Structure of refractory materials based on local mineral raw

Jasur Rashidov[1*], *Bakhrom* Ibragimov[2], *Farkhod* Chulliyev[3], and *Iroda* Salimova[1]

[1]Tashkent University of Architecture and Civil Engineering, Tashkent, Uzbekistan
[2]Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, Tashkent, Uzbekistan
[3]National University of Uzbekistan named after Mirzo Ulugbek, Tashkent, Uzbekistan

Abstract. The paper is devoted to the results of microscopic analysis of the structure of fire-resistant materials developed on the basis of local mineral raw materials. The authors point out that in this regard, a special place is occupied by the microscopic analysis of refractory materials, because the use of various radiation and various designs of microscopes from optical to electronic requires various special preparation of objects and special methods for deciphering the observed images. Moreover, the use of these methods in relation to the fire-resistant compositions obtained during the experiments, consisting of kaolin, wollastonite, soda water glass, silica, finely dispersed thermovermiculite, silicon dioxide, dolomite, etc., demonstrates their microrelief morphology, which gives rise to other experiments related to increasing the quality of fire resistance of the objects under study.

1 Introduction

Among the entire range of refractory materials, corundum and mullite-corundum refractories, which have sufficiently high refractoriness and strength, are widely used. On the basis of corundum and mullite, a number of compositions have been developed, intended, mainly, like other classes of refractories, to meet the needs of the metallurgical industry[1-6].

The problem of obtaining effective heat-insulating materials from local mineral raw materials always remains relevant, and in this regard, tile press materials also need thermal protection.

2 Methods of research

In this regard, the plate press materials obtained during the experiments are chemically unrelated components (mineral particles and organic), including binders, which form the structure of a new composite material [7-13]. In this regard, it is very important to establish the nature of their interaction in the main composition [14-20]. Based on this, in order to

*Corresponding author: jasrash55@gmail.com

 https://doi.org/10.1051/e3sconf/202340102057

study the structure of the resulting tile materials developed on the basis of the mineral a wollastonite , kaolin, nanoparticles of silicon dioxide, silica, dolomite, thermo vermiculite , liquid glass, their electron microscopic analysis was carried out using optical and electron microscopy methods (See electronic images of samples (Figures 1-10)).

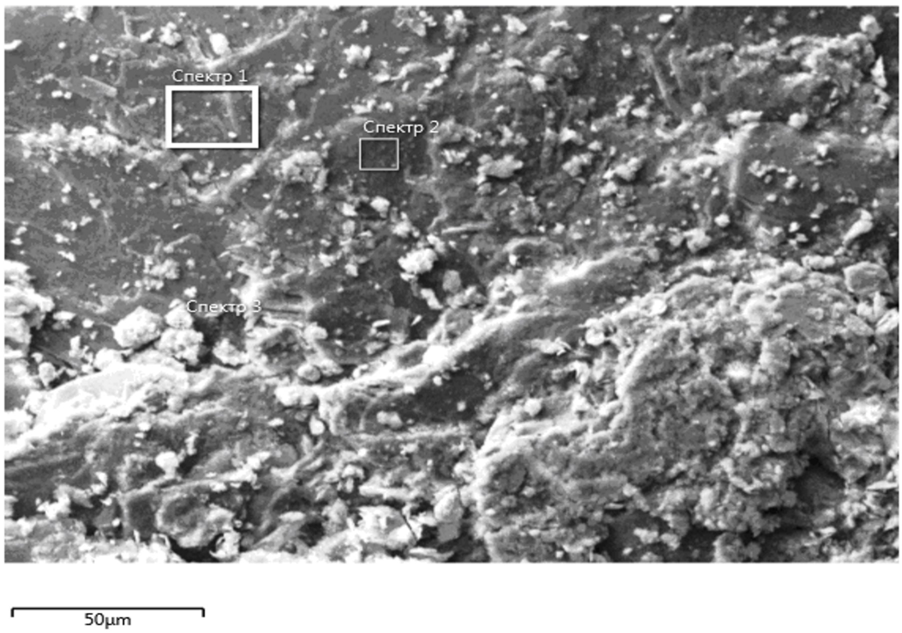

Fig. 1. Electronic photographs of particles of a composition consisting of kaolin, the mineral wollastonite and sodium liquid glass

