with normal cracks in torsion [5, 6, 19]. At the same time, the use of the methods of elasticity theory [7] is probably not possible for all cases of solving the problem [6, 19].

One of the methods for solving the problem of determining the displacement of fractured edges during torsion is the method proposed in [4], the use of which can substantially simplify the solution of the engineering problem.

Following [4], it can be assumed that the mutual displacement of the shores of the crack will be a clear function of the height of the compressed zone, the height and width of the beam section and the distance between the cracks, which allows us to apply the methods of approximation to determine this dependence. Let us first consider the dependence of the displacements in a beam of a rectangular cross-section on two parameters-the width b and the section height h-for a fixed value of the distance between the cracks and the height of the zone compressed from the bend. In this case, perhaps not for all cases, it is possible to construct a graph of such a dependence in the form of a certain surface.

Below are examples to explain the derivation of the approximation dependencies.

Example 1. Let there be a beam of a rectangular cross-section made of a material with a modulus of elasticity Eb = 32500 MPa, a shear modulus of 10000 MPa. The remaining parameters have

Such values: distance between cracks l_{crc} = 400 mm; Height of the compressed zone $x = 30$ mm, torque T = 1000 N · cm.

Approximation of the required surface in the Matlab environment is quite simple. The authors have previously carried out a series of calculations on the FEM using volumetric finite elements. Variable parameters and movements are shown in Table 1.

Table 1

Variable parameters and movements.

№ P/p	Dist. Between cracks. l_{crc}, мм	Height of the compressed zone x, мм	b, мм	h, мм	Displacement of the crack edges (according to FEM) $\Delta \cdot 10^3$ (мм)
1	400	30	60	100	3.104
2			80	100	1.668
3			100	100	1.043
4			60	180	7.614
5			80	180	3.879
6			100	180	2.305
7			160	180	0.769
8			180	180	0.585

As a result of processing the initial data in the Matlab environment, the approximate surface shown in Fig. 2.

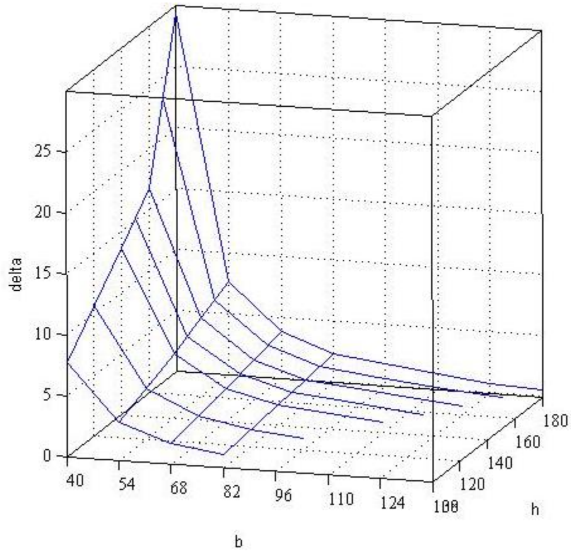

Figure 2 - The dependence of the displacement of the crack banks (delta) on Width (b) and height (h) of the beam section.

To compare the displacements obtained as a result of the approximation with the displacements obtained directly from the calculations using the Lira program using volumetric finite elements, table 2 is compiled. In column 6 of the table, the values of the displacements obtained by the FEC (the Lira program) are given. In column 7 - the displacements obtained on the basis of approximation in the Matlab environment. As can be seen from the table, the values in columns 6 and 7 coincide with a sufficiently high accuracy, which confirms the correctness of the adopted approach to the solution of the problem.

Table 2

Comparison of displacements of crack banks obtained by the Lira program using volumetric finite elements and the approximation method.

№ P / p	Dist. Between cracksl_{crc}(мм)	Height of the compressed zone x (мм)	b (мм)	h, (мм)	Displacement $\Delta\cdot10^3$ (мм)		Error (%)
					MCE	Approxi mation	
1	2	3	4	5	6	7	8
1	400	30	60	140	5.2469	5.3575	2.11
2			80	140	2.72018	2.7735	1.96
3			100	140	1.641188	1.6743	2.02
4			140	140	0.770339	0.8139	5.65
5			60	160	6.40637	6.4858	1.24
6			80	160	3.288858	3.3262	1.14
7			100	160	1.96683	1.9898	1.17
8			160	160	0.688064	0.6992	1.62
9			120	120	0.89508	0.90685	1.31
10			90	130	1.87789	1.8287	2.62
11			90	150	2.292	2.263	1.29
12			130	150	0.99102	1.0638	7.34
13			150	150	0.71663	0.7994	11.55

A similar approach is fairly simple to apply for elements with any other shape of sections (T-shaped, I-beams, box-like, etc.), and also with inclined cracks. The number of variables for the approximation can be different.

