ENSURING PERFORMANCE COATINGS OF CONCRETE FOR ROADS, DUE TO THEIR MODIFICATIONS

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INTRODUCTION

The results of studies of the effect on the performance of the coatings of concrete intended for roads, with modification of their compositions plasticizer XTC-6 and polypropylene fibers MAPEFIBRE NS 12/NS 18 calculated mathematical models describing changes in physical-mechanical and operational characteristics, coatings, are considered. Recommendations on the use of research results in the construction of highways.

1. ACTUALITY OF THE RESEARCH

One of the urgent problems of the development of roads is to improve their performance and increase durability. One of the main elements of the road affecting its performance and durability - this is the road surface. Covering roads not-mediocre, bears the load of the vehicle and provides the necessary performance indicators such as the estimated vehicle speed, calculated load, bandwidth, as well as indicators of traffic safety, in addition, they protect the road base on the effects of weathering **[1]**. It stresses the need to improve the quality of the road surface of concrete, due to their modification.

2. AIM OF THE RESEARCH

The aim is, to develop a modified formulation for cement concrete pavement by introducing into its composition additives XTC-6 and polypropylene fibers.

The experiment conducted according to the recommendations [2, 3]. The factors and their range of variation was chosen based on the results of preliminary experiments, comrade [4, 5, 6]:

x_1 – amount of Portland cement 500 (C), from 370 to 570 kg/m^3.

x_2 - the amount of plasticizer XTC-6, 0 to 1,5% by weight of cement.

x_3– the amount of polypropylene fibers MAPEFIBRE NS 12/NS 18 (diameter – 0,34 microns, a fiber length of 12-18 mm, density – 0,91 g/m^3, tensile strength - 700 MPa), from 0 to 0,6 kg/m^3.

3. MAIN PART

The experiments conducted by the author in the following sequence:

- Estimated mobility of the concrete mix (CM) according to **[7]**, using a normal cone. In the experiments for all compositions mobility of CM it was in the range of 16 to 18 cm;
- Concrete samples were kept in conditions of hardening for 28 days (t = 200C, W = 80%);
- Then 10x10x10 cm samples were tested for compressive strength at 100 ton press TESTING PL 100 [8], and on samples 4x4x16 cm-determined etc. of flexural [9];
- On samples determined 7x7x7 cm abrasion of concrete on the device LCI-3 [10] and its impact resistance [11].

Studies of the properties of modified concrete paving performed using the methods of experimental design [12]. The experiment carried out of 27 points plan (Table).

The calculation results are water-cement ratio (W/C), the compressive strength of the samples ($f_{ck.cube}$), Tensile strength in bending ($f_{ctk.}$), anti-shock performance (T) and attrition (G) yielded mathematical models (1-5):

$$W/C = 0{,}487 - 0{,}052x_1 + 0{,}008\,x_1x_2 - 0{,}107\,x_2 - 0{,}032\,x_2^2 + 0{,}006\,x_3 - 0{,}021x_3^2 \quad (1)$$

$$f_{ck.cube.}\,(MPa) = 49{,}786 + 4{,}291\,x_1 - 0{,}806\,x_1^2 + 0{,}851x_1x_2 - 1{,}067\,x_2x_3 + 2{,}026\,x_2 + 1{,}639\,x_2^2 + 0{,}739\,x_1x_3 - 1{,}026\,x_3 \quad (2)$$

$$f_{ctk.}\,(MPa) = 5{,}349 + 0{,}344\,x_1 + 0{,}218\,x_1x_2 + 0{,}248\,x_2 + 0{,}793\,x_2^2 + 0{,}156\,x_3 \quad (3)$$

$$T\,(J/cm^2) = 5{,}085 + 0{,}611\,x_1 + 0{,}310x_1^2 - 0{,}250\,x_1x_2 + 0{,}500\,x_2 + 0{,}310\,x_2^2 \quad (4)$$

$$G\,(g/cm^2) = 0{,}627 - 0{,}046\,x_1 + 0{,}019x_1x_2 + 0{,}017\,x_2x_3 - 0{,}038\,x_2 \quad (5)$$

