ISSN: 2775-5118 VOL.4 NO.3 (2025) I.F. 9.1

ELECTRON SCANNING MICROSCOPY (ESM) AND ELEMENTAL ANALYSIS OF AK-2 FIRE RETARDANT COMPOSITION

t.f.f.d. (PhD) Sadikov Akramjon Ro'ziboyevich
Karimov Bahodir O'ktam o'g'li - Assistant of the Department
of "Occupational Protection and Technical Safety",
Karshi State Technical University
Karshi State Technical University, 180100. Mustakillik Street-225, Karshi, Uzbekistan.
Email: akramjonsadikov0@gmail.ru

Abstract. The results of microscopic analysis of the AK-2 brand flame retardant composite based on phthalocyanine pigment for the proposed textile materials were studied. The uniform distribution of the chemical components in the formation of this flame retardant composite meets the requirements for flame retardant products.

Keywords: Electron microscope, matrix, microstructure, homogeneous mass, welders, electricians, firefighters, and AK-2 brand flame retardant composite.

Introduction: The use of flame-resistant textile materials is classified by industries as follows: they are used as special clothing for metallurgists and metal casting workers, welders, electricians, firefighters, as well as workers in the oil and gas, coal mining, and other high-risk industries with explosive and fire hazards. [1].
For this purpose, we propose modifying textile materials to increase their flame resistance by using AK-2 antipyrene. Electron microscopy studies allow us to examine in detail the characteristics of the microstructure of the matrix of the material under study, the distribution of the filler substance, the degree of its spread, and the uniformity of its distribution within the sample. [2, 3.]

Analysis of literature on the topic. In recent years, in the Republic of Uzbekistan and abroad, extensive scientific research in the field of flame retardants has been carried out by foreign scientists E. Tekey, R.N. Sabirzyanova, F. Laoutid, N.S. Zubkova, O.N. Mikryukova, E.P. Lavrentyeva, U. Dzhon, J. Alongi, G. Barbara, M.I. Misnon, J. Chilton, E. Kandare, E.D. Weil, D.B. Ajgaonkar, A.N. Netravali, H. Huang, K. Mizuta and other scientists to create a new generation of flame retardants for various industries and special fire-resistant materials in the textile industry.

In our republic, a number of scientific studies are being conducted to create a new generation of flame retardants for special fire-resistant materials in various industries and the textile industry,

as well as to develop technologies for their application, improve physical and chemical properties, and develop economically and environmentally efficient technologies. This is being developed as a result of the scientific research work of A.T. Djalilov, S.S. Nigmatov, N.A. Samigov, I.A. Nabiyeva, A.S. Rafikov, B.T. Ibragimov, A.A. Mukhamedgaliyev, A.A. Suleymanov, F.N. Nurkulov, Sh.E. Kurbanbayev, R.I. Ismoilov, I.I. Ismoilov, R. Boltaboyev, I.I. Siddikov and other scientists.

Analysis and Results. Based on the scientific results obtained in the development of technology for producing flame retardants based on phthalocyanine pigments: New flame retardant compositions based on phthalocyanine pigments created for fire protection of textile industry materials have been implemented in the textile fabric manufacturing enterprises of “STATERM” LLC and “Seven systems” LLC (according to the certificate of the Ministry of Emergency Situations of the Republic of Uzbekistan dated November 9, 2023, reference number 5/4/38–3321–son). The electron microscope analysis of the AK-2 grade flame retardant composite based on phthalocyanine pigment shows that, in the first image, the appearance of the flame retardant composites and the formation of a homogeneous mass indicate that the powdered materials in the composite, when combined with several chemical substances, being smaller than 25-30 microns, significantly improve the physical-mechanical properties.

