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ABOUT THE POSSIBILITY OF USING THE WASTE ACM CATALYZER IN THE SYNTHESIS OF INORGANIC PIGMENTS BLUE COLOUR

ЩОДО МОЖЛИВОСТІ ВИКОРИСТАННЯ ВІДПРАЦЬОВАНОГО КАТАЛІЗАТОРА АКМ ПРИ СИНТЕЗІ НЕОРГАНІЧНИХ ПІГМЕНТІВ СИНЬЇ ГАМИ КОЛЬОРІВ

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Abstract. *The conditions of formation of chromophore compounds using the activated alumina-cobalt-molybdenum hydrogenation catalyst of the ACM type are investigated in the work. It is shown that mixed magnesium-cobalt-aluminum spinel is formed in the presence of MgO at high-temperature firing, which forms a blue-blue color of the pigment. When MgO is excluded from the model charge composition, the achromatic gray color of the pigment is formed in the presence of Cr_2O_3 and V_2O_5 due to the formation of black cobalt chromium molybdates and cobalt vanadium molybdates.*

Key words: *waste catalyst ACM, inorganic pigments, chromophore compounds, mixed spinels, high temperature synthesis, test syntheses, diffraction patterns.*

Inorganic pigments of blue and blue color gamut are widely used for decoration of fine ceramic products, industrial building materials and are synthesized in the oxide system: CoO-Al_2O_3-ZnO. The pigment ability of pigments of this color gamut is provided by $Co_{1-n-y}Zn_{n-y}Al_{x+y}[Co_xZn_yAl_{2-x-y}]O_4$ spinel-chromophores.

Compounds Co (II) (tetrahedral spatial configuration of placement in the oxygen frame of the crystalline spinel lattice) are colored in different shades of blue and blue. The introduction of pigments of zinc oxides, aluminum, magnesium, which form with spinach oxides chromophores with areas of continuous solid solutions, allows them to regulate their color gamut and color intensity [1,2].

High concentration (up to 50%) in pigments of cobalt oxide (II), which has a high price, necessitates the use of alternative raw materials - spent catalyst for the

hydrogenation of ACM, which is a source of cobalt and aluminum oxides and has a composition, wt%: Al_2O_3 – 84, CoO-4, MoO_3 -12.

Investigation of the synthesis of inorganic pigments of blue gamma using the spent catalyst ACM was performed by the method of test syntheses. The composition of the model pigments is planned to complete the replacement of Al_2O_3 and CoO oxides and to create chromophore compounds with maximum color intensity and to obtain the necessary technological and color properties of the pigments used for the production of high-temperature dyes.

Color characteristics of model pigments and charge batch are given in tab. 1.

Table 1

Color characteristics of pigments of optimal formulations synthesized using a spent ACM catalyst

The pigment index	The components of the mixture of model pigments, wt.%							Characterization of the pigment
	ACM	*ZnO*	*MgO*	*CaO*	Co_2O_3	Cr_2O_3	V_2O_5	
1	100	-	-	-	-	-	-	blue
2	90.0	10.0	-	-	-	-	-	blue
3	90.0	-	-	10.0	-	-	-	blue
4	90.0	-	10.0	-	-	-	-	intensive blue
5	80.0	10.0	10		-	-	-	intensive blue
6	50.0	-	50.0	-	-	-	-	blue
7	50.0	50.0	-	-	-	-	-	dark blue
10	88.5	-	10.0	-	-	1.5	-	dark blue
11	95.0	-	-	-	-	5.0	-	grey
12	90.0	-	-	-	-	10.0	-	grey
13	87.0	10.0	-	-	-	-	3.0	grey
14	60.0	36.5	-	-	-	-	3.5	grey

As can be seen from tab. 1, the color palette of the synthesized pigments naturally acquires different shades of blue, from blue to gray with increasing molar ratio of Cr_2O_3:CoO. In addition, the color of the pigments is significantly influenced

(as seen in the example of pigments 4-7) magnesium oxide. As the magnesium oxide concentration increases, the pigments become more blue. This is due to the formation of aluminum-magnesium spinel, which enhances [3] the blue color of the pigment. The content of Al_2O_3, ZnO does not significantly affect the color of the pigment.

On the development of the process of forming spinel structures of mixed type $Co_{(1-x-y)}Al_xCr_y[Co_{(x+y)}Al_{(2-2n-x)}Cr_{(2n-y)}]O_4$ and $Co_{(1-n-x)}Zn_{(n-y)}Al_{(x+y)}[Co_xZn_yAl_{(2-x-y)}]O_4$ at temperatures higher than 1073 K are indicated by the diffraction patterns of the optimal blue gamma pigment compositions. Increasing the concentration of zinc-alumo-cobalt spinel in pigments with a low (0.45) molar ratio of Cr_2O_3/CoO leads to a regular shift of the color of the synthesized pigments into the blue tone, which provides mixed $(ZnCo)[Al]_2O_4$ (d =2.443, 2.326, 1.561, 1.238 Å) [4]. As found [5] or spinels is characterized by a tendency to form continuous solid solutions. Thus, a solid solution of cobalt-aluminum spinel $xCoO\cdot(1-x)MgO\cdot Al_2O_3$ with colorless magnesium-aluminum spinel is formed in the composition of blue-blue pigments. $Mg[Al]_2O_4$ (d = 2.44, 1.086, 1.056, 1.654 Å), which in the presence of Co (II) becomes blue in color and enhances the blue-blue color of the pigment [3]. The introduction into the composition of the investigated pigments of oxides of other chromophore metals leads to a significant change in their color. One and a half percent of chromium oxide (III) in the mixture changes the color of the synthesized pigment to dark blue due to the formation of mixed magnesium-cobalt-alumo-chromium spinel $xCoO\cdot(1-x)MgO\cdot yCr_2O_3\cdot(1-y)Al_2O_3$. Increase in molar ratio chromium oxide (III): cobalt oxide (II) to (0.6-1.16) and the removal of spinel-forming MgO pigments (13, 14) and the presence of V_2O_5 leads to the synthesis of gray pigment, which indicates the probability of formation of black cobalt-chromium-molybdenum cobalt-chromium-vanadium mixed oxides.

The presence in the pigments of 10% molybdenum oxide (VI), as an integral part of the ACM catalyst, does not significantly affect the cobalt-magnesium-aluminum pigment color properties.

Thus, the possibility of using the spent catalyst ACM in the synthesis of inorganic pigments of blue-gray scale while solving environmental problems.

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Анотація. *В роботі досліджено умови утворення сполук-хромофорів при використанні відпрацьованого алюмо-кобальт-молібденового каталізатора гідрування типу АКМ. Показано, що в присутності MgO при високотемпературному обпалі утворюється змішана магній-кобальт-алюмінієва шпінель, що формує синьо-блакитний колір пігменту. При виключенні MgO із модельного шихтового складу в присутності Cr_2O_3· та V_2O_5 формується ахроматичний сірий колір пігмента за рахунок утворення чорних кобальт-хром-молібдатів та кобальт-ванадій-молібдатів.*

Ключові слова: *відпрацьований каталізатор АКМ, неорганічні пігменти, сполуки-хромофори, змішані шпінелі, високотемпературний синтез, пробні синтези, дифрактограми.*

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