



THERMAL ANALYSIS OF TaCoPc ORGANIC PIGMENT WHICH CONTAINS METALL

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Abstract. This article has been investigated the thermal properties of an organic pigment which contain a metal. According to the results of thermogravimetric and differential thermal analysis, the rate of thermal decomposition of the organic pigment stored in the metal and its temperature dependence is given.

Key words: terephthalic acid, phthalic anhydride, urea, cobalt, thermogravimetry, differential thermal analysis, intensity, temperature.

Introduction. Pigments containing phthalocyanine are widely used in industry. They are an expensive chemical product. In order to reduce their cost and improve their quality, the synthesis of new types of dyes is urgent. Also, such research allows creating new color spectra [1]. Phthalocyanine is an aromatic group containing 18 delocalized electrons, and this group is distinguished by its characteristic of forming intensely colored compounds. Especially, its metal complexes are widely used as pigments. The thermal stability of these compounds is also high [2]. It has been proven that phthalocyanine groups are colorless compounds in the monomolecular state, and that they absorb light in the blue range due to the fact that they exist in the form of complexes, dimers, and supramolecular compounds in the substance [3]. The relative stability of phthalocyanine dyes leads to long-term presence of dyes containing various heavy metals in the natural environment. Now, the degree of decomposition of these dyes by various representatives of fungi has been studied, and high efficiency has been achieved [4].

The possibility of using phthalocyanine as a catalyst in the catalytic oxidation of organic compounds was studied, and it was determined that the catalytic activity of the copper phthalocyanine dimer is optimal in an environment with a pH 11 [5].

Currently, in the period of technical development, the development of phthalocyanine chemistry is considered a sustainable way of development [6]. Also, these compounds are of biological interest due to their molecular structure being similar to naturally occurring metalloporphyrins [7]. They have a sharp green-blue color, show high chemical and thermal stability, and are used as pigments and dyes [8].

Currently, phthalocyanine complexes are spreading in various fields of science and technology. These complexes are important in the fields of construction, medicine, optics and industry because they have many useful properties [9-10].

In recent years, due to the lack of raw materials, a number of enterprises have reduced the production of lacquer materials, creating new types of paints is one of the important scientific and technical tasks. Organic dyes are not produced in our country and are mainly imported from other foreign countries. At the same time, organizing the production of these paints in our country, first of all, allows to reduce the import of paints. On the other hand, cotton cellulose, polyacrylonitrile, silk and wool allow to improve the properties of organic dyes that are most suitable for dyeing products [11-12].

The purpose of the study. Study of thermal properties of organic pigment TaCoPc based on terephthalic acid, cobalt salt, phthalic anhydride, urea and catalyst.

Method and object of research. The thermal stability of the compound of the synthesized cobalt-containing organic pigment with terephthalic acid was analyzed by differential-thermal and thermogravimetric methods on the device of the Japanese company SHIMADZU-DTG 60. It was studied by automatic recording of the derivatogram in the derivatograph at a speed of 10 degrees/min, T-900, TG-200, DTA - 1/10, DTG - 1/10 galvanometer sensitivity.

Research results and their discussion. The synthesized organic pigment was obtained in the presence of terephthalic acid, phthalic anhydride, urea, cobalt salt and catalyst. Thermogravimetric analysis was performed to study the thermal properties of the compound. Simultaneous TGA and DTA analyzes were performed in the temperature range of 20-600 °C on the SHIMADZU DTG-60 thermal analyzer (Fig. 1).

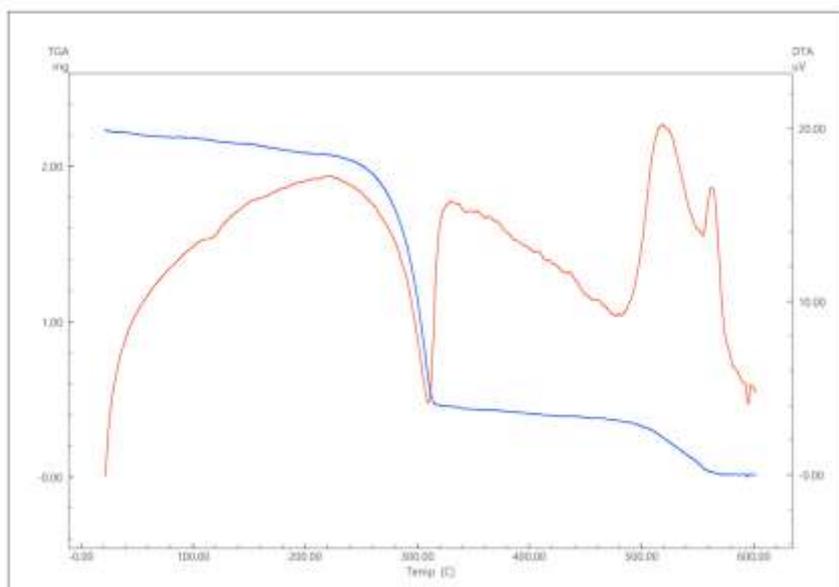


Figure 1. Thermogravimetric derivatogram (TGA) and differential thermogravimetric analysis (DTA) of organic pigment TaCoPc

Thermal analysis of TaCoPc organic pigments with a new composition was carried out in the temperature range of 20-600 °C. All samples of the thermal analysis of the mentioned pigments were carried out in a dynamic mode at a speed of 10 degrees/min in an aluminum mortar. In addition, endothermic and exothermic points of organic pigment were proved.