Creating a library of function approximants (similar to Table 2, Figure 2) will greatly simplify the solution of many problems of determining the stiffness parameters of reinforced concrete elements with cracks that can enter as a separate block into existing software systems.

When determining the stiffness parameters of a reinforced concrete element with normal (or inclined) torsion cracks, to determine the movements of any points, it is necessary to compile approximate expressions (based on a certain number of calculations using MCEs), in which the cross-sectional dimensions b and h, the height of the compressed zone (The height of the zone through which the torque is transmitted), as well as the length of the block separated by normal cracks, the angle of the fracture (in the case of inclined cracks), etc.

For more complex sections, the number of variable parameters will be larger. For example, when the height of the compressed zone is within the edge of the reinforced concrete element of the I-section (Figure 3), the displacement of the crack sides (the angle of mutual rotation of the two blocks separated by a normal crack) will be a function of seven variables:

$$\Delta_{crc} = f(b_1, h_1, b_2, h_2, t, h, x).$$

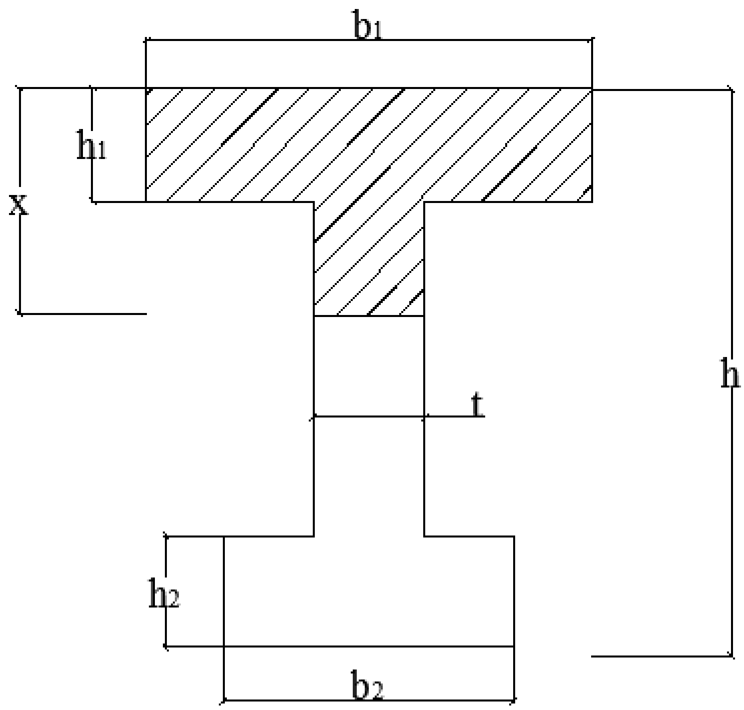

Figure 3 - Scheme to determine the parameters of the approximant for a reinforced concrete I-section with a normal crack.

To approximate such functions of several variables, one can use a software implementation of one of the algorithms of the apparatus of the best Chebyshev approximation, described in [12a, 12b, 12c, 12d].

It should be noted that the database of values of these parameters of approximants can be obtained for specific values of the elastic modulus E and the shear modulus G of concrete. Taking into account that this problem is linear, to obtain displacements in an element with other values of elasticity and shear module, it is easy to multiply them by the ratio of the corresponding values of the parameters of the considered construction (or the corresponding iteration stage) and the values of the parameters given in the database.

Example 2. Consider the concrete case of calculating the torsional stiffness of hollow-core slabs according to the proposed technique. The section of a hollow-core plate can be represented with sufficient accuracy in the form shown in Fig. 4.

