Plasma gasification of SPENT ion exchange resins and the ash conditioning in Geopolymer matrix

Y. ZABULONOV[1], B. ZLOBENKO[2]*, A. ROZKO[3], Y. FEDORENKO[4], A. PUHACH[5]
[1 2 3 4 5] *SI "Institute of Environmental Geochemistry" NAS of Ukraine, 34a Palladin Ave., 03142 Kiyv, Ukraine*

** Corresponding author email: borys.zl@gmail.com*

Pre-treatment of radioactive spent Ion Exchange Resins (IERs) to reduce the waste volume for disposal is one of the complex problems for nuclear industries, and this topic has been investigated in work package six of the PREDIS project. The “PULSAR” research group of the Institute has novel technology for the thermal treatment of radioactive solid organic waste. The pyrolysis of IERs is one of the most effective methods for reducing radioactive waste volume. We have applied the multiloop circulation gasifier principle in waste processing, resulting in more profound waste destruction. Furthermore, toxic volatiles after-gasifiers in the pyrolysis gas using a plasma torch and decompose entirely. The gasification process parameters were optimised to gradually convert volatile Cs species into inorganic and thermally stable compounds. Due to the strong dependence of carbon content in the ash on the temperature of IER waste gasification, one of the main goals was to minimise the carbon content of the ash.
Physical and chemical characterisation of ash aimed to investigate the application of a geopolymer binder and the problems associated with ash requirements. Interactions between the ash components and the geopolymer grout can affect the matrices' setting, hardening, and strength development. The obtained ash has been encapsulated in an alkali-activated geopolymer matrix with a loading factor of up to 24 wt.%. The obtained matrix samples demonstrated a compressive strength of more than 25 MPa with a porosity of about 0.5%. Due to such low porosity, the samples dry slowly, and cracking occurs when a water concentration gradient occurs. To prevent this, metakaolin was added to the mortar binders, increasing the porosity to 15% and reducing the compressive strength to 19.3 MPa, achieving preliminary compliance with waste acceptance criteria. A leaching test was done for chemical durability. This study demonstrated that novel technology gasification and conditioning ash in a geopolymer matrix would be beneficial for reducing the volume of Low and Intermediate Level Waste.

Acknowledgements: The PREDIS project has received funding from the Euratom research and training programme for 2019-2020 under grant agreement No 945098

031_abstract_final