

VI INTERNATIONAL CONFERENCE

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«Polymer materials in concrete technology»

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Problem statement

- Traditional concretes obtained with the use of cement are not without disadvantages, which can be significantly reduced due to the use of polymer materials in concrete technology.
- In this paper, we will consider some areas of rational use of polymer materials in cement concrete technology.



The method of application of crushed plastic waste in concrete technology

- Within the framework of this study, the possibility of using practically non-recyclable plastic waste in the composition of fine-grained concrete was studied: polyvinyl chloride chips, crushed scraps of polyvinyl chloride water pipes, plexiglass.
- Polyvinyl chloride chips (figure 1) with a length of 10-15 mm, a width of 3-4 mm and a thickness of 0.2 mm are practically not disposed of at small manufacturers of plastic windows. This component does not require any additional preparation before being introduced into the concrete mixture.
- Polyvinyl chloride pipe clippings (figure 2) are formed as a result of installation, repair, replacement of sections of water supply networks, mainly in residential and public buildings. A large number of such cuts are pipe cuts with an outer diameter of 22 mm and a wall thickness of 4 mm. Before being introduced into the concrete mixture, pipe trimmings were cut into rings (figure 2) 3-4 mm thick.



Figure 1. Polyvinyl chloride chips



Figure 2. Polyvinyl chloride pipe trimmings

Table 1. Compositions of the concrete mixture with the inclusion of crushed plastics

Compon ents	Content, wt. %													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Portland Cement M 500	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Quartz sand	75	74.5	74	73	72	71	70	74.5	74	73	74.5	74	73	72
Polyviny l chloride chips	-	0.5	1	2	3	4	5	-	-	-	-	-	-	-
Rings made of polyviny l chloride pipe scraps	-	-	-	-	-	-	-	0.5	1	2	-	-	-	-
Shredded Plexiglas s scraps	-	-	-	-	-	-	-	-	-	-	0.5	1	2	3
Water- cement ratio	0.5													
Bending strength of concrete, MPa	2.4	1.23	3	2	1.53	1.7	1.93	2.7	2.18	1.7	2.63	2.32	3.13	2.4
Compres sive strength of concrete, MPa	21.58	25.42	37.5	28.25	19.92	15.42	19.53	34.13	32.22	25.69	35.37	34.3	28.84	21.58

The method
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The method of introducing sodium polyacrylate into the concrete mixture

- We suggest using sodium polyacrylate as a water-retaining polymer additive for fine-grained concrete.
- Sodium polyacrylate is the sodium salt of polyacrylic acid. One of the main properties of the compound is the ability to absorb liquids 200-300 times its own mass. It is an anionic polyelectrolyte with a negatively charged carboxyl group in the main chain.
- Sodium polyacrylate is produced industrially in granules. Taking into account the adsorption capacity of this material, the direct introduction of its granules into compositions for the preparation of cement composites will inevitably lead to internal stresses in the final product. Therefore, such an additive must be pre-prepared. Dry grinding of solid granules requires a lot of energy. Therefore, sodium polyacrylate granules were placed in a container with water and kept until swelling, figure 3. Subsequently, such granules in a water-saturated state were easily crushed to form a homogeneous translucent mass.

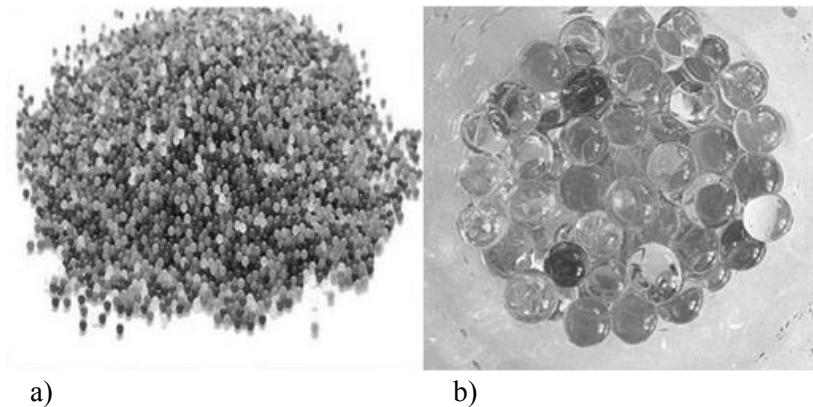


Figure 3. Granules of sodium polyacrylate: a) dry; b) in a saturated state with water.

The method of impregnation of concrete with monomers followed by their polymerization

- Consider the use of styrene, acrylonitrile, and methyl methacrylate as impregnating materials. The concrete surface was fed with monomers, and monomers were applied to the surface in the amount of 1000 and 1500 ml/m² together with 2% of the initiating system "benzoyl - dimethylaniline oxide" (1:0.5). Benzoyl peroxide acts as an initiator in this system, and dimethylaniline accelerates the decay of the initiator into free radicals. The specified content of the initiating system ensures the completeness of the transformation and high strength of the polymer. Monomers, penetrating deep (up to 10 mm) of the product, are cured by the mechanism of free radical polymerization. It is also possible to impregnate concrete, the surface of which is covered with a protective and decorative glassy layer, figure 4.

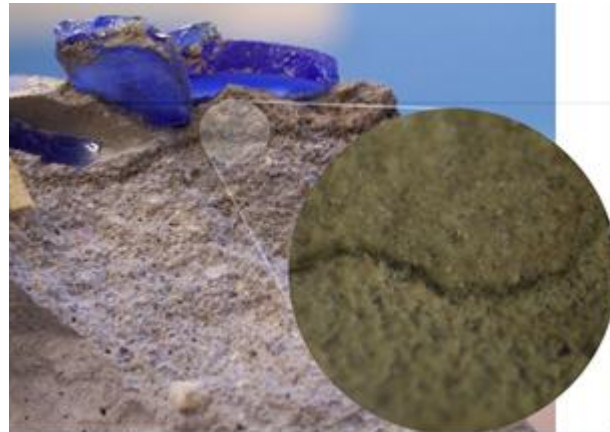


Figure 4. A section of a concrete sample with a protective and decorative vitreous layer impregnated with a monomer (consumption of monomer - methyl methacrylate 1000 ml / m²), an increase of 49 times.

Conclusions

- Introduction to fine-grained concrete mixtures of crushed polyvinyl chloride, polymethylmethacrylate in an amount of 0.5-2 wt. % helps to increase the strength of concrete during bending and compression.
- When using sodium polyacrylate as a water-retaining polymer additive (the recommended amount is 0.1-2 wt. %), its preliminary preparation is needed by holding the granules in water until filling, followed by grinding.
- Monomers of styrene, acrylonitrile, methyl methacrylate must be applied to the concrete surface together with 2% of the initiating system "benzoyl - dimethylaniline oxide" (1:0.5).

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