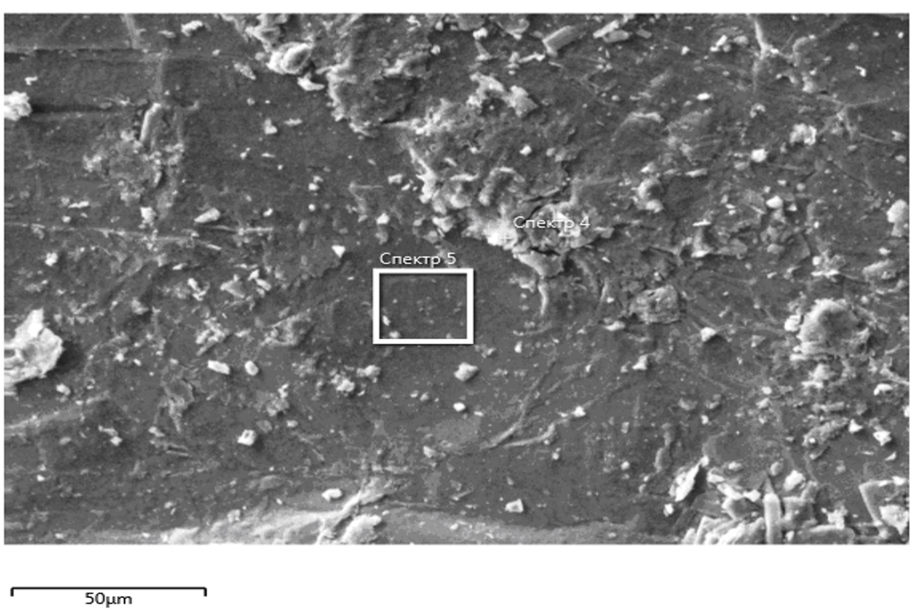

Fig. 2. Electronic photographs of particles of a composition consisting of finely dispersed wollastonite, silica, sodium liquid glass

 https://doi.org/10.1051/e3sconf/202340102057

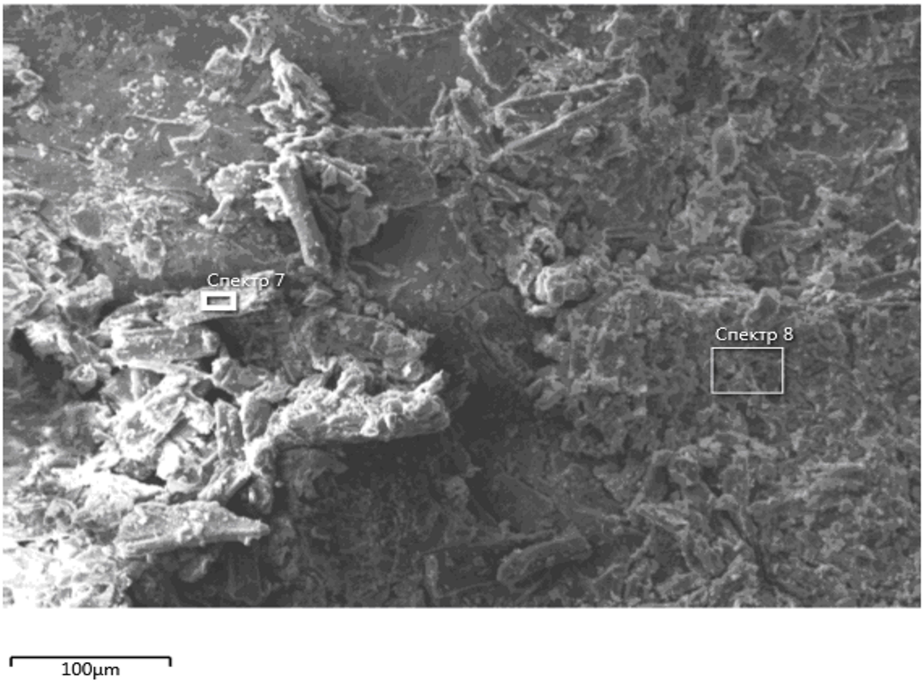

Fig. 3. Electronic photographs of particles of the composition of the tile material, consisting of finely dispersed thermo vermiculite, kaolin, sodium liquid glass

