Benassi Laura - Technology of sustainable inertization of waste material and by-products.

My PhD concerns the detailing and the development of the COSMOS RICE project (Colloidal Silica Medium, to Obtain Safe inert, from rice husk ash). In particular, the research topics involved in this project are waste materials and their possible reutilization.

The European economy is based on a high level of resources consumption, such as raw materials, energy and ground. About a third of the used resources become waste or emission into the environment. For this reason, nowadays the municipal solid waste (MSW) has become one of the major environmental concerns in many European countries, as well as in Italy, where landfill is practiced as the main waste treatment method. However, because of the high environmental impact of the landfill, Europe sets specific directives according to the waste delivery to landfills has to be greatly reduced. Thus, municipal solid waste incineration (MSWI) was inevitably indicated as an effective alternative to landfill for MSW treatment. It has the advantage of reducing MSW mass (about 70%) and volume (about 90%) in an efficient way and it also allows energy recovering [1]. Nevertheless, the disposal of residues generated from an incinerator is an environmental concern, mainly for their high heavy metal content and leachability, thus they need to be treated further to prevent secondary pollution. In the last years a method to inertize MSWI fly ash with a room temperature process has been developed at the University of Brescia. This process is based on the colloidal silica use in order to obtain a new material called COSMOS that can be used as base material for many applications. Thank to this process, chemical reaction occurs opportunely by mixing MSWI fly ash, previously mixed with Coal fly ash and flue-gas desulphurization (FGD) residue fly ash, with the commercial colloidal silica formulation [2]. However, colloidal silica is a commercial man-made material so it is the major cost of the COSMOS process. Starting from the promising results, the research activity demonstrated that the obtained inertized material shows very good properties and the effective possibility to promote its reuse [3]. In order to face the cost concern the commercial colloidal silica, another new project has been financed by European Commission: COSMOS-RICE. In the COSMOS-RICE project, rice husk ash is directly used thanks to its high content of amorphous silica, replacing colloidal silica [2].

During my PhD, I have worked on the project, studying possible alternative suitable waste ashes and raw materials to change a part in the fly ash mix used so far. I have also explored the effects of some pre-treatment on the rice husk ash, and their possible influence on the batches. Moreover, I am studying different variables involved in the process: the rice husk ash quantity used, the mixing temperature during the samples preparation and the rice husk geographic origin. In this way the growing field effect inspection (possible presence of heavy metals) would have been possible.

This project is included in the research area dedicated to the new materials for engineering and aims to identify possible new materials starting from primary and secondary recycling materials. In particular, industrial waste fly ashes and their leachable heavy metals content will be abated thanks to silica content present in some wastes, as the rice husk ash.

This topic is very interesting for the European Community, since the global warming regarding the lack of raw material in Europe. It tries to give an answer to the growing need of finding new material, also coming from recovering.

Reference:

[1]: R. Ardesi, E. Bontempi, L. E. Depero, A. Gianoncelli, A. Zacco, M. Uberti and G. Tomasoni, “Un nuovo processo di inertizzazione delle ceneri leggere dell'inceneritore”. Brescia Ricerche n. 71- anno XX, 2010.

[2]: Bosio, A., Zacco, A., Borgese, L., Rodella, N., Colombi, P., Benassi L., Depero L.E., Bontempi, E., 2014. A sustainable technology for Pb and Zn stabilization based on the use of only waste materials: A green chemistry approach to avoid chemicals and promote CO_2 sequestration. Chem. Eng. J. 253, 377–384.

[3]: http://cosmos-rice.csmt.eu/