THERMOGRAVIMETRIC AND DIFFERENTIAL THERMAL ANALYSIS OF A THERMOSTABLE MATERIAL SYNTHESIZED FROM LIQUID GLASS AND SILICAGEL

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Abstract. Results of research on thermogravimetric and differential thermal analysis of a thermostable substance obtained by modifying liquid glass and Silicagel - The substance obtained on the basis of silicagel and liquid glass was studied using thermogravimetric and differential thermal analysis. Modern methods of analysis were used for the research, and the thermostability of the substance was also thoroughly studied.

Key words: differential thermal analysis [DTA], thermogravimetric analysis [TGA], heat resistance, liquid glass, sintering, polymerization, thermal stability

Annotatsiya. Suyuq shisha va kremnizolni modifikatsiyalab olingan termobarqaror moddaning termogravimetrik va differensial termik tahlili buyicha tadqiqot natijalari -Kremezol va suyuq shisha asosida olingan modda termogravimetrik hamda differensial termik tahlil yordamida o'rganildi.Tadqiqotlar uchun tahlilning zamonaviy usullari qo'lanilgan , shuningdek moddaning termobarqarorlik jihati chuqur tadqiq etilgan .

Kalit so'zlar: Differensial termik analiz[DTA],termogravimetrik analiz[TGA] issiqlikka chidamlilik , suyuq shisha, kremnezol, polimerizatsiya, termobarqarorlik

Аннотация. Результаты исследования термогравиметрического и дифференциального термического анализа термостабильного вещества, полученного путем модификации жидкого стекла и кремезола. Вещество, полученное на основе кремезола и жидкого стекла, было изучено с помощью термогравиметрического и дифференциального термического анализа. Для исследования были использованы современные методы анализа, а также тщательно изучена термостабильность вещества..

Ключевые слова: дифференциальный термический анализ [ДТА], термогравиметрический анализ [ТГА], жаростойкость, жидкое стекло, спекание, полимеризация, термическая стабильность.

Introduction

Today, one of the urgent tasks is to create a new generation of protective equipment with complex properties based on the achievements of new technologies in ensuring the fire safety of building structures and structures. According to fire statistics, fires around the world cause serious damage to human life, the economy and the environment.

Today, in the era of technology, one of the most urgent tasks is to protect industrial facilities and structures with complex structural structures from fire. In

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developed countries, great attention is paid to the creation of effective fire protection equipment and coatings aimed at increasing the fire resistance of building structures and materials.

In the Republic of Uzbekistan, comprehensive measures are being taken to ensure the fire safety of buildings and structures by creating and improving modern fire protection equipment and systems.

In our republic, various chemical compositions consisting of nitrogen, phosphorus, boron, metals and other substances have been created based on innovative technologies, and certain scientific and practical results have been achieved in obtaining fireproof materials using these flame retardants, in particular, important measures are being taken to create oligomeric flame retardants containing nitrogen, phosphorus, boron and metals based on new approaches. The Strategy of Actions for the Further Development of the Republic of Uzbekistan sets out important tasks aimed at "mastering the production of fundamentally new types of products and technologies that ensure the competitiveness of national goods in the domestic and foreign markets". In this regard, the development of economically efficient and environmentally friendly technologies for the production of oligomeric flame retardants containing nitrogen, phosphorus, boron and metals and composites that increase the properties of bulging thermostability based on local raw materials is of great importance.

In this area, a number of studies are being carried out, in particular, on the creation of fire-resistant means of building structures and materials based on local raw materials, and on improving the quality of fire extinguishing methods and technical means.

Since the 20th century, SiO2 nano-sized particles have been widely used in many products, and since 1960, metal nanoparticles have been used [6]. It has been found that compacts of these very small (~10nm) crystals have unique physical properties that can be used for various engineering purposes.

Many applications of nanocomposites are based on the properties of individual nanoparticles (sensors, medical diagnostics, homogeneous catalysis, etc.); At the same time, there are important areas that require self-assembled assemblies of nanoparticles (nanoelectronics, optoelectronics, photonics, heterogeneous catalysis, etc.).

Currently, great attention is paid to the creation of fire protection products based on modern technologies and their use to increase the fire resistance of building structures and materials[1]. Accordingly, targeted scientific research in areas including the creation of models of the mechanisms of physical and thermochemical processes occurring in protective coatings under the influence of heat; the creation of compact, accurate and rapid methods for assessing the impact

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of fire-retardant fillers on the fire safety indicators of building structures and materials; the creation of a new generation of highly effective heat and fire-retardant coatings based on widely available natural resources are important issues.

In the world, scientific research is being conducted to study oligomeric flame retardants and develop technologies for their production in order to reduce the flammability of wooden building materials. In this regard, in order to prevent fires in wooden construction materials, agricultural fields and forestry, special attention is paid to studying the optimal composition and physicochemical properties of phosphorus-containing oligomeric flame retardants, as well as to studying the mechanism of action of modifying flame retardants with wood materials. Decree of the President of the Republic of Uzbekistan No. PF-4947 dated February 7, 2017 "On the Strategy of Actions for the Further Development of the Republic of Uzbekistan".

OBJECT AND METHODS OF RESEARCH

The objects of research were substances formed by the modification of liquid glass and cremnisol, as well as samples of ethylene glycol. Modern methods of thermogravimetric and differential thermal analysis were used for the research, and the thermostability properties of the synthesized substance were analyzed and studied in depth.

RESEARCH RESULTS

Thermogravimetric and differential thermal analysis of the synthesized substance was carried out using a Shimadzu [DTG-60] instrument. The analysis results are presented in Figure 1.