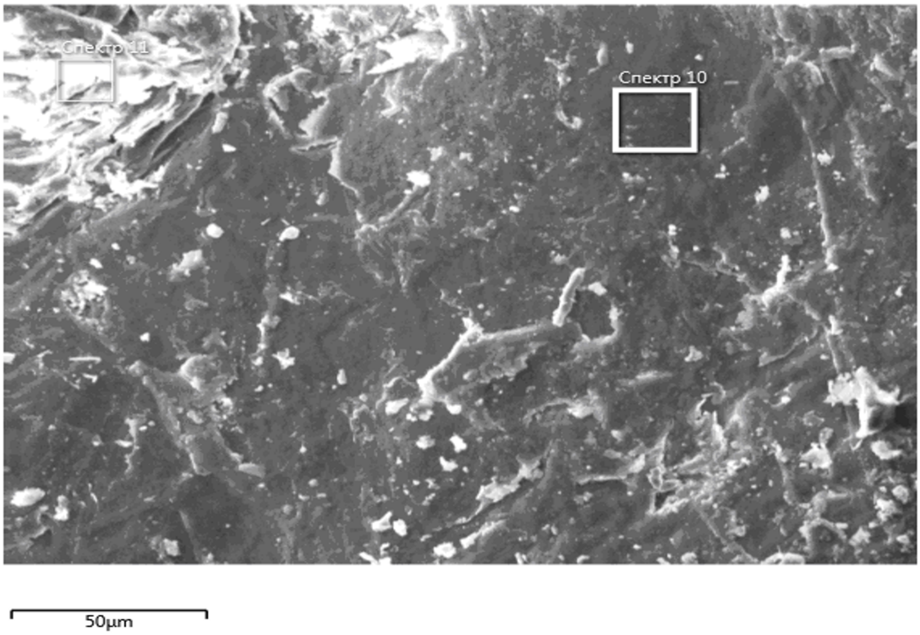

Fig. 4. Electronic photographs of particles of the composition consisting of the finely dispersed mineral wollastonite, silicon dioxide nanoparticles, and sodium liquid glass