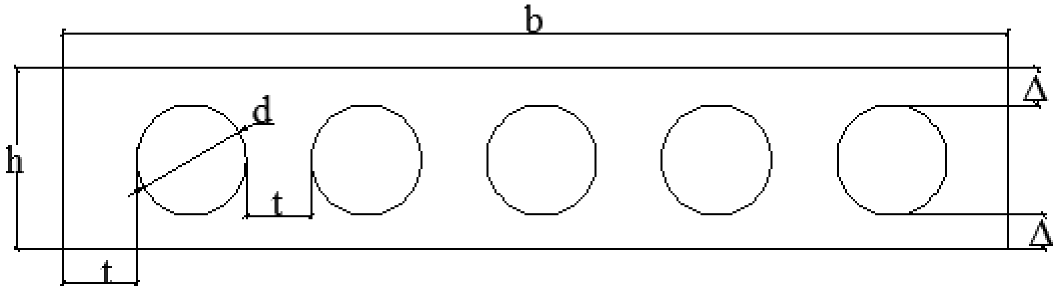

Figure 4 - Scheme to determine the approximation parameters for a hollow-core plate with a normal crack.

The function of mutual displacement of the crack banks in this case will have the form:

$$\Delta_{crc} = f(b, h, d, t, \Delta, n),$$

Where n is the number of voids; The remaining notations are shown in Fig. 4.

In order to approximate the numerical experiment data in this case, it is effective to use the apparatus of the best uniform (Chebyshev) approximation using generalized polynomials [12a, 12b, 12c, 12d]. Thus, for example, using this apparatus for a T-element with a width of the upper flange b1, its thickness h1, the width of the edge b2, the height of the edge h2, based on a series of Lira calculations using volumetric finite elements, the result of a numerical experiment for the angle of mutual Rotation φ of two blocks separated by a normal crack in the form:

$$\varphi = \frac{-0{,}00011792 b_1 h_1 + 0{,}1886524}{b_2 h_2 + 16{,}95905}$$

Formula (10) makes it possible to calculate the angle of mutual rotation of the crack edges for any values of the geometric parameters of the T-element. It should be noted that this formula was obtained on the basis of data from a numerical experiment with varying the geometric data of the T-section at a specific height of the compressed zone (in this case it is the thickness of the shelf of the brand). If the height of the compressed zone also needs to change, then the rotation angle function φ will contain not four variables (as in formula (10)), but five, including the height of the compressed zone (the zone through which torque is transmitted from block to block). But in any case, once obtained (although based on a fairly complex set of data from a numerical experiment), this function can be used in the design practice as many times as you like.

It should be noted that the advantages of the above method of determining the torsional stiffness by creating a database of values of the parameters of the approximants is also that it allows to take into account the nonlinear properties of concrete. Taking into account that the calculation taking into account the nonlinear properties of materials is carried out with the help of iterations, then at each step of iterations new deformation characteristics should be adopted. In the database, the mutual displacement of the shores of the normal crack is a function of the geometric parameters and the height of the zone compressed from the bending (normal crack height) of the expression (8) obtained for specific fixed values of the elastic modulus E and the shear modulus G of the concrete. Therefore, having experimental data of these parameters for a particular case under consideration, at each step of the iteration we use an expression of the type (8) with correction for the value of the elasticity and shear module at the current iteration to these parameters accepted in the database.

As for the experimental data on the modulus of elastic modulus of concrete, there are quite a large number of them in the literature. In contrast, experimental data on the nonlinear change in the modulus of shear of concrete were apparently first obtained under the guidance of the author of the article [8]. In these works, an experimentally grounded diagram of concrete displacement having a small section of the descending branch was proposed. Data on nonlinear deformation by torsion are also given in [23, 24, 27].

Thus, we can conclude that, having an apparatus for determining the torsional stiffness of a reinforced concrete element with normal cracks, taking into account the nonlinear properties of concrete, introducing it as one calculation block into the program complexes mentioned above, we can calculate the complex multiple-statically indeterminate systems (overlaps, Bridges, building frames, etc.), taking into account the effect of torsional stiffness on the redistribution of forces between individual elements of the system.

Example 3. Consider the importance of taking into account the change in the torsional stiffness of a rectangular section element depending on the height of the zone without cracks (the height of the compressed zone for the beam element) and the diameter of the longitudinal reinforcement. Table 3 shows the values k_t for different variants of a rectangular section element with the following initial data: E_b = 25000 MPa; G = 10000 MPa; b = 125 mm; h = 250 mm; M_t = 10 kN * cm; L_{crc} = 500 mm. The data of the table are obtained by N.M. Sribnjak by an approximate method [19].

