UTILIZATION OF THE COAL FLY ASH IN MULTILAYER COMPOSITE STRUCTURES FOR EXPLOSION MITIGATION

***SIMONA BADEA*[1]**
***MIHAELA MUREȘAN*[1]**
***ENIKO VOLCEANOV*[2]**

***Abstract**: Protection against shock waves is considered the main property of cellular materials, and thus, their interaction with waves generates a significant challenge. This paper presents the wastes utilization perspective by using the binding properties (through geo-polymerization) of the coal fly ash and applying and validating the process parameters of the innovative production of ceramic elements for ballistic protection structures with shapes that allow combining the curved surfaces that follow the target surface which are protected.*

***Keywords**: composite structures, fly ash, ceramics.*

1. Project objectives

The main project objective consists in obtaining modular composite structures for protection against complex effects of improvised explosive devices (IED) such as: shock waves, primary and secondary splinter/fragments, local fire.

To figure out this objective, we will focus on the following main targets: **(a)** to develop new composite materials "tailored cellular structure materials" (ceramic and polymeric) with a high added value, **(b)** to elaborate new methods and techniques for simulating and characterizing experimental composite materials (ceramic and polymers), therefore creating the premises for innovation, increasing the quality and competitiveness of the safety composite multilayer structures for blast mitigation; **(c)** to improve the scientific knowledge, competence and technological capacity in the field of advanced composite materials, in order to increase the competitiveness of the Romanian industry and bringing it close to the level of European Countries and NATO

[1] Scientific Research Center for CBRN Defense and Ecology, 225 Olteniței Sos., Sector 4, 041309 Bucharest, Romania, smsbadea@yahoo.com
[2] University POLITEHNICA of Bucharest, 313 Splaiul Independenței, Bucharest, Romania, evolceanov@yahoo.com

countries with Romania's sustainable involvement, within the economic, social and environment plan.

2. Originality of scientific approach

The conversion of a waste material (coal and lignite fly ash) in a secondary raw material and further to cellular light weight eco-ceramics capable of advanced absorption of the shock wave energy demonstrates the high level of originality of this project.

Energy production plays an important role in our society, and the supply of energy needs a great number of social and economic activities, determining the rate at which we proceed in the direction of sustainable development. However, this process uses large amounts of natural resources and generates measurable amounts of releases and wastes, affecting the health of humans and the natural environment in negative ways.

The reutilization of these wastes varies depending on the countries, from 100% in Netherlands to lower than 20% in other EU countries [1]. In Europe, a minor part of the produced fly-ashes have found applications in the cement industry as additives, as well as for concrete production replacing cement, in road construction, in the production of structural materials and as soil additives. Nevertheless, the major part of the produced fly-ashes (more than 60 wt.%) is directly land filled [2]. This represents a huge negative environmental impact including the leaching of potentially toxic substances into soils and groundwater, the changes in the elemental composition of vegetation growing close to the ashes, and the accumulation of toxic elements in the food chain [3].

3. Conclusions

There exists a very high technological challenge and strong economic, environmental and social motivation to develop methods of utilizing fly-ash from thermal power plants using coal, lignite for producing high added value products. Besides using this waste material in the cement industry, coal, lignite fly-ash can be used to produce novel, high added-value dense and porous glass-ceramic materials, as initially demonstrated by the partners involved in this project, with properties that can compete with similar industrial products. The study focused on the development of dense ceramics and glass-ceramic

products, and porous glasses and glass-ceramics, which ensure the development of appropriate technologies for the utilization of waste products.

Acknowledgement

This work was realized under the Program "Partnerships in priority areas – PNII", developed with the support of MEN - UEFISCDI, project no. 283/2014, *Modular composite structures for protection against complex effects of improvised explosive devices.*

References

[1] G. BELARDI, S. MASSIMILLA, L. PIGA – *Crystallization of K–L and K–W zeolites from fly-ash*, Resour. Conserv. Recycl., Vol. 24, pp. 167-181, 1998

[2] X. QUEROL, A. ALASTUEY, L.J. FERNADEZ-TURIEL, A. LOPEZ-SOLER – *Synthesis of zeolites by alkaline activation of ferro-aluminum fly-ash*, Fuel, Vol. 74, pp. 1226–1231, 1995

[3] C.L. CARLSSON, D.C. ADRIANO – *Environmental impacts of coal combustion residues*, J. Environ. Qual., Vol. 22, pp. 227–247, 1993