AS A PLASTICIZER TO IMPROVE THE QUALITY OF CONCRETE IN THE CONDITIONS OF A DRY AND HOT CLIMATE

Baybulekov A.B. – c.t.s., Professor
Shagiev I.N. – Master of construction materials, products and structures
South - Kazakhstan State University named af. M.Auezov,
The Republic of Kazakhstan

One way of technological progress in the field of modern construction - is the use of concrete having high strength, frost resistance, water resistance to various aggressive factors. The preparation of such concrete can be achieved only by modification of various chemical additives [1].

The basic modifiers concrete and mortar plasticisers are of different origin.

Use of additives of a certain quality in the optimal amount can manage the processes of structure of concrete and mortars, receive technical and economic effect and increase the durability of concrete [2]. It is known that the use of plasticizers in a hot and dry climate improves operational properties of concretes, particularly in road construction [5].

The need to expand the use of plasticizers become even more urgent with the increase in the monolithic construction and manufacture of concrete products in open areas in dry and hot climates.

The deficit of the raw material base for superplastificators requires intensive search for new effective plasticizers based on industrial waste, and the development of methods to strengthen their action.

Currently, chemical industry produces plasticizers based on condensation products of naphthalenesulfonic acid and formaldehyde, melamine-formaldehyde resins based on sulfonated naphthalene formaldehyde compounds, polyethylene glycol polikorbaksilatov, sulfatosoderzhaschih waste acrylate productions lingosulfanatov, waste of manufacturing fodder yeast, byproducts pentaerythritol byproducts cellulose, alkaline waste of caprolactam, etc. [3].

Most, like the regions of Europe and Central Asia, is a manufacturer of cotton seed which in large quantities are produced annually vegetable oil. In the production process of cottonseed oil, depending on the technological scheme and the method of cultivation of the main products produced many secondary products and wastes. These products include waste oil and fat production (gossipol resin), which today is going into special pools that are a source of pollution.

Basically high-performance plasticizing additives industry is not available, so supplements are purchased in other countries, which increases the cost and reduces the quality of long-term storage.

In this regard, there is an urgent need to develop a technology for high-performance plasticizing additives for concrete and solutions on the basis of local materials and, in particular, waste oil and fat production of oil and fat plant.

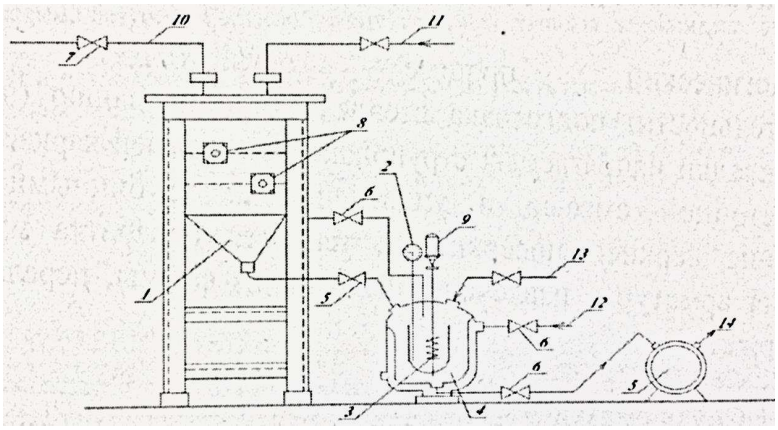
Currently, these wastes are little used, mainly accumulated in special storage facilities, which creates economic and environmental problems. Economic problems of companies related to the compensation payments, the need for warehousing and storage gossipolovoy resin. Environmental problems caused by its toxic properties. Therefore, the development of technology for plasticizing and multifunctional additives for concrete and building solutions based on waste oil industry is an urgent problem, which will help to get quality and cheap domestic products for concrete improve the ecological situation in the region.

Gossipolov resin uniform, viscous mass from dark - brown to black in color, practically insoluble in water, readily soluble in the petroleum distillate products (gasoline, kerosene, diesel fuel), chloroform, acetone, etc. It consists of 10-12% of nitrogen containing compounds, 35-40% conversion of fatty acid products of lactones and polymerized resin contains polyphenols, hydrocarbons, nitrogen - and phosphorus-containing compounds - reactive high complexing properties.

