HIGH TEMPERATURE SYNTHESIS OF INORGANIC PIGMENTS IN THE ZnO-MgO-CoO-Al(OH)$_3$-Al SYSTEM

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The self-propagating high-temperature synthesis method based on the velocity of processes and the use of simple equipment is an alternative to available and generally accepted technologies for producing inorganic pigments, in particular, to ceramic and sol-gel methods [1].

Cobalt oxides Co_2O_3, Co_3O_4, oxides ZnO, MgO and aluminum hydroxide $Al(OH)_3$ were used to synthesize medium blue pigments. Aluminum powder (ASD-4) was used as a metal reducing agent. Pigments were obtained in a constant-pressure bomb in air. To provide a layer-by-layer combustion mode, the mixture was heated to temperatures of 300÷500 °C and then the end of the sample was ignited with an electric coil.

The synthesis of SHS pigments with a particle size of ~ 1-2 μm became possible after replacing Al_2O_3 with $Al(OH)_3$. Studies have shown that heating aluminum hydroxide to 500–550 °C leads to the formation of γ-Al_2O_3 particles of the same size (~ 0.6 μm), while long keeping $Al(OH)_3$ in a furnace at a temperature of ~ 500 °C contributes to the coarsening of these particles. The particle size distribution was determined on a DelsaMax PRO analyzer.

High-velocity SHS processes reach high temperatures in a short time. Due to this, the hydroxide structure is rapidly destroyed releasing gaseous reaction products with the formation of submicron and active aluminum oxide, which reacts with cobalt oxide due to high temperatures, forming a fine spinel structure, as confirmed by studying the microstructure of the samples using scanning electron microscopy (Philips SEM 515) (Fig. 1).

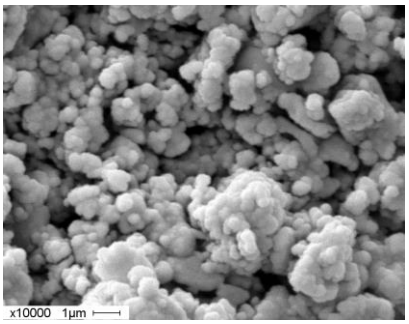

Fig. 1 SEM image of a pigment obtained from the ZnO-MgO-CoO-Al_2O_3 system, (Philips SEM 515).

It is known that aluminum spinels have a high hardness (7÷8 on the Mohs scale), which requires significant costs for their grinding [2]. In this regard, the obtaining of fine spinel SHS-pigments directly in the combustion wave simplifies their flow diagram (only disaggregation is required instead of grinding). Spinels based on zinc, magnesium, cobalt oxides easily form solid substitution solutions, which is favorable for obtaining medium blue pigments in various shades.

Thus, the addition of aluminum hydroxide $Al(OH)_3$ to the reaction mixture provides obtaining blue spinel pigments with a particle size of ~ 1 ÷ 2 μm.

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REFERENCES

[1] A.P. Amosov, I.P. Borovinskaya, A.G. Merzhanov, "Powder technology of self-propagating high-temperature synthesis of materials," Moscow: Mashinostroenie-1, 2007, 567 p. (in Russian).

[2] L.B. Khoroshavin, "Spineloid nano-refractories," Yekaterinburg: Ural Branch of the Russian Academy of Sciences, 2009. (in Russian).