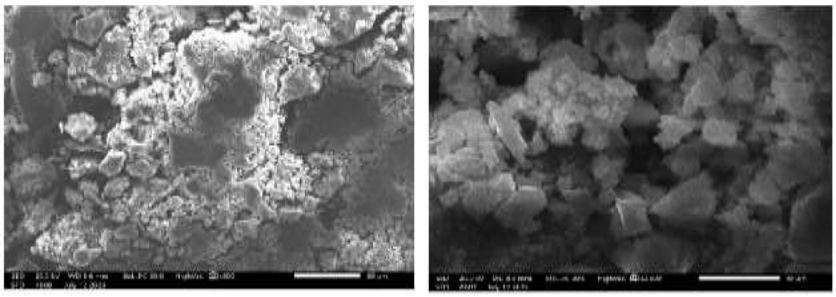

Figure 1. Surface of AK-2 grade flame retardant composite at 400x and 2500x magnification under an electron microscope.

The results of the microscopic analysis of the AK-2 grade flame retardant composite based on phthalocyanine pigment show that when this flame retardant composite is formed, the chemical substances within it are uniformly distributed, which meets the requirements for flame-retardant products. The surface of the AK-2 flame retardant composite and its enlarged electron microscope analysis revealed a clear distribution of particles, with no signs of any defects.

ISSN: 2775-5118 VOL.4 NO.3 (2025) I.F. 9.1

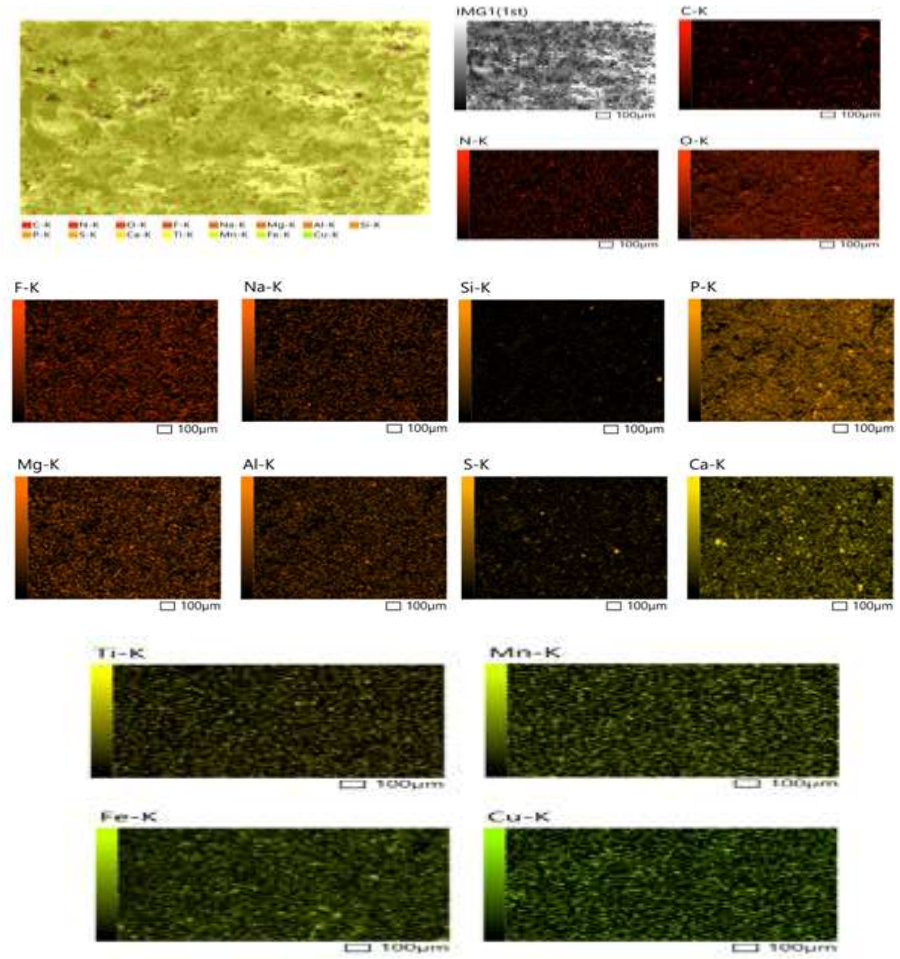

Figure 2. Electron microscopic analysis of the distribution of elements on the surface of the AK-2 fire retardant composite

Elemental analysis of the AK-2 brand flame retardant composite based on phthalocyanine pigment. In Figure 2, it was determined that the structure of the AK-2 brand flame retardant composite contained and distributed uniformly the particles of chemical substances, and the amounts of these chemical components were analyzed using elemental analysis.