The study of chemical properties of gossipolov resin is distillation cotton soap stock fatty acids showed that a homogeneous viscous mass of black color with a characteristic smell of cotton oil. It contained 96,3% solids, 3,7% moisture and other volatiles, 1-1,2% ash. Total lipid to 82%, unsaponifiables 25%, the fatty acids up to 5%, 1% nitrogenous substances, konifoli to 1%. The gossipol resin also includes phospholipids, triglycidyl, stearin, tocopherols, and others. Study of the fractional composition of the gossipol resin show that she is from three factions: the unsaponifiable, fatty acid and phenolic units [4].

For the synthesis of new chemical additives used tar distillation of fatty acids (gossipol resin), which is a fatty acid fractions prevailing C_{11}-C_{11}-60…65%, fosfotitov 13…26% and unsaponifiables 18...21,5% (a mixture of complex triglitseids, coloring substances, tocopherols, sterols, gossypol and derivatives thereof). The second component is an aqueous solution of caustic soda (NaOH). To extract unsaponifiables used white spirit. For additives distillation of fatty acids of plant oils previously saponified 5-20% aqueous alkali solution at a ratio of 1.3...5 at 70-85^{0}C saturated material (not water-soluble fraction) was separated by extraction with mineral spirits in the ratio gossipol resin: white spirit 1: 5.

Thermo alkali chemical treatment was carried out in a reactor equipped with steam jacket, stirrer and cooling coil. The starting components are loaded with the stirrer running continuously in the following sequence: hot water, an aqueous solution of sodium hydroxide, gossipol resin cold water. Water and gossipol resin metered volume feeder and then fed to the reactor by gravity. Caustic soda is weighed and loaded into the reactor through the hole in the roof (Picture 1).

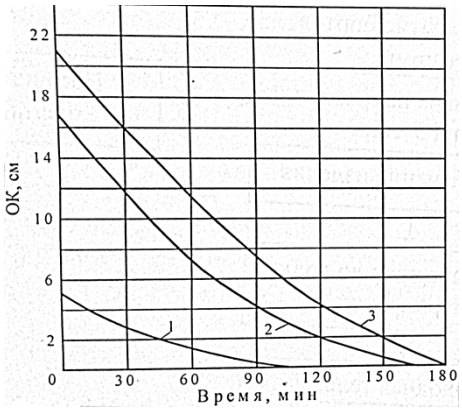


Picture 1 - Technological scheme of the synthesis of a plasticizer based resin gossipol
1-dispenser; 2-actuated thermometers; 3-coil; 4 capacity; 5-vortex pump; 6-mechanical valves; 7 solenoid valves; 8-level switch sensors resin and water; 9-motors; 10 pipe to pump tar; 11 respectively, the supply of hot and cold water; 12-steam; 13-inning alkali solution; 14-feed the finished products into the container.

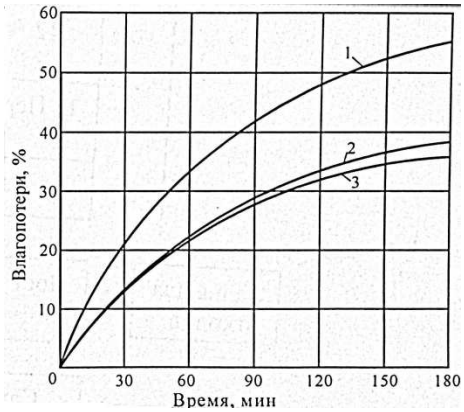
In the proposed scheme, despite the fact that the regeneration is made of organic solvents in small amounts, they remain in solution. Positive role of such agents is the stabilizing effect of additives are of deterioration during prolonged storage.

Supply of warm water facilitates and accelerates the heating of the components in the reaction mixture to 40…45^{0}C the first preparation step, and continuous stirring ensures a homogeneous mixture prevents the formation of the resin products of high viscosity. During the synthesis additives should be brought to a temperature of 72…80%, which provides a dissolution clod shaped portion. At this temperature, the reaction proceeds rapidly and lasts for 2 hours. To the extraction saponifiable fraction was white spirit via vacuum evaporator further discharge of the fractions [4].

The obtained plasticizer (fatty acid modified) are dark brown liquid density of 1,01…1,025 g/sm^3, without any negative specific odors and absence of reducing substances (poly-aminosaharids). The content of it organic and organic-materials to 28,000 mg/m^3 and pH of 11,5…12,0. It follows that the proposed use of additives is not particularly limited, and an alkaline solution in the received character range not dangerous to stone and cement reinforcement.



Picture 2 - Kinetics of loss of mobility in time under hot and dry climates (W/C = 0,50, flow-cement 370 kg/m^3). 1-without the additive; 2, with the addition of 0,40%; 3, with the addition of 0.60%.



Picture 3 - Kinetics moisture loss concrete in dry and hot climate (W/C = 0,50, the consumption of cement, 370 kg/m^3). 1-without the additive; 2-with the addition of 0,40%; 3-with the addition of 0,60%.

The main factor for the negative influence of high temperatures and low relative humidity of the environment on the formation of the concrete structure is moisture loss intense, leading to a decrease in the mobility of concrete, premature termination of the process of hardening, as well as the deterioration of the concrete structure [5]. Given these circumstances investigated the effect of plasticizer in the resulting change in mobility of the concrete mix, moisture loss of concrete and plastic shrinkage in the dry and hot climate.

The results of studies of the effect obtained by plasticizing additive on the kinetics of loss of mobility of the concrete mix and kinetics moisture loss at elevated temperatures and low relative humidity environment indicates that the introduction of additives FAM (fatty acid modified) in the concrete mixture lead to a substantial improvement of technological and physical properties [Picture 2]. The mobility of the concrete mix increased from 6 till 12-15 sm, and the longer time it is stored. Moisture loss concrete samples during 6 hours tverdevshih under hot and dry climate, with the addition amounted to 35-37%, and no additive - 60% [Picture 3].

Data on the effect of a new plasticizer on the relative change in the growth of the strength of concrete, depending on the hardening conditions show that concrete with the addition of FAM in a hot and dry climate in the initial period of hardening have higher strength as compared with concrete without the additive and further curing is more intensive, due to the relatively smaller moisture loss. Introduction to the concrete mix an additive has a positive effect on the formation of cement stone structure, increasing the density of concrete, as evidenced by the increase frost resistance by 25-30% and 20-25% water resistance.

As can be seen from picture 4 the introduction of plasticizer FAM reduces initial plastic shrinkage of the concrete in the dry and hot climate, due to slow moisture loss.

Picture 4 - Kinetics change the initial plastic shrinkage (W/C = 0,50, the consumption of cement, 370 kg/m^3). 1^1 and 1 without additives; 2^1 and 2, with the addition of 0,40%; 3^1 and 3, with the addition of 0,60%.

A pilot batch produced additives tested in the factory for the production of construction products, as well as on construction sites. The introduction of the concrete mix additives in an amount of 0,35-0,5% by weight reduces the consumption of cement binder 10-12%, improving quality indicators of concrete and improves the conditions of technological operations of transport of concrete, and laying seal it and to care for the concrete in the dry and hot climate.

Conclusions

Research process thermo alkali processing and modification gossipolresins have shown that on the basis of waste oil industry can get the chemical additives that improve the plasticizing action of the main characteristics of the concrete mix and the mechanical properties of concrete, especially in hot and dry climates.

Literature

1. Bazhenov Y.M, Demyanova V.S., Kalashnikov V.I. (2006). Modified high-quality concrete: nauch.izd. - M.: ACB to -368 p.

2. Higerovich M.I., Bayer V.E. (1979). Hydrophobic plasticizing additives for cement mortars and concretes M .: Stroiizdat to -125 p.

3. Kalashnikov V.I., Ivanov IA., Kuznetsov Y.S., Isheva P.I. (1985). The use of production wastes of antibiotics as plasticizers for concrete and reinforced concrete, - №1,38-39

4. Markman A.L., Rzhehin V.P. (1965). Gossypol and its derivatives. MM: Pischprom. 183 p.

5. Mironov S.A., Malinsky E.N., Concrete technology problem in a dry and hot climate. Proc.: Materials of II All-Union coordination meeting on the issue: "The technology of concrete work in the dry and hot climate", 1976, p.7-10.