BRITE SMELTERS PROJECT

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Valorisation of Pb-Zn Primary Smelters Slag

BRIEF DESCRIPTION:

Partners:

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Objectives:

This project aims to identify the most suitable applications for the features of the slags of primary fusion of lead and zinc. It aims to improve the metallurgic process through the production of a slag which cut particles, and the morphology is characterized by less inclination for leaching.

It's possible to create new and inert materials from the slags, which could be used to improve (for example) the features of the bricks quality products.

It includes:

Five phases which characterize the research: for example, the slags evaluation , in particular about heavy metals leaching, the comparison among the different leaching processes, the development of a leaching system, metallurgic optimization of slags , so that it could be possible to reach the lowest solubility of heavy metals, and then to test the slags, so that they could replace the raw materials.

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OBJECTIVES:

The objectives of this project are:

- ✓ To help all the EC actors -dealing with "metallurgic slag" - having a common approach and understanding to the problem. This is possible thanks to a large pre-normative work including a comparison of the existing standard testing procedures for heavy metals leaching.

- ✓ To understand in depth the phenomena involved in the leaching mechanism, in order to be able to improve the metallurgical process producing a slag that, because of its chemical composition, of its particle size and of its morphology will result only slightly leaching. This is possible developing a leaching model and optimizing the metallurgical process.

- ✓ To develop cost effective process and techniques in order to use the above mentioned non-ferrous slag into safe construction and civil engineering materials, to substitute partially or totally quarry raw materials. This should be possible improving the functional and structural characteristics of the final product and reducing the negative effects linked to their biodegradability.

- ✓ To develop, starting from slag, new and inert materials with high resistance and low density that could be used in to improve the brisk properties, in the insulation materials or concrete products, to replace expensive raw materials (es. expanded clay).

Lead and Zinc primary smelters produce and landfill every year about 1 Mt of slag with increasing costs.

Nearly all these producers, together with the final users, created a R&D consortium, which aim is to expand the use of slag in the civil engineering and building industries. Independent research Institutes joined the consortium, bringing their expertise on waste, end- product and leaching characterization and evaluation.

The main steps of the proposed research are:

- ✓ slag evaluation and characterization, focusing on heavy metal leaching;

- ✓ comparison among the different leaching procedures in use

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- ✓ Investigation on the leaching phenomena in order to develop a leaching standard model.
- ✓ metallurgical slag optimization to find the lowest heavy metals solubility, including optimal post - treatments to improve the particles size distribution, the apparent density and all the characteristics needed to use the slag instead of raw materials
- ✓ to test slag in all application fields where they could replace significant amount of raw materials: final products will be characterized and evaluated, leaching and durability will be examined.

The original approach of the proposers results from the wideness of their consortium, that assure a full covering for all the fields where the slag could replace significant amounts of quarry raw materials and underlines the importance of the environmental impact in the tested applications.

Successful completion should avoid the dumping of 1 Mt/y of slag in EC and save an equivalent amount of natural resources, while it should influence the increasing competitiveness of EC non-ferrous industry and improve functional, structural and degradation resistance characteristics to the construction materials.

STATE OF THE ART

Lead and Zinc concentrates that are melted in primary production plants are characterized by metal quantities of 40-60%, that means about 800 kg of slag per ton of produced metal.

Actually these slag vary in composition, depending on raw materials and metal production processes. Nowadays this slag is produced at high temperature (about 1.200°C), quenched and granulated with water into small particles similar to black sand.

Considering the chemical characteristics of the slag, the problem related to their use are very different from the ones caused by other kind of metallurgic slag, as the iron slag or the secondary non ferrous melting slag. The first ones are characterized by hydraulic properties and low amount of iron, and many uses have been developed for it. In the second ones the leaching of some toxic elements happens, so they must be disposed in controlled areas.

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However no specific research has been carried out for the use of slag from primary lead-zinc industry; vice versa the iron slag are commonly used as road base material, concrete aggregates and so on.

MAIN INNOVATIONS

The aim of this project is to find out suitable applications for the slag from primary lead-zinc industry. We have studied:

- ✓ the possibility to use the slag instead of the raw materials
- ✓ the control of the environmental impact both of the slag and of the products obtained using the slag.

The first point implies the study of the slag chemical and physical properties, following the actual normative for the obtained final products.

- ✓ The second point needs a detailed approach both for the slag leaching mechanisms and for the final products. This approach will take into account both short and long term leaching behavior.

RESULTS OBTAINED

On the basis of the results obtained with a mixture of slag, brick clay and expanding additives, we want on studying the influence of the ratio slag/binder on the chemical/physical characteristics of the lightweight aggregate obtainable.

Because of the initial working programmers, the activities of our company were reduced to the study of two Italian slag typologies and to the individuation of the thermal standard cycle for each binder mixture tested.

The thermal cycle results easily reproducible with traditional industrial plants and the produced granules are suitable or the rotating oven cooking because the range between the melting point (required for the granule expansion) and fusion point is quite wide (about 50°C).

Even the obtained densities are surely interesting and the mechanical resistance of the grains, even if not directly measured because of the scarce quantity, is

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comparable to the mechanical resistance of the expanded clay of the same density.

So, if the leaching tests give good results, the material will be used for the production of new kind of aggregates alternative to expanded clay.

The innovation of these aggregates consists in the scarce water absorption, thanks to the completely ceramized surface.

Unfortunately the interruption of the experimentation phase doesn't allow to have definitive and complete information regarding the project feasibility, but anyway the technological tests gave very satisfactory results.

MARKET PERSPECTIVES

Considering the tonnage involves, the incidence of the slag input is negligible compared to the aggregate market (below 0,1%) and should have no effect on the financial equilibrium of the mines and quarry business.

Because of the high cost of transports, compared to the quality of the aggregates as raw material, only the local market, closer to the smelters plans, should be considered.

Most of them are located in industrial areas: Benelux, Germany, north of France, where the raw material are scarce and the need of aggregates is high.

In some special cases we shall consider the need to upgrade slag in order to produce high quality materials , as the expanded aggregates.

These products have a higher value (up to 300 ECU/ton for expanded perlite) and can be transported to the production area and in some cases can be exported.

They will be in competition with the expanded perlite, expanded clay and exfoliated vermiculite: the expended clay production is about 3 Mton/year, of which more than 2 M ton are worked in Northern Europe.

Vermiculite bulk production if 0.6 M t/year. The European production of perlite is negligible and some quantities come from Greece and Italy (700.000 t).

Perlite is mainly imported from China and Russia while vermiculite comes mainly from South Africa.

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