 https://doi.org/10.1051/e3sconf/202340102057

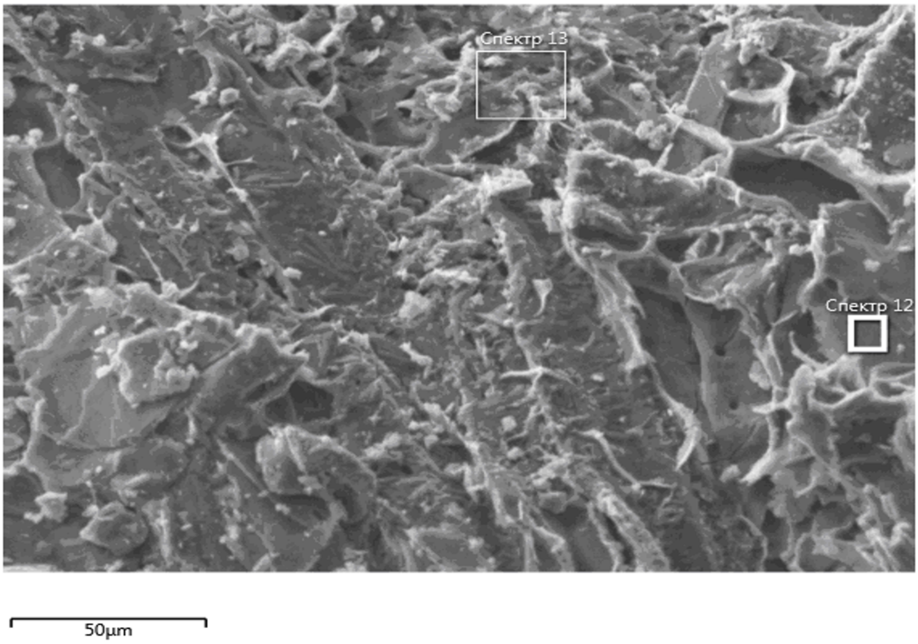

Fig. 5. Electronic photographs of particles of a composition consisting of finely dispersed thermo vermiculite, dolomite, sodium liquid glass

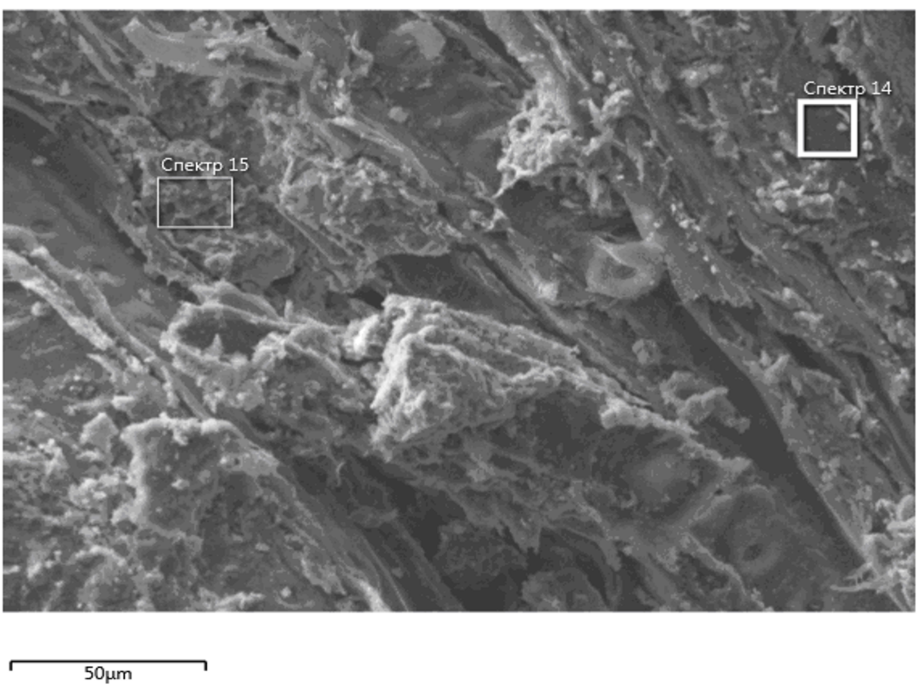

Fig. 6. Electronic photographs of particles of a composition consisting of kaolin, dolomite, sodium liquid glass

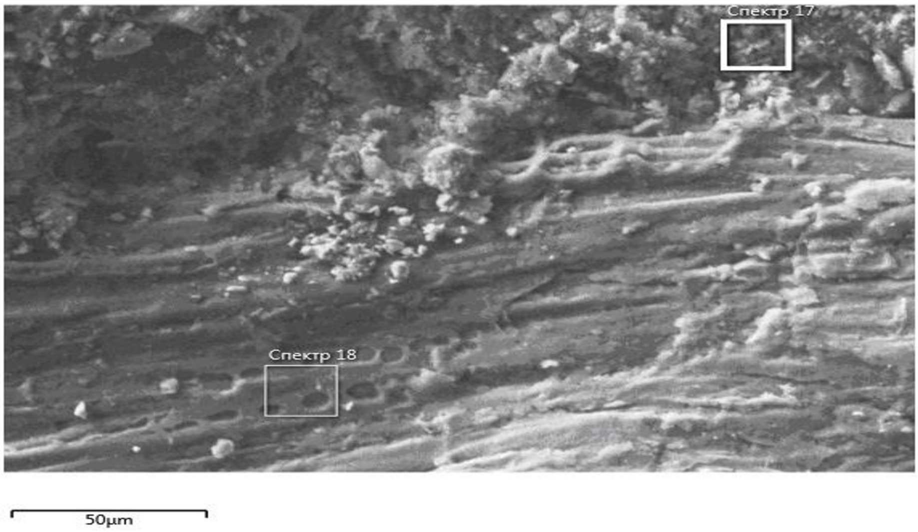

Fig. 7. Electronic photographs of particles of a composition consisting of kaolin , a fine mineral wollastonite and sodium liquid glass