As can be seen from Table. 3, the torsional stiffness of an element with normal cracks can be much less than the rigidity of an element without cracks, and it depends both on the distance between the cracks, the height of the zone without cracks, and on the diameter of the longitudinal reinforcement.

Table 3

Changing the torsional rigidity of a reinforced concrete element with normal cracks as a function of the diameter of the reinforcement and the height of the cracks.

L_{crc} (мм)	X (мм)	d_s(мм)	Δ_{Mt} (мм*100)	Δ_{Qed} (мм*10000)	k_t
500	25	0.8	2.766	7.178	1.63
500	25	1.2	2.766	7.178	1.44
500	25	1.8	2.766	7.178	1.3
500	50	0.8	1.512	4.027	1.56
500	50	1.2	1.512	4.027	1.4
500	50	1.8	1.512	4.027	1.28
500	75	0.8	0.926	2.580	1.48
500	75	1.2	0.926	2.580	1.36
500	75	1.8	0.926	2.580	1.25
250	25	0.8	2.766	7.178	2.27
250	25	1.2	2.766	7.178	1.88
250	25	1.8	2.766	7.178	1.6

After determining the nagel force in the longitudinal reinforcement and the rigidity of the reinforced concrete element with normal torsional fractures, it is easy to determine the concrete strength of the zone compressed from bending from the action of torque by the method [3].

Example 4. Let us now consider the effect of torsional stiffnesses on the spatial work of bridges and overlaps. Modern methods for calculating the reinforced concrete structures of bridges and overlaps take into account the change in flexural stiffnesses in the course of cracking. Alteration of the torsional rigidities is almost not paid attention. This is due, first of all, to a very small study of this issue, although, as mentioned above, consideration of this factor is essential for the redistribution of effort between the elements of bridge structures and overlaps. Consider, for example, a ribbed system with a span of 5000 mm with five ribs 250x250 mm when the middle (third) rib is loaded with a uniformly distributed load q = 10 kN / m. The thickness of the shelves connecting the ribs is 50 mm. Suppose that the shelves are connected to the ribs at the level of the centers of gravity of the latter, as well as the hinged connection of the shelves (imitation of the assembled ribbed system). Table 4 shows the values for five different versions of the torsional stiffness of the first three ribs (from left to right) of such a ribbed system. The calculations were made by the method of [2]. To the right of the value of the bending moments, errors are given with respect to the basic version, in which the same torsional stiffness of all ribs of the ribbed system is provided.

Table 4

Comparison of bending moments [kN · m] in the ribs of a ribbed system when the torsional stiffness of individual ribs changes

№	Ribber stiffness values	$M_{1,max}$		$M_{2,max}$		$M_{3,max}$	
		value	ε, %	value	ε, %	value	ε, %
1	All edges of the same section (base version)	3,194	0	6,688	0	11,498	0
2	The first rib has a torsional rigidity of 2 times less	3,015	6	6,802	1,7	11,540	0,3
3	The first rib has a torsional stiffness of 4 times less	2,711	18	6,995	4,5	11,611	1
4	The second rib has a torsional stiffness of 4 times less	1,085	294	6,486	3,1	12,978	12,8
5	The second and fourth ribs have a torsional stiffness of 4 times less	1,184	269	7,083	5,9	14,729	28,1

It follows from the table that when the torsional stiffness of one rib is reduced by a factor of 4 (which is quite possible in real reinforced concrete beams), bending moments can vary several times (!), Which imposes a significant imprint on the stress-strain state of the beam and system in question Whole. Thus, this simple example shows how important it is to take into account the change in torsional rigidity in the beams of bridges and overlapping when normal cracks form in them.

In spite of the fact that to approximate functions f of type (8) or (9) it is necessary to carry out a sufficiently large but finite number of calculations using software complexes in which the finite element method with the use of volumetric finite elements is realized, which may seem complicated, the advantage of such Approach is obvious, because Once obtained, such dependencies can be used as many times as necessary by designers and engineers to solve specific problems in the manner described above.

Creating a library of approximants will greatly simplify the solution of many complex problems, where the number of such elements would be much smaller than the number of finite elements using the traditional finite element method.

Conclusions and prospects of research. A new approach to the determination of torsional stiffnesses of reinforced concrete elements with cracks is proposed, which allows solving torsion problems of reinforced concrete elements of any cross-section using methods for approximating the displacement functions at the crack location obtained from solving a number of problems using the finite element method. It should be noted that the use of the best Chebyshev approximation in this apparatus makes it possible to improve significantly the efficiency of solving problems. Also the significant effect of torsional stiffnesses on the spatial work of bridge elements and overlapping under the action of local band loads is shown.