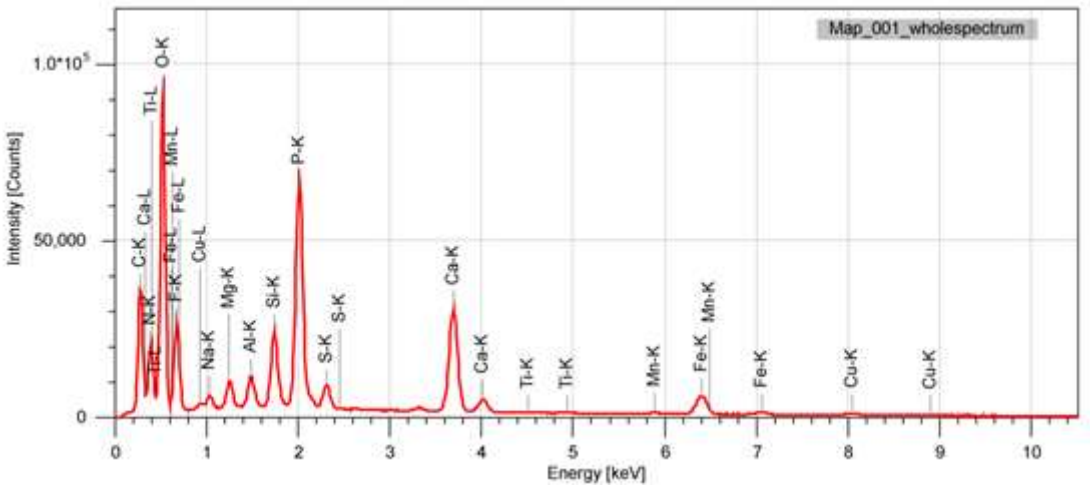

Figure 3. Electron microscope elemental analysis of AK-2 flame retardant composite

ISSN: 2775-5118 VOL.4 NO.3 (2025) I.F. 9.1

SEM analysis of the AK-2 brand flame retardant composite we received revealed the following elements: C -20.91%, O - 35.27%, N - 9.68%, P - 8.10%, Ca - 5.11%, Fe - 2.34%, Cu - 0.49%, Na - 0.60%, Mg - 0.86%, Al - 0.88%, Si - 1.90%, S - 0.91%, Mn - 0.15%, , Ti - 0.06%.

CONCLUSION

1. During the study of the literature, the chemical and physical properties of phthalocyanine pigments were analyzed. According to it, phthalocyanine pigments do not change when heated in open air at 400–500 0C and do not change even at 900 0C in an airless environment. Accordingly, in the dissertation, we aimed to obtain flame retardants based on phthalocyanine.

2. AK–2 brand flame retardant composites were synthesized based on phthalocyanine pigments and their properties were determined using modern physicochemical methods (IR spectroscopy and water and oil permeability of fabrics using GOST 413–91, GOST 10681–75).

3. Flame retardant composites obtained based on phthalocyanine pigments were studied by determining the thermal stability of the flame retardant properties of textile materials modified with AK–2 flame retardants. Cotton fabrics without flame retardant composites lose 71.497% of their mass at 386.20 °C, while cotton fabrics with AK–2 flame retardant composites lose 25.612% of their mass at 386.51 °C.

4. Increasing the concentration of flame retardant composites based on phthalocyanine pigments to 20% provided a high oxygen index in textile materials, and it was proven that AK–2 flame retardant is equal to its analogues, compared to 35.3 in Analog Apyrol CEP and 35.5 in AK–2.

5. The formation of coke and mass loss of modified flame-resistant textile materials were determined, as a result, mass loss was determined to be 97.6% for unmodified textile materials, and 50.5–19.84% for modified materials. The widespread use of these modified flame-retardant textile materials as special clothing for firefighters, oil and gas industry workers, welders, metallurgists, and workers in various manufacturing enterprises has been proven to be environmentally and economically efficient.