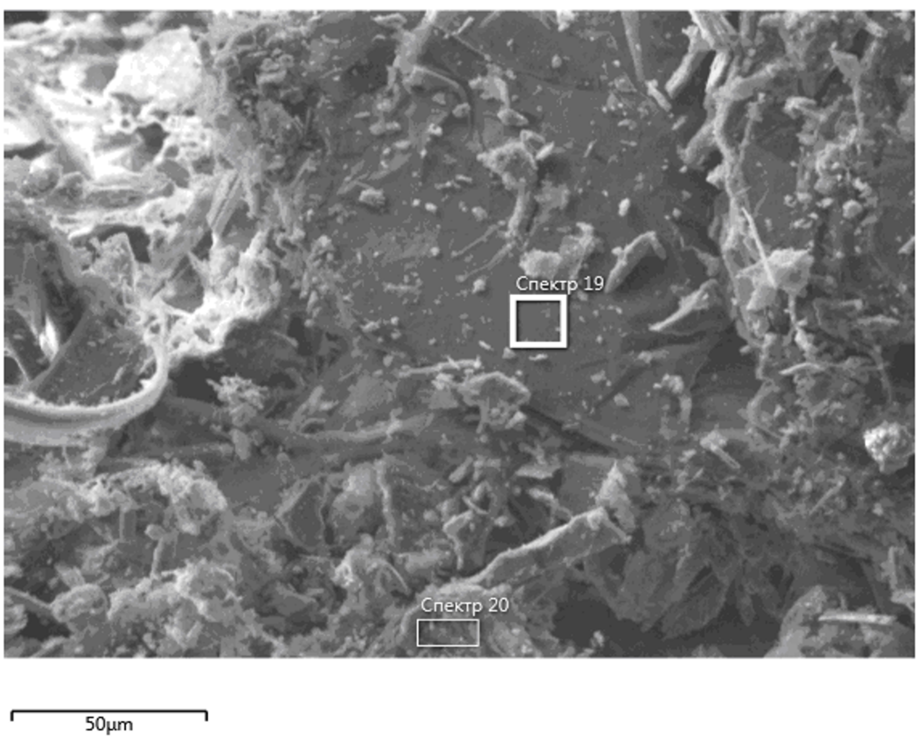

Fig. 8. Electronic photographs of particles of a composition consisting of a finely dispersed mineral wollastonite, thermovermiculite and sodium liquid glass

