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Study of Production PVC Composition

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Abstract

This article has described the technological process and scheme of obtaining PVC compositional materials with applying new thermo stabilizers on the base of local industrial wastes.

Keywords: product-T, shorcit modified, gossypol resin, plastogram, thermo stability.

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In accordance with the main directions of economic and social development of the republic , the chemical industry is developing at an accelerated pace, especially the production of local raw materials and materials that ensure technical progress in all sectors of the economy. The creation of the Shurtan Gas Chemical Complex and a number of planned production facilities for the production of polyvinyl chloride (PVC) indicate the need for and demand for this polymer in the republic.

Polyvinyl chloride is the most widely used in various industries and in the economy due to its low price and availability of raw materials, subject to various modifications and production due to this large range of materials and products based on it.

This polymer also has a disadvantage – low resistance to various energy impacts, which is expressed in the increased tendency of the obtained materials to age. To protect PVC from the effects of heat, light, atmospheric and other factors, during the processing of the polymer and during the operation of products, it is necessary to use stabilizing additives related to various classes of chemical compounds. The most important requirements for additives introduced into PVC compositions in order to ensure the production of stabilized high-quality materials are processability, availability, and non-toxicity [1,2,3].

Currently, the republic has the ability to create new types of stabilizers and search for mineral fillers for PVC based on secondary raw materials from production and minerals, which have a qualitative effect on the performance characteristics of products.

Potential raw materials for the creation of heat stabilizers are secondary products - technological waste from the production of caprolactam product-T and other impurities , as well as waste from the oil and fat industry - gossypol resin (GS).

Based on these components, a technological process and a scheme for the production of PVC compositions have been developed [4].

For To prepare a PVC composition, it is necessary to know the sequence of the technological process and

the production scheme.

They consist of the following operations:

Preparation of raw materials and dosing of components.

Powder components: polyvinyl chloride (PVH - C-7058M grades, etc.); filler - shorsit modified; heat stabilizers - calcium, magnesium, barium, zinc and lead salts of product-T; compound BMR -9-1.

Paste components: gossypol resin or stearic acid.

The basic technological scheme of production of PVC composition is shown in Fig. 1.

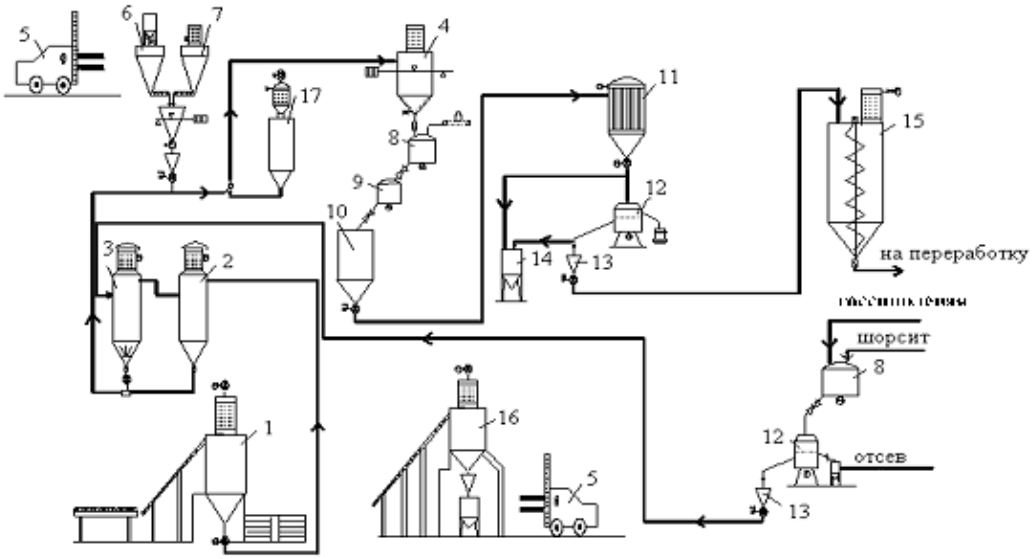

Fig. 1. Basic technological scheme of production of PVC composition

1– unloading unit; 2–PVC storage silo; 3–modified shorsite storage silo ; 4–suction pump; 5–electric car; 6-7–section for adding salts to product T; 7 ' –bunker electronic-pneumatic scale; 8–hot mixer; 9–cold mixer; 10–intermediate tank; 11–separator; 12–screen; 13–special tank; 14–container; 15–daily silo; 16–unloading section thermal stabilizers ; 17 – capacity for regenerate.

Polyvinyl chloride enters the silo through the unloading sections (pos. 1) using a compressor station with compressed air.

Shorsite is modified in a mixer (pos. 8) with gossypol resin in a ratio of 2:0.15 in parts by weight. The mixing process lasts about 30-35 minutes. At the first stage of mixing, a reduced rotation speed of 750 rpm of the mixing element is switched on . Heating of the mixed substances occurs due to friction of the component particles with each other and with the wall of the mixer. When the temperature of the mixed substances reaches 80 ± 5^0C, the process stops, the jacket-type mixer is cooled with water to $30\text{-}35^0$C. After that, the finished shorsite is fed with compressed air to the screen (pos. 12), in which sieves No. 014, No. 035 are installed. The finished modified shorsite that has passed through the screen sieves is collected in a special container (pos. 14) or immediately and transported to the silo (pos. 3) with compressed air.