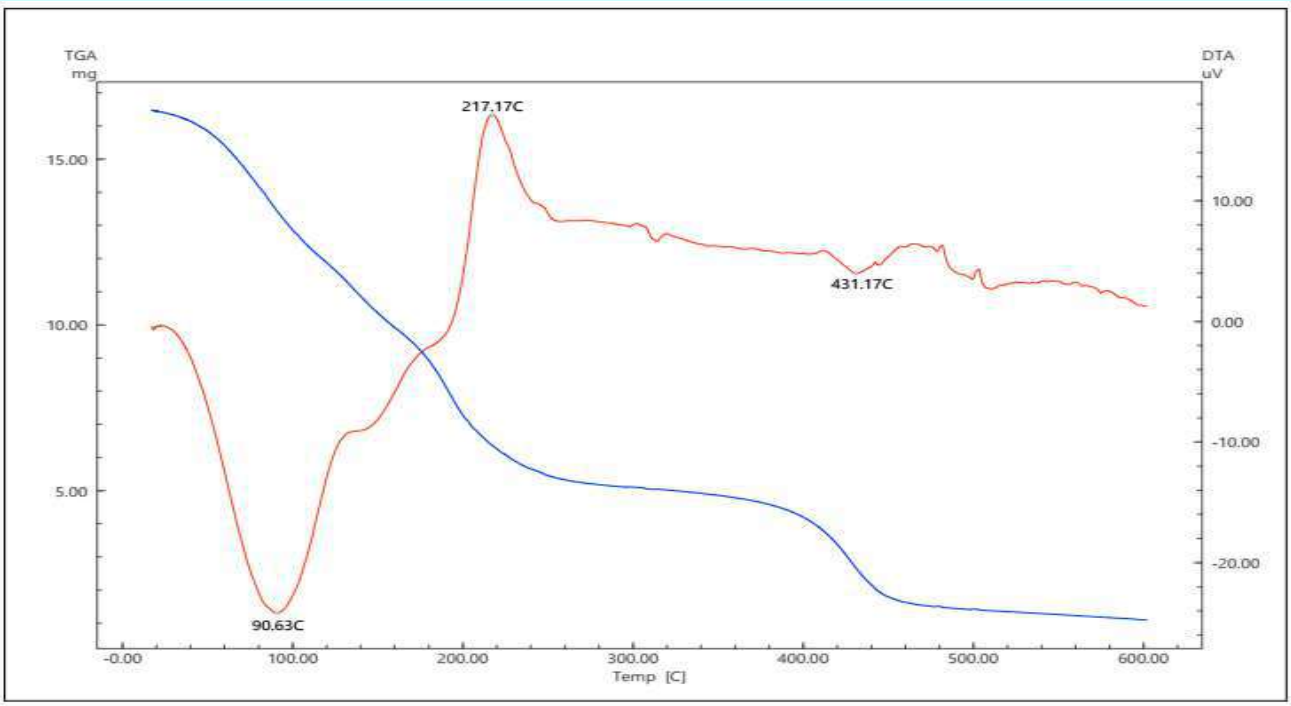


Figure 1. Thermogravimetric and differential thermal analysis of the synthesized substance

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This is a combined TGA-DTA thermogram (TGA — Thermogravimetric Analysis, DTA — Differential Thermal Analysis), which simultaneously shows the change in mass of the sample (TGA, blue line) and the temperature difference between the sample and the standard (DTA, red line) with increasing temperature. The TGA-DTA thermogram (temperature range: 25–600 °C, heating rate typically 10 °C/min) shows the following main processes: TGA (blue line — mass change): The sample loses a significant amount of mass (about 5–6 mg) between 25 °C and 90 °C. This loss has a maximum rate around 90.63 °C and is usually due to the evaporation of bound water (or moisture). Between 100–200 °C, mass loss continues, but slows down. After 200 °C, the mass remains almost unchanged (stabilizes around 5 mg) — this indicates that the sample has reached a stable state after dehydration.

In the range of 400–500 °C, another small mass loss is observed (noticeable at around 431 °C), which may be a decomposition of organic components or a thermal decomposition step. DTA (red line – heat flow): A large endothermic peak is observed at 90.63 °C — this is a heat absorption process associated with the evaporation of bound water (endothermic effect). A sharp exothermic peak is registered at 217.17 °C — this indicates an exothermic process such as crystallization, polymerization or oxidation of organic or crystalline phases in the sample. There is a smaller exotherm around 431.17 °C followed by several minor peaks — this may be related to thermal decomposition or later stages of oxidation.

CONCLUSION

"In the TGA-DTA analysis of the sample, two main processes were observed in the temperature range of 25–600 °C. A strong endothermic effect and corresponding mass loss at 90.63 °C are associated with the evaporation of bound water. A clear exothermic peak at 217.17 °C indicates a thermal transformation of organic or crystalline phases in the sample (e.g., crystallization or oxidation). A small exothermic effect and mass loss observed at 431.17 °C correspond to a thermal decomposition step at high temperatures."

Thermogravimetric and differential thermal analysis of our refractory material obtained from the modification of liquid glass and silica sol were sufficiently analyzed. When comparing the results of the analysis with the data presented in the literature, it was found that the properties of our obtained substance are similar to the properties of antiprenes, which exhibit fire resistance properties. Also, the synthesized substance can be processed and used as a raw material for various branches of the chemical industry.

The physical state, structure and chemical composition of the synthesized (oligo) polymers, crystallization temperature, gel formation time and exposure to chemical reagents allowed to achieve the specified thermal and physical

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characteristics of fire-resistant compositions. Using the created compositions, mechanisms for fire protection of wooden and inorganic building structures were developed; effective fire-resistant coatings based on urethane were created, with the help of which methods for increasing the fire resistance of wooden and inorganic building structures and developing multi-stage fire protection were developed. The speed of application and high light stability made such an application process very effective in the flooring industry where high speed and high decorative properties are required.

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