In the long term, it is proposed to define functions of the type (8) or (9) for solving the problems of reinforced concrete elements torsion of different cross sections and their various sizes, as well as extending the proposed approach for the calculation taking into account the nonlinear properties of reinforced concrete.

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SECTION 2. Applied mathematics. Mathematical modeling.

BASIC EQUATIONS OF TRANSPORT AND DIFFUSION OF POLLUTANTS IN THE ATMOSPHERE

Abstract: *The structure of the spatial non-stationary numerical model calculating anthropogenic disturbances in the mesoscale meteorological processes is briefly discussed. The results of calculating the microclimate and fog formation variations of cooling reservoirs are presented.*

Key words: *the air fluctuations, the atmosphere, the model*
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ОСНОВНЫЕ УРАВНЕНИЯ ПЕРЕНОСА И ДИФФУЗИИ ПРИМЕСЕЙ В АТМОСФЕРЕ

Аннотация: *Кратко обсуждается структура пространственной нестационарной численной модели расчета антропогенных нарушений в мезомасштабных метеорологических процессов. Представлены результаты расчета микроклимата и вариаций образование тумана от охлаждения резервуаров.*

Ключевые слова: *воздух, флуктуации, атмосфера, модель.*

Introduction

Перенос загрязняющих субстанций в атмосфере осуществляется ветровыми потоками воздуха с учетом их мелкомасштабных флуктуаций. Пусть $\varphi(x,y,z,t)$ - интенсивность аэрозольной субстанции, мигрирующей вместе с потоком воздуха в атмосфере. Решение задачи будем искать в цилиндрической области G с поверхностью S, состоящей из боковой поверхности цилиндра $\sum$, нижнего основания $\sum_0$ (при $z=0$) и верхнего основания $\sum_H$ (при $z=H$), x, y, z -декартовы координаты, ось z направлена вертикально вверх. Пусть u, υ, w-составляющие вектора скорости частиц воздуха. Тогда перенос субстанции вдоль траектории частиц воздуха с сохранением ее интенсивности описывается уравнением переноса:

$$\frac{d\varphi}{dt}=0, \text{ где } \frac{d}{dt}=\frac{\partial}{\partial t}+u\frac{\partial}{\partial x}+\upsilon\frac{\partial}{\partial y}+w\frac{\partial}{\partial z}. \quad (1)$$

Materials and Methods

Для нижней части атмосферы с хорошей точностью выполняется закон сохранения массы, выраженный уравнением неразрывности:

$$div\bar{u}=\frac{\partial u}{\partial x}+\frac{\partial \upsilon}{\partial y}+\frac{\partial w}{\partial z}=0. \quad (2)$$

С учетом (2) уравнение (1) преобразуется к виду

$$\frac{\partial\varphi}{\partial t}+div(\bar{u}\cdot\varphi)=0. \quad (3)$$

При выводе (2.3) было использовано тождество

$$u\frac{\partial\varphi}{\partial x}+\upsilon\frac{\partial\varphi}{\partial y}+w\frac{\partial\varphi}{\partial z}=div(\bar{u}\cdot\varphi)-\varphi\, div\,\bar{u}. \quad (4)$$

Вертикальная составляющая скорости удовлетворяет условию

$$w=0 \text{ при } z=0,\ z=H. \quad (5)$$

Для уравнения (3) необходимо задать начальные данные

$$\varphi=\varphi_0 \text{ при } t=0 \quad (6)$$

и условия на границе S области G:

$$\varphi=\varphi_s \quad \text{на S} \quad u_n<0, \quad (7)$$

где φ_0 и φ_s - известные функции, u_n – проекция вектора u на внешнюю нормаль к поверхности S. Соотношение (7) определяет решение на той части S, где воздушные массы вместе с исследуемой субстанцией вносятся в область G.

Точное решение задачи (3), (5), (7) возможно в том случае, когда известны значения функций u, υ, w в пространстве и во времени.

Уравнение (3) может быть обобщено. Так, если в процессе распространения часть субстанции входит в реакцию с внешней средой или распадается, то этот процесс можно интерпретировать как поглощение субстанции. В этом случае уравнение (3) перейдет в следующее:

$$\frac{\partial\varphi}{\partial t}+div(\bar{u}\,\varphi)+\sigma\varphi=0, \qquad (8)$$

где $\sigma \geq 0$ - величина, обратно пропорциональная времени. Смысл этой величины будет понятен, если в (8) положить $u = \upsilon = w = 0$ тогда уравнение (8) имеет решение $\varphi=\varphi_0\, e^{-\sigma t}$. Отсюда видно, что σ есть величина, обратная интервалу времени, за который интенсивность субстанции по сравнению с начальной интенсивностью φ_0 уменьшается в e раз.

Если в области определения решения имеются источники рассматриваемой загрязняющей субстанции φ, описываемые функцией $f(x,y,z,t)$, то уравнение (8) примет вид

$$\frac{\partial\varphi}{\partial t}+div(\bar{u}\,\varphi)+\sigma\,\varphi=f. \qquad (9)$$

Для достаточно гладких функций задача (9), (5), (7) имеет единственное решение.

Рассмотрим стационарный процесс распространения субстанций. Если коэффициенты уравнений u,ϑ,ω и входные данные задачи φ_S и f не зависят от времени, то стационарная задача, соответствующая (9),(5),(7), формулируется следующим образом:

$$div(u\varphi)+\sigma\varphi=f, \qquad (10)$$

$$\varphi=\varphi_S \text{ на } \sum \text{ при } u_n<0. \qquad (11)$$

Задача (10), (11) описывает частный процесс переноса субстанций с неизменными во времени входными данными. Однако на бор таких частных решений, соответствующих различным стационарным входным данным задачи $\bar{u}, f, \varphi_S$, может использоваться и при описании более сложных физических ситуаций, реализуемых на практике. Предположим, что в различные периоды времени в атмосфере в данном регионе происходят те или иные типы движений воздушных масс, которые за период характерного времени можно считать стационарными. После каждого такого периода происходит перестройка движения воздушных масс и наступает новое стационарное состояние. Поскольку перестоńрка циркуляций происходит за период, которой намного короче времени существования данного типа движений, то можно пердположить, что перемена типов движений происходит мгновенно. Пусть этих типов будет n. Тогда приходим к системе независимых уравнений

$$div(\bar{u}_i\varphi_i)+\sigma\varphi_i=f \qquad (12)$$

и условий $\varphi_i=\varphi_{is}$ на $\sum$ при

$$u_{in}<0, \qquad i=\overline{1,n}. \qquad (13)$$

Задача (12), (13), где φ_{iS} - значения функции φ_i на границе S, u_{in} - проекция вектора скорости ветра i -го типа на внешнюю нормаль к границе, соответствует каждому из интервалов времени $t_i<t<t_{i+1}$, длина которого Δt_i. Если все задачи (12), (13) решены, то решение задачи о среднем распределении примеси за период $T=\sum_{i=1}^{n}\Delta t_i$ находится в виде линейной комбинации

$$\tilde{\varphi}=\frac{1}{T}\sum_{i=1}^{n}\varphi_i\Delta t_i \qquad (14)$$

Задачу (12)-(14) можно называть статической моделью.

Решение стационарных задач вида (10), (11) и (12)-(14) имеет много общего с решением задачи о среднем за некоторый период времени T распределении субстанции на основе специальных образом поставленных нестационарных задач. Действительно, рассмотрим задачу

$$\frac{\partial\varphi}{\partial t}+div(u\varphi)+\sigma\varphi=f. \qquad (15)$$

$$\varphi=\varphi_S \text{ на } \sum \text{ при } u_n<0,$$

$$\varphi(\bar{r},T)=\varphi(\bar{r},0), \qquad \bar{r}=(x,y,z)\in G. \qquad (16)$$

Функции $\bar{u}$ и φ_s не зависят от t. Эта задача для достаточно гладких функций имеет единственное решение. Интегрируя (15) в пределах $[0,T]$, получим

$$div(u\varphi)+\sigma\varphi=f, \qquad \varphi=\frac{1}{T}\int_0^T\varphi dt \qquad (17)$$

из которого, в силу единственности решения задачи (10), (11), следует, что среднее за период T решение задачи (10), (16) совпадает с решением задачи (10), (11).

Conclusion

Решения задач о среднем за период T распределении субстанций с помощью статической модели и нестационарной задачи с некоторыми предположениями достаточно близки друг к другу.

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