SYNTHESIS OF PIGMENTS BASED ON COBALT TITANATES

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By the method of self-propagating high-temperature synthesis (SHS) in the system MgO-ZnO-Co3O4-TiO2-Al2O3, titanium-containing spinel-type pigments were synthesized.

The purpose of this work is to study the phase composition and structure of high-temperature inorganic pigments based on cobalt titanates.

The synthesis temperatures of these pigments reach 1900 °C. The resulting orthotitanates of cobalt and magnesium decompose to metatitanates, which have a lower melting point 1, which contributes to darkening and sintering of the product. To obtain pigments in a fine-dispersed state, it is necessary to reduce the maximum synthesis temperature in the SHS process. To achieve this goal, aluminum hydroxide Al(OH)3 was additionally introduced into the composition of the charge, consisting of TiO2, MgO, ZnO, Co3O4, magnesium nitrate Mg(NO3)2·6H2O and Al, in an amount of 5, 10, 20, and 30% by mass. The best results were obtained with the addition of 20% Al(OH)3.

The synthesis was carried out in cups made of metal mesh, in the air, at atmospheric pressure in a gradient resistance furnace. For the synthesis of titanium-containing spinel, samples of bulk density were used, the ignition of which was carried out from the side surface, where the furnace temperature was maximum (Fig. 1).

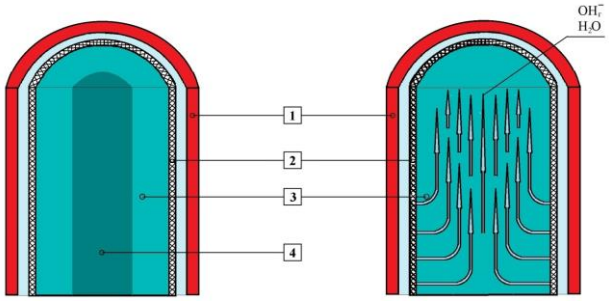

Figure 1 – Scheme of synthesis with the use of aluminum hydroxide Al(OH)3 and without it, where 1 – resistance furnace, 2 – cup made of stainless steel, 3 – synthesized sample, 4 – zone of increased temperatures

X-ray diffraction analysis of the pigment with a content of 20% Al(OH)3 in the charge showed that the main phases are solid solutions of alumospinels and magnesium and cobalt titanates. Gases formed during the thermal decomposition of aluminum hydroxide loosen the charge in the heating zone, reducing the maximum combustion temperature, which allows the synthesis to be carried out in the solid phase without melting the product, obtaining it in a fine-dispersed state. This is confirmed by studies of the pigment microstructure (Fig. 2).

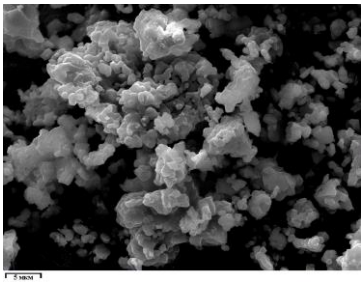

Figure 2 – Microphotographs of the pigment structure based on magnesium and cobalt titanates with the use of 20% Al(OH)3 in the charge composition (Philips SEM 515)

The introduction of Al(OH)3 into the composition of the charge promotes the production of a pigment with a particle size of ≤ 5 μm, light blue in color. These pigments can be used in the composition of ceramic paints.

REFERENCES

[1] Physicochemical properties of oxides / Handbook. Ed. by G.V. Samsonov. – M.: Metallurgy, 1978. – 471 p.