References:

ISSN: 2775-5118 VOL.4 NO.3 (2025) I.F. 9.1

1. Иванова С.Н. Анализ ассортимента огнезащитных текстильььных материалов и их классификация / С.Н. Иванова, О.Н. Микрюкова, Ю.М. Шульц, Т.С. Лебедева, М.В. Загоруйко, Бесшапошникова В. И. // Дизайн и технологии – 2018, №64(106). – С. 61-68.

2. Sadikov A.R., Fayziyev J.B., Nurqulov F.N. //Ик-спектри дифференциальный термический анализ олигомерного антипирена на основе фталоцианина // Universum: технические науки: электрон. научн. журн. 2023. 6(111). 57-61 с.// часть 3

3. Sadikov A.R., Fayziyev J.B., Nurqulov F.N. // Ftalotsianin komplekslarini to‘qimachilik sanoatidagi ahamiyati // Fan va texnikada innovatsion texnologiyalar: fizik yechimlar, metrologik o‘lchashlar hamda elektronika va asbobsozlik muammolari // 3sho’ba-130bet //Qarshi-2023

4. Садиков А.Р., Файзиев Ж.Б., Нуркулов Ф.Н. Фталоцианин комплексларини тўқимачилик саноатидаги аҳамияти // QarMII– Fan va texnikada innovatsion texnologiyalar: fizik yechimlar, metrologik o‘lchashlar hamda elektronika va asbobsozlik muammolari. Respublika ilmiy–amaliy konfrensiya materiallari to‘plami. Qarshi–2023yil. 130–131betlar .

5. Sadikov A.R., Nurqulov F.N., Fayziyev J.B., To‘qimachilik materiallarini olovbardoshligini oshirishda nonotexnologiyalarning ahamiyati // QarMII– Fan va texnikada innovatsion texnologiyalar: fizik yechimlar, metrologik o‘lchashlar hamda elektronika va asbobsozlik muammolari. Respublika ilmiy–amaliy konfrensiya materiallari to‘plami. Qarshi–2023yil. 147–149 betlar .

6. Садиков А.Р., Файзиев Ж.Б., Нуркулов Ф.Н. Тўқимачилик саноати учун фталоцианин комплексларини синтези // “Нодир ва ноёб металлар кимёси ва технологияси: бугунги ҳолати, муаммолари ва истиқболлари”. Республика илмий–амалий конференция материаллари тўплами. Термиз–2023. 226–227 бетлар

7. Садиков А.Р., Файзиев Ж.Б., Нуркулов Ф.Н. АК–1 антипирен композициясининг электр сканерловчи микроскоп (ЭСМ) ва элемент таҳлили // “Ilm–fan muammolari tadqiqotchilar talqinida”, mavzusidagi Respublika ilmiy konferensiyasi materiallari to‘plami, 30–avgust 2023–yil. 107–110 betlar.

8. Sadikov A.R., Fayziyev J.B., Nurqulov F.N., Umirov N. N. Ftalotsianin pigmentlari asosida yangi antipiren kompozitsiya tarkiblarini yaratish va fizik–kimyoviy hamda mexanik xususiyatlarini o‘rganish // «Nazariy va eksperimental kimyo hamda kimyoviy texnologiyaning zamonaviy muammolari» Xalqaro ilmiy–amaliy anjumani materiallari to‘plami. Qarshi–2023 yil 20–oktabr. 598–600 betlar.

9. Sadikov A.R., Fayziyev J.B., Nurqulov F.N., Umirov N. N. Zamonaviy olovbardosh to‘qimachilik materiallar turlarini tahlil qilish va ularga qo‘yiladigan talablar // «Nazariy va

ISSN: 2775-5118 VOL.4 NO.3 (2025) I.F. 9.1

eksperimental kimyo hamda kimyoviy texnologiyaning zamonaviy muammolari» Xalqaro ilmiy–amaliy anjumani materiallari to‘plami. Qarshi 20-oktabr 2023-yil. 601–603 betlar.