REVIEW

scientific supervisor to the dissertation of Kaliyeva Assem Mukhtarkhanovna titled "Obtaining and investigating composite materials for flameless heaters," submitted in fulfillment of the dissertation requirements for the degree of Doctor of Philosophy (Ph.D.) in specialty 6D073400 – Chemical technology of explosives and pyrotechnics

The dissertation of A. Kaliyeva is devoted to the study of improving the quality of chemical compositions for flameless heaters. Today, the use of flameless heaters for heating various liquids or solids in field conditions by activating chemical (exothermic) materials with water or air is becoming theswidespread (disposable food heating). In the last few years, these composite materials have also found their application in the medical field. Such heaters play an important role in providing first aid to various closed injuries, electric heaters, and field injuries that are difficult to obtain physiotherapy procedures.

The powder mixture for carrying out the exothermic reaction is mainly done by adding water to magnesium and magnesium-based mixtures. In addition, the basic composition of these composites can also be replaced by powders of calcium carbonate, sodium carbonate, calcium oxide, and aluminum. All powder alloys are obtained by pressing metal catalyst particles onto the magnesium surface through a mill and then dividing the finished powders into fractions. Most fractions are taken in micron sizes. Micron composites of flame retardant heater compositions are characterized by an uneven distribution of intense heat at the stage of redox action. In this regard, the relevance of Kaliyeva Assem Mukhtarkhanovna's dissertation work on the topic "Obtaining and investigating composite materials for flameless heaters" is beyond doubt.

During the execution of the PhD dissertation, A. Kaliyeva conducted successful experiments. The results are obtained by generalizing theoretical and experimental data. I am sure that the validity and novelty of the scientific results of the dissertation are as follows: The result is new because, for the first time, an aluminum-based composite was obtained, and for the first time, silicon monocoxide was used as an oxidizing agent. The resulting composites were tested for exothermic reactions in the presence of air and showed results worthy of flameless heaters; The result is new, because the aluminum powder used in the composition of Al-Al_2O_3-CaO-Na_2CO_3 was subjected to preliminary mechanochemical treatment. The activated metal powder had a positive effect on the resulting composition and helped to increase thermal characteristics. The composite showed that when interacting with water, heat is evenly distributed, and can retain heat for a long time; The result is new, because for the first time, silicon dioxide was used for compositions based on alkali metals. Silicon dioxide has been used as an oxidizing agent in solid phase interaction and in order to increase the degree of dispersion of aluminum, It is also involved as a modifier in the process of grinding aluminum in a mechanical reactor, to break or remove the oxide layer on the surface of aluminum parts. The results of the research work carried out to

identify the optimal compositions of the obtained Al-Al_2O_3-CaO-Na_2CO_3-SiO_2 system and its mechanical activation were obtained.

The degree of novelty of the results presented in the dissertation is confirmed by the publication of the main results in publications recommended by the committee for quality assurance in the field of education and science of the Republic of Kazakhstan and in a publication with a foreign impact factor. She published seven papers on the topic of the dissertation, including one article in an international publication indexed in the Scopus database, three articles in journals recommended by the committee for control in the field of education and science of the Ministry of Education and Science of the Republic of Kazakhstan, and three theses in conference materials. The dissertation work was performed in the laboratories of the Al-Farabi Kazakh National University, Institute of Combustion problems and the Polytechnic University of Milan (Italy).

I think that the dissertation on volume, content, and practical significance corresponds to the requirements of the PhD dissertation, and its author Kaliyeva Assem deserves a degree of doctor of philosophy (Ph.D) in the field of chemistry in the specialty "6D073400 – Chemical Technology of explosives and pyrotechnics".

Scientific supervisor
PhD, associate professor Ye. Tileuberdi

Қолын растаймын
Подпись заверяю

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