NETWORK PROGRESS PROJECT

CONTENTO TRADE SRL

Technological innovation for the environment

BET 2 - 0553
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New products from glassy combustion residues

BRIEF DESCRIPTION:

Partners:

KEMA NEDERLAND, The Netherlands
Technische Universiteit Delft (TU), The Netherlands
ABO Academy University (FINABO), Finland
Protection des Metaux (PM), France
Contento Trade, Italy
Università degli Studi di Messina (UMESS), Italy
CRE Group Ltd, United Kingdom
Mitsui Babcock Energy Ltd. (MBEL), United Kingdom
University of Hertfordshire (UHERTS), United Kingdom
University of Limerick (UL), United Kingdom
University College Cork (UCC), Ireland
Universidad De Cantabria (UC), Spain
Consejo Superior De Investigaciones Cientificas (CSIC), Spain
Asociacion de Investigation y Cooperacion Industrial de Andalucia (AICIA), Spain
Technical University of Crete (TUC), Greece
Hebrew University of Jerusalem (HUI), Israel

Objectives:

The aim of the research in NETWORK PROGRES field is linked to the development of methods for vitreous waste of combustion (which are considered harmful to the environment), so that it could be possible to obtain environmental compatible and of high worth products; they could be used for environmental protection. In addition, the research aims to the separation and/or the extraction of components from vitreous residues of combustion, elements harmful to the environment, and the transformation of vitreous residues of combustion into mineral phases, useful and permanent, for example zeolites.

It includes:

A particular care for the development of innovative products, based on techniques of separation, extraction and their combination to produce high worth materials. The attempt to promote the collaboration among research projects, to pass on the knowledge to industrial field, to update the knowledge, to fill gaps, to formulate new research projects: so, the project aims to the total reutilization.

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OBJECTIVES:

Electric power generation plants and municipal (and industrial) waste incinerator plants (MWI) are the main products of glassy combustion residues. The EU production of coal residues amounts to about 60 Mt/year and is still growing