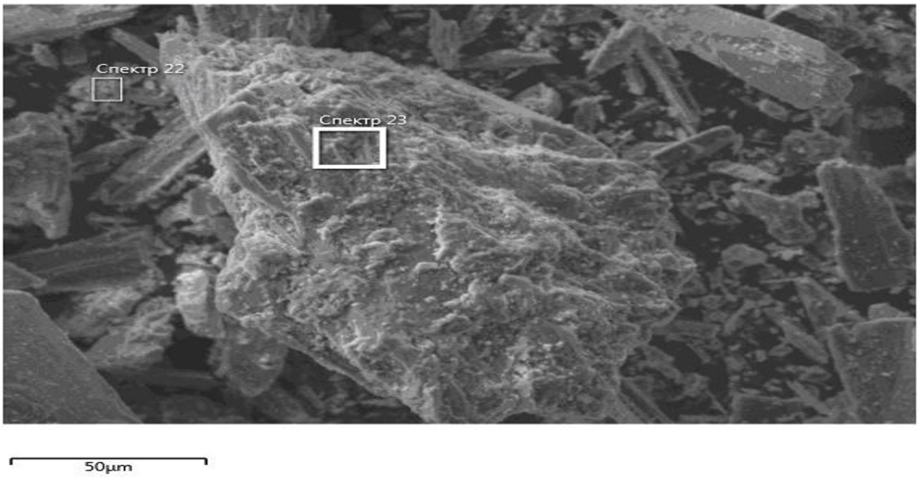

Fig. 9. Electronic photographs of wollastonite particles

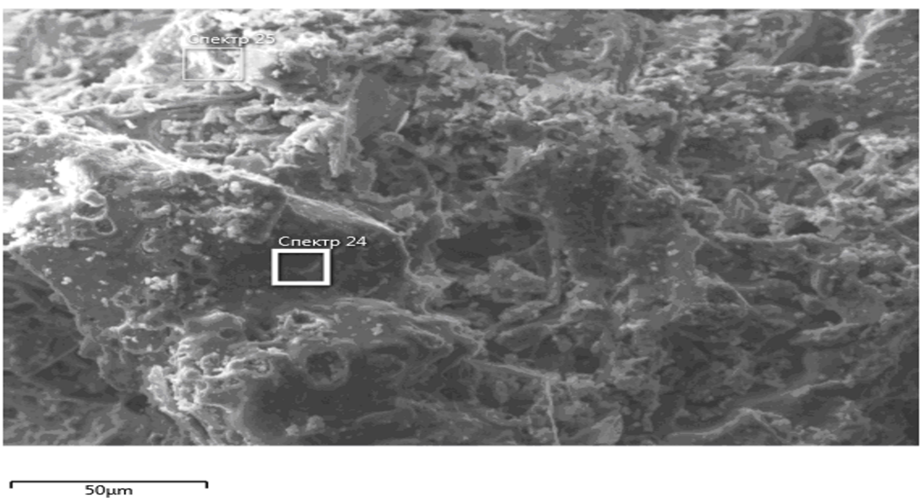

Fig. 10. Electronic photographs of particles of a composition consisting of a finely dispersed mineral wollastonite and dolomite, sodium liquid glass

3 Results

The study of photographs of the particle surface of the obtained materials and from other analyzes, it can be concluded that the samples of the compositions of Figures 2–4 and 7, having a smoother surface than the other samples, formed a denser structure, which gives the material more strength physical and mechanical characteristics. And also in Figure-9, you can see that these are particles of the wollastonite mineral, separately distributed over the entire surface, do not form a dense structure, a comparison of which with others gives the basis for making some comparative conclusions in favor of other samples with smoother surfaces.

4 Conclusions

Thus, the possibilities of microscopic methods have the following important features:

- using these methods, it is possible to carry out the calculation of quantitative parameters and fix the results of the object under study. It is currently recommended to equip microscopes used in this field with digital cameras that can be connected to a personal computer;
- the diagnostics of minerals is carried out using the polarization method of microscopy in an immersion medium. The surfaces of mineral grains, layers, filaments, plasma, their relationships are considered;
- when equipping laboratories with microscopes, all of the above factors should be taken into account - the ability to conduct research using a variety of microscopic techniques, including digital processing of the results;
- modern high-quality optical systems, digital equipment can significantly improve the quality and information content of the optical method used in the creation of thermal insulation and refractory materials.