Table. Experimental design (x_1.. x_3) and formulations studied concretes (X_1 … X_2)

№	X_1	X_2	X_3	x_1	x_2	x_3
	C	XTC	F	C	XTC	F
1	370	0	0	-1	-1	-1
2	370	7,5	0	-1	0	-1
3	370	15	0	-1	1	-1
4	470	0	0	0	-1	-1
5	470	7,5	0	0	0	-1
6	470	15	0	0	1	-1
7	570	0	0	1	-1	-1
8	570	7,5	0	1	0	-1
9	570	15	0	1	1	-1
10	370	0	0,3	-1	-1	0
11	370	7,5	0,3	-1	0	0
12	370	15	0,3	-1	1	0
13	470	0	0,3	0	-1	0
14	470	7,5	0,3	0	0	0
15	470	15	0,3	0	1	0
16	570	7,5	0,3	1	-1	0
17	570	0	0,3	1	0	0
18	570	15	0,3	1	1	0
19	370	0	0,6	-1	-1	1
20	370	7,5	0,6	-1	0	1
21	370	15	0,6	-1	1	1
22	470	0	0,6	0	-1	1
23	470	7,5	0,6	0	0	1
24	470	15	0,6	0	1	1
25	570	0	0,6	1	-1	1
26	570	7,5	0,6	1	0	1
27	570	15	0,6	1	1	1

For ease of analysis model (1-5) presented in graphical form (Figure 1, 2, 3, 4, 5).

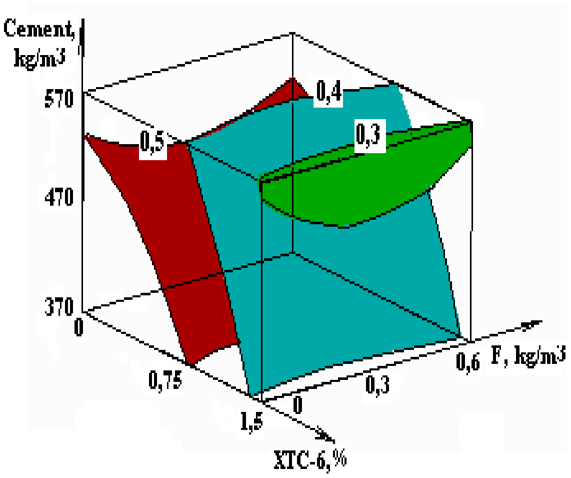

Figure 1. The effect of the amount of C (x_1) additives XTC-6 (x_2) and F (x_3) to the W/C.

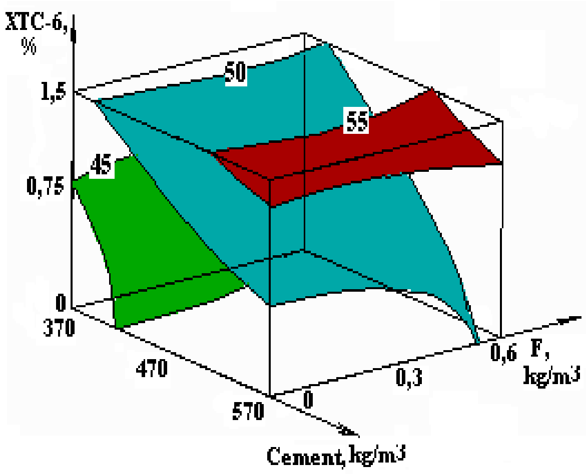

Figure 2. Influence of the amount of C (x_1), XTC -6 (x_2) and F (x_3) to the concrete compressive strength (MPa).