The maximum temperature of 600 °C was selected for the TaCoPc organic pigment with a new composition in dry mass presented in Figure 1, and the results of the pigment analysis were studied according to the presented thermogravimetric derivatogram (TGA) and differential thermogravimetric analysis. Two exothermic effects were observed at temperatures of 518,

563 °C and three endothermic effects at temperatures of 116, 310, 478 °C. 2.23 mg of TaCoPc pigment was taken in an open-mouth crucible made of aluminum resistant to temperature of 600 °C, and the temperature was gradually increased starting from 20 °C.

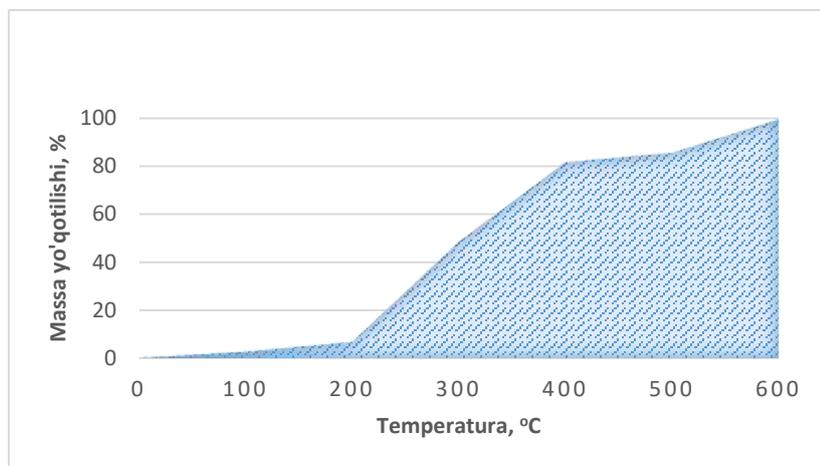


Figure 2. The curve of thermogravimetric analysis results of TaCoPc pigment

The analysis of the thermogravimetric curve of organic pigment shows that the TGA curve mainly takes place in the temperature range of 3 intensive mass losses. The 1st mass loss range is 22.5 - 224.3 °C, the 2nd mass loss range is 224.3 - 320.77 °C, and the 3rd mass loss range is 320.77 - 600 °C corresponds to the temperature. The analysis shows that mass loss in the 1st mass loss interval is 0.162 mg, i.e. 7.265%, while in the 2nd mass loss interval, an intensive decay process occurs. In this interval, the main amount of mass loss is 1.607 mg, i.e. 72.063%. The mass loss in the 3-mass loss range is 0.449 mg, i.e. 20.135% (Fig. 2).

It can be seen that the first mass loss is the loss of unbound water. In the second main stage of decomposition, in the case of lower molecular compounds such as carbon dioxide, ammonia, after the decomposition of the organic part, mainly a mixture of metal carbonates and oxides and partially coal remains. In the third stage of decomposition, carbonates are also decomposed, and metal oxides and coal residues remain.

Differential thermogravimetric analysis of the organic pigment is presented in Figure 2. Differential thermogravimetric analysis of organic pigment shows that energy absorption occurs in the range of 235.4 - 330.8 °C. The highest heat absorption occurs at a temperature of 309.88 °C. Energy release occurred between 482.94 - 548.56 °C and 555.16 - 581.44 °C. The highest heat output occurs at a temperature of 518.6 °C.

The analysis of the results of the thermal decomposition of the substance at different temperatures is given in Table 1.

Table 1

Analysis of TGA and DTA curve results of organic pigment TaCuPc

Nº	Temperature °C	Lost mass, mg (2,23 mg)	Lost mass, %	The amount of energy consumed ($\mu\text{V}\cdot\text{s}/\text{mg}$)	Time spent (min)	dw (mg)	dw/dt (mg/min)
1	100	0,06	2,69	13.18	8.88	2.17	0,006
2	200	0,15	6,72	16.92	19.5	2.08	0.007

3	300	1,08	48,4	7.94	29.25	1.15	0,036
4	400	1,82	81,6	13.04	39.3	0.41	0,046
5	500	1,91	85,6	13.19	49.4	0.32	0,038
6	600	2,22	99,5	5.01	59.6	0.012	0,037

As can be seen from the table, the main decomposition process occurs in the range of 224.3 - 320.77 °C. This shows that the compound can be used as an effective pigment for the preparation of lacquer products.

Conclusion. According to the results of the analysis of the thermal stability of the organic pigment TaCoPc, it was shown that the addition of terephthalic acid to the composition of the organic pigment increases its temperature resistance.

Given the dry and hot weather of the summer months of our Republic, enamel paints prepared by adding organic pigments can be recommended to be used as a coating for building materials, iron, wood, etc.

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