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THEORETICAL REVIEWS OF DIFFERENT BRANDS OF MELAMINE-FORMALDEHYDE RESINS AND THEIR PRODUCTION TECHNOLOGIES

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Annotation
This article presents theoretical analyzes of the processes of polycondensation of melamine and formaldehyde substances, hardening of melamine-formaldehyde resins, storage of solutions of melamine-formaldehyde oligomers in water, periodic or continuous production of melamine-formaldehyde resins in industry.

Keywords. Melamine, formaldehyde, polycondensation, chemical technology, heavy organic synthesis, chemical industry.

Condensation of melaminoformaldehyde resin

The condensation process of melaminoformaldehyde resin is carried out in accordance with the technological regulation of production, as in the process of formation of other resins. Because each brand of resin has its own regulations. Melaminoformaldehyde resins are manufactured for two different uses. They are divided into types that glue and soak wood materials.

One of the adhesive resins, the MF-VRN brand, contains a minimum amount of formaldehyde. Water resistant. Characteristics: concentration - 60±2%, pH=7.0, viscosity according to VZ-246 50...90 sec, free formaldehyde content 0.3%. Ammonium chloride in the amount of 1% is added to the resin to obtain glue from this resin. This resin is resistant to the effects of the external environment and moisture, and it is used for hot gluing of plywood. It is also used in the production of urea glues as water-resistant additives from this resin.

Melaminoformaldehyde resins are also used for cold gluing. For example, SM 60-08 tar is used for this purpose. Its properties: dry matter content 58...62%, viscosity according to VZ-246 30...80 s, pH=8.8, free formaldehyde content 0.8%. Its solidification takes place in an acidic environment - the necessary environment is created by adding 40% lactic acid. This type of glue is used for gluing wood with high humidity. However, due to the high cost of melamine resins, they are less commonly used as adhesives, and are mainly used as wetting agents. Below we will familiarize ourselves with the information on four brands of melamine formaldehyde resins (Table 1).

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Table 1 Physico-chemical properties of melamine formaldehyde resins

№	Indicator name	Resin brand			
		MP	SPMF-4	SPMF-5	SPMF-7
1	Appearance	Colorless transparent liquid			
2	Viscosity according to VZ-246	11-13	15-18	16,5-18,5	15,5-18,5
3	Mass fraction, %	36-40	55,5-56,5	56-57	56-57
4	Amount of free formaldehyde, %	1,0-1,5	0,5	0,5	0,5
5	pH	8,5-9,0	8,5-8,9	8,5-8,7	8,2-8,8

Curing of melaminoformaldehyde resins

Melaminoformaldehyde resins are widely used in the production of paper films used to cover wooden boards, plywood and other wooden materials. Melaminoformaldehyde resins have the property of hardening both when heated and under pressure. provides resistance to organic solvents, diluted acid and alkali solutions. Modifiers are added to the reaction mixture to improve the properties of hardened melamine resins. Such substances change the fluidity of resin during hardening, increase the elasticity of melamine resins hardened under the influence of high pressure and heat.

In addition, the modifying components ensure the viability and long service life of the resin, they improve the wettability of the coated paper with the resin, improve the anti-adhesion properties of the resin, and ensure that it does not stick to the metal during pressing. Usually, modifiers are substances that contain NH_2 and NH groups. Among them are thiomochevina, cyanamine, urethane, dicyandiamide, amyl, sulfoacids, methylglucoside, lower alcohols. For example, monofunctional compounds partially inhibit molecular growth, as well as resist polymerization during solidification. Polyfunctional compounds, as a result of the placement of the macromolecule between the triazine rings, the distance between individual triazine rings increases, and as a result, the product becomes more elastic.

In the process of storage of solutions of melaminoformaldehyde oligomers in water, a gradual increase in viscosity is observed. This indicates that the polycondensation reaction is in progress. This process can continue until the oligomer turns into a solid state. This condition is characterized by the formation of a three-dimensional structure.

MP resin is intended for impregnating sulfated paper with a density of 20-22 g/m². Papers processed in this way are used as covering and protective coating material for decorative plywood. SPMF-4, SPMF-5 and SPMF-7 tars are intended for the production of paper films used to cover glued wooden board materials. Melaminoformaldehyde resins are difficult to burn, they are considered safe according to their reaction to fire. Surfaces treated and coated with such resins exhibit high operational properties.

Since melaminoformaldehyde resins are thermoreactive oligomeric products formed by polycondensation of melamine and formaldehyde, their composition depends on the ratio of melamine and formaldehyde. As mentioned, one molecule of melamine can

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attach up to six CH_2O molecules to itself, and the joining of the first three molecules occurs at a high rate..

This situation occurs due to a large difference between the equilibrium constant and rate constants in hydroxymethylation of melamine and its methylol derivatives. For example, in the substitution of one to six hydrogen atoms of melamine, the rate constant of hydroxymethylation decreases by about 10 times, and the equilibrium constant decreases by up to 40 times. It is this phenomenon that explains the formation of various methylol compounds and mixtures of melamine.

As the amount of formaldehyde in the reaction medium increases, the number of compounds with a high exchange rate also increases. At the same time, the rate of change of melamine also increases. For example, in polycondensation, the molar amounts of CH_2O and melamine are equal to 1, 3, 5, and 7 in reaction conditions of 40°C, pH 9, 24 hours, and the degree of melamine conversion is 40, 80, 90, and 100%, respectively. According to their composition, they correspond to the following reaction products: 30% monomethylolmelamine and 7% dimethylolmelamine; 36% mono-, 30% di- and 10% tri-; 27% is a mixture of mono-, 36% di- and tri-, 9% tetra- and 2% pentamethylolmelamines. And hexamethylolmelamine is found in products obtained in CH_2O:melamine > 10 ratios. At CH_2O:melamine ratios equal to 30, the amount of tetra-, penta- and hexadimethylolmelamines is 32, 30 and 12%, while the amount of mono-, di- and trimethylolmelamines decreases. goes.

Condensation of methylol derivatives of melamine ends with the formation of thermoreactive oligomers with a branched structure. In this case, the degree of polycondensation usually does not exceed 3.

Scheme of production of melaminoformaldehyde resins in industry periodically or continuously. Melaminoformaldehyde resins are obtained in the industry on a periodic or continuous scheme. In this case, it is 53-54 by mass compared to 100% formaldehyde. Commercial formalin is poured into the reactor and dissolved with water until a concentration of 30% is formed. Then alkali solution is added to the resulting solution until the pH value reaches 7.8-8.5. Melamine is added to the reactor while the mixer blade is running, and the mixture is heated to 80-95°C. The polycondensation reaction is carried out at a temperature sufficient until the "water number" of the resin reaches 6-15. "Water number" refers to the amount of water added to the reaction solution to make it turbid in ml. Resin is obtained in the form of a 50% aqueous solution. Melamine-formaldehyde resins in powder form are obtained by drying. Resin drying can be done using a thermal vacuum or spray drying.

Melamine-formaldehyde resins solidify when heated in neutral or alkaline environments, and in acidic conditions solidify at room temperature, forming insoluble and non-liquefiable polymers with a network structure. Cured products have high strength, are resistant to heat, water, moisture, friction, light, and have good painting properties.

In order to obtain resins that are soluble in organic solvents and water and can be combined with various plasticizers, oligomers and polymers, melamine-formaldehyde

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resins are modified with alcohols (in most cases with butyl alcohol), with urea or with guanamines. As a result, urea-formaldehyde resins are obtained. Such products are used as binders in the production of aminoplasts, press powders, paper layered plastics, asboplastics, and artificial marble. In addition, urea, melaminoformaldehyde resins are used to make paper, cardboard and fabric water-resistant, and to protect them from fading.

Melamino-formaldehyde resins modified with alcohols are the basis of melamino-alkyd varnishes, melamino-formaldehyde resins modified with sodium salts of n-aminobenzosulfonic acids are used as plasticizers of concrete products.

Conclusion

In order to further study the synthesis processes of melaminoformaldehyde adhesive, the physico-chemical properties, reactivity and other parameters of melaminoformaldehyde resin were analyzed in comparison with its closest analogue - carbamidoformaldehyde resin.

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