SYNTHESIS OF IRON-CONTAINING SPINEL-TYPE PIGMENTS

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Compounds based on transition elements are used as chromophores to obtain spinel-type pigments. Iron oxide Fe_2O_3 has the greatest effect on colority among the iron triad elements. A variety of color is achieved not only by the different degree of iron oxidation - (2+, 3+), but also by easy mutual conversion of iron oxides into each other due to the redistribution of ions between octahedral and tetrahedral hollows in the structure without significant changes.

The different color pigments (blue-green and dark brown) were obtained during the synthesis of pigments, using Fe_2O_3 oxides from different manufacturers, when the component composition of a green mixture consisting of Fe_2O_3, Co_2O_3, Cr_2O_3, Al_2O_3 and Al was constant and the other parameters of synthesis (diameter, density, etc.) were varied. The spectra of images are shown in Fig. 1.

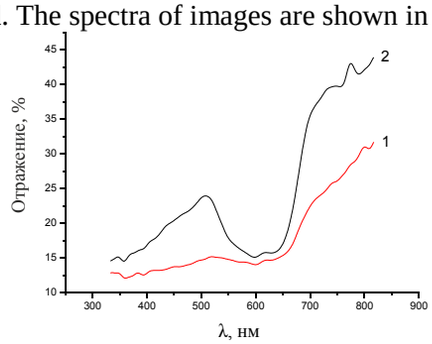

Fig. 1. Image spectra of $CoO-Cr_2O_3-Fe_2O_3-Al_2O_3$ pigments, where 1 is the dark brown pigment (initial Fe_2O_3, "ARD"), 2 is the blue-green pigment (initial Fe_2O_3, "ACS"), Evolution-600 .

X-ray diffraction analysis (DRON-UM1 diffractometer with filtered Co kα radiation) showed that the blue-green pigment $CoO-Cr_2O_3-Fe_2O_3-Al_2O_3$ contained hercinite $FeAl_2O_4$ as the main phase and the large amount of $CoCr_2O_4$ and $CoAl_2O_4$. Fe_3O_4 oxide is the main phase in the composition of black pigment. According to IR spectroscopic analysis (Nicolet 5700 FT-IR spectrometer), there is the bond stretch of tetrahedrally (Fe^{2+}, Co^{2+}) and octahedrally (Al^{3+}, Cr^{3+}) coordinated cations for 647 cm^{-1} and 543.6 cm^{-1} in a blue-green pigment (from Fe_2O_3 "ACS") consisting of a solid solution between alumospinels and chromospinels, which is typical for the structure of normal spinels. IR spectrum of the dark brown pigment synthesized from Fe_2O_3 "ARD" demonstrates additional absorption bands in the range of 400÷850 cm^{-1}, which indicates that the pigment has a structure of a mixed spinel [1].

According to X-ray diffraction analysis, initial oxide Fe_2O_3 "ARD" contains magnetite Fe_3O_4 as an impurity along with the main phase of α-Fe_2O_3. The quantitative analysis carried out using the Match program and the PDF-2 database showed that the amount of Fe_3O_4 magnetite was ~ 12 wt% in the initial Fe_2O_3 "ARD" and the remaining part was α-Fe_2O_3. Initial oxide Fe_2O_3 "ACS" contains not only Fe_3O_4 at the noise level but also lepidocrocite γ-FeO(OH). Water released during heating due to dehydration of iron oxide, in contact with aluminum contained in the green mixture, forms hydrogen that creates conditions for the SH synthesis of pigments, which contributes to the formation of hercinite. Magnetite in initial iron oxide Fe_2O_3 "ARD" acts as seed particles which are used for crystallization of Fe_3O_4, which contributes to the obtaining of dark brown and black SHS pigments.

REFERENCES

1. *Barabanov V.F* .// Modern physical methods in geochemistry.- L.: LSU, 1990.