References

1. Khadzhishalapov G. N., Hajiyev A. M., Khezhev T., and Alimuradov S. A. Heat Resistant Light Solutions on the Activated Composite Binder from the Local Mineral Raw Materials. In Materials Science Forum, Vol. 974, pp.400-405. (2020).
2. Karhu M., Lagerbom J., Solismaa S., Honkanen M., Ismailov A., Räisänen M. L., and Kivikytö-Reponen P. Mining tailings as raw materials for reaction-sintered aluminosilicate ceramics: Effect of mineralogical composition on microstructure and properties. Ceramics International, Vol. 45(4), pp.4840-4848. (2019).
3. Sawadogo Y., Zerbo L., Sawadogo M., Seynou M., Gomina M., and Blanchart P. Characterization and use of raw materials from Burkina Faso in porcelain formulations. Results in Materials, Vol. 6, p. 100085. (2020).
4. Babakhanova Z. A., and Aripova M. K. Slag resistant and refractory ceramic compositions in MgO–Al2O3–SiO2 system on the base of local raw materials of Uzbekistan. In IOP Conference Series: Materials Science and Engineering, Vol. 1091, p. 012057. (2021).
5. Akhmedov M. K., Gulamova D. D., Karimova D. A., and Tadzhieva D. F. Thermally resistant chamotte refractories based on the native Uzbekistan minerals. Applied Solar Energy, Vol. 43, pp. 109-112. (2007).
6. Berdiev K. R. Study Of Structural Properties And Flame Of Vollastanite, Dolomite, Vermiculite Minerals. The American Journal of Applied sciences. pp.30-37. (2021).
7. Narov R., Rashidov J., and Yusupov K. Influence of compound additive on concrete in hot and dry climate. In E3S Web of Conferences, Vol. 365, p. 02012. (2023).
8. Routschka Gerald. Refractory materials. Essen, Vukan-Verlag GmbH, p.512. (2004).
9. Ihlen Peter M. Utilisation of sillimanite minerals, their geology, and potential occurrences in Norway-an overview. Norges Geologiske Undersokelse Vol. 436 pp.113-128. (2000).
10. Maslennikova L. L., Babak N. A., and Naginskii I. A. Modern building materials using waste from the dismantling of buildings and structures. In Materials Science Forum, Vol. 945, pp. 1016-1023. (2019).

11. Komnitsas K., and Zaharaki D. Geopolymerisation: A review and prospects for the minerals industry. Minerals engineering, Vol. 20(14), pp. 1261-1277. (2007).
12. Albhilil A. A., Palou M., and Kozánková J. Characterization of cordierite-mullite ceramics prepared from natural raw materials. Acta Chimica Slovaca, Vol.6(1), (2013).
13. Zanelli C., Dondi M., Raimondo M., and Guarini G. Phase composition of alumina–mullite–zirconia refractory materials. Journal of the European ceramic society, Vol.30(1), pp. 29-35. (2010).
14. Lemougna P. N., MacKenzie K. J., and Melo U. C. Synthesis and thermal properties of inorganic polymers (geopolymers) for structural and refractory applications from volcanic ash. Ceramics International, Vol. 37(8), pp. 3011-3018. (2011).
15. Ion R. M., Fierăscu R. C., Teodorescu S., Fierăscu I., Bunghez I. R., Ţurcanu-Caruţiu, D., and Ion M. L. Ceramic materials based on clay minerals in cultural heritage study. Clays, Clay Minerals and Ceramic Materials Based on Clay Minerals, Vol. 26. (2016).
16. Babashov V. G., Bespalov A. S., Istomin A. V., and Varrik N. M. Heat and sound insulation material prepared using plant raw material. Refractories and Industrial Ceramics, Vol. 58(2), pp. 208-213. (2017).
17. Kuldashev A. H., and Djuraev S. M. Fire and Heat Protective Properties of Coatings for Metal Structures. Nexus: Journal of Advances Studies of Engineering Science, Vol.1(4), pp. 108-113. (2022).
18. Giannopoulou I., and Panias D. Structure, design and applications of geopolymeric materials. In Proceedings of the 3rd International Conference on Deformation Processing and Structure of Materials, pp. 20-22. (2007).
19. Just A., Schmid J., and König J. Post-protection effect of heat-resistant insulations on timber-frame members exposed to fire. Fire and materials, Vol.36(2), pp.153-163. (2012).
20. Maréchal M., del Campo Estrada E., Moulin G., Almeida G., Pin L. V., Cuvelier G., and Bonazzi C. New insulating and refractory mineral foam: Structure and mechanical properties. Materials Science and Engineering: A, 780, p.139153. (2020).