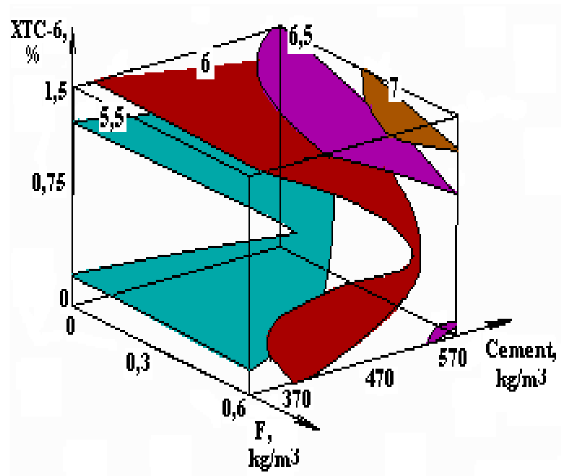

Figure 3. Influence of the amount of C (x_1), XTC-6 (x_2) and F (x_3) Tensile Flexural concrete (MPa).

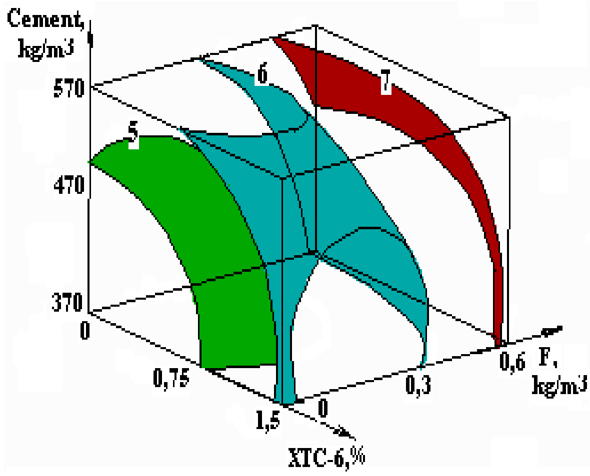

Figure 4. Effect of the amount of C (x_1), XTC-6 (x_2) and F (x_3) on the impact resistance (MPa).

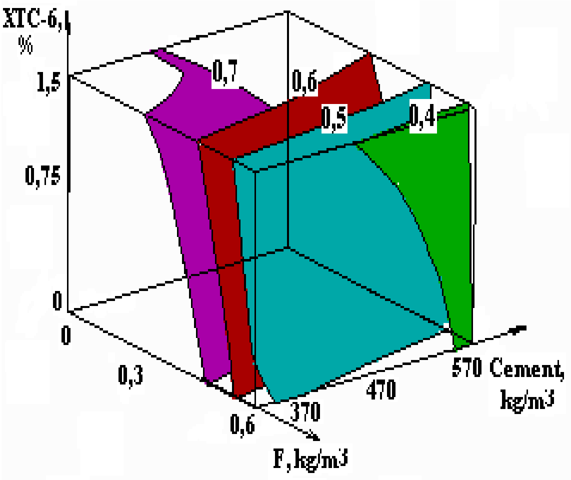

Figure 5. Influence of the amount of C (x_1), XTC -6 (x_2) and F (x_3) abrasion concrete (g/cm^2).

CONCLUSIONS

- By increasing the amount of Portland cement (from 370 to 570 kg/m^3) increased levels of compressive strength from 45 to 55 MPa (22%) and almost proportionally increases tensile strength of Gibe from 5 to 7 MPa (20%).

- The introduction of concrete plasticizer XTC-6 in an amount of from 0,75 to 1,5% by weight of the cement concrete mix increases the mobility and allows lower W/C ratio of 0,5 to 0,3 (15%).

- Application of the polypropylene fiber 12 MAPEFIBRE NS/NS 18 0,3 to 0,6 kg/m^3, tensile strength increases flexural 10-15%. Increases resistance to impact factor of 1,5. Reduces abrasion of cement concrete from 0,7 to 0,4 g/cm^2 (25%).

Thus, the studies suggest that the introduction of the Portland cement concrete up to 500 kg/m^3, together with plasticizer XTC-6 and polypropylene fibers (MAPEFIBRE NS 12/NS 18) leads to improved physical and mechanical properties of concrete pavements.

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