Of the powdered components, according to the developed recipe, calcium, magnesium, barium, zinc and lead salts of product-T, compound BMR -9-1 from the unpacking section (pos. 16) are delivered to the mixing department (pos. 6, 7) by electric car. The components (pos. 6, 7) according to the working factory recipe are dosed and fed to the electronic-pneumatic hopper scales (pos. 7 '). After weighing, the components are fed to a special container (pos. 13). The volume of the electronic-pneumatic hopper scales 120 литров. The weighing limit of these scales is within 0- 5 кrand 5- 20 кг. Thermal stabilizers from a special container through pumps are fed to the suction scales (pos. 4). The weighing limit of the

suction scales is 10- 150 кг. The added component in small doses, i.e. Gossypol resin and stearic acid are weighed manually in separate electronic scales and fed to a two-stage hot mixer (pos. 8, 9) using a belt conveyor. For the corresponding type of product, according to the approved recipe of the plant, all components included in the PVC composition are fed to a two-stage hot mixer. Heating of the mixed composition occurs due to friction of the component particles with each other and with the walls of the mixer. Additional heating is provided to maintain the initial temperature.

At the first stage of mixing, the reduced rotation speed of the mixing element is switched on, after 2-3 minutes it switches to an increased rotation speed. The rotation speed of the working element is 750-1500 rpm . Without stopping the process of displacement at a temperature of 80 ± 5^0C, stearic acid and other ingredients (as needed) are introduced.

One loading of the hot mixer is . In the hot mixer 150 кг, 7 loadings can be made 350 литровin one hour, i.e. the productivity of the hot mixer is 1050 kg/hour, the volume of the mixer is . When the heating temperature in the upper chamber reaches 120 ± 5^0C, the mixture from the upper chamber of the mixer is poured into the lower chamber of the cold mixer (pos. 9), where it is cooled to 40 ± 5^0C. Here, the cooling agent is water. The process can be carried out automatically. The volume of the cold mixer is 1500 litr, the rotation speed of the working element is 130 rpm .

The cooled composition in turn enters the post-mixing tank (pos. 10), from where it is transported to the separator (pos. 11) using a suction pump. After separation, the composition enters the screen (pos. 12), from where the finished composition enters a special tank (pos. 13). From there, it is transported to the daily silo (pos. 15) using a pump for further use. Special mixers are installed in the daily silos to maintain the homogeneity of the composition. The volume of the daily silo is 15 m ^{3} . The remaining part of the composition in the screen sieves (screenings) enters a separate container (pos. 1). The screenings enter the fine grinding crusher. The crushed fine grinding is transported using a pump to the regenerate tank (pos. 17), where it is gradually added to the primary composition of the composition up to 10-20% of the total mass of the composition.

All the above-mentioned technological processes are automated and controlled by remote control.

The plastogram of this composition was obtained on the German laboratory equipment " Brabender " and has the following appearance:

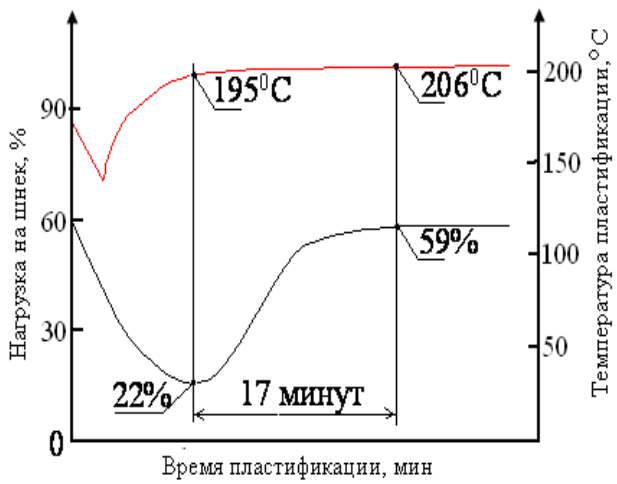

Fig. 2. Plastogram of the standard PVC composition formula

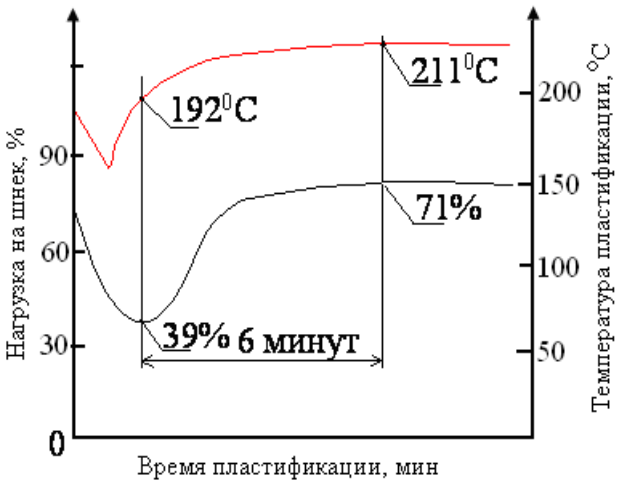

Fig.3. Plastogram PVC compositions stabilized with calcium salt of product T. Concentration of stabilizer 1.0 mass. h.

The plastogram of the standard formulation (Fig. 2) shows that the time from the start of the

plasticization process to the complete plasticization of the PVC composition is 17 minutes, the load on the " Brabender " screw at the start of plasticization is 22% and at the moment of complete plasticization 59%. The thermal stability of the composition at 190 ^{0} C was 45 minutes, the melt flow rate (MFR) was 0.3 g/10 minutes.

According to variant No. 1 (table 1), 1.0 mass. parts of calcium salt of product-T are added to the PVC composition and the amount of compound VM R -9-1 is reduced to 1,0 m. parts. In this case, the plastogram has the following appearance (Fig. 3).

As can be seen in the plastogram , the plasticization time is reduced to 6 minutes, which allows for significant energy savings. The reduction in MFI (0.2 g/10 min.) shows that with an increase in the weight of the polymer macromolecules, the physical and mechanical strength of the material increases, and the thermal stability increases to 65 min. The results obtained have better indicators compared to the indicators of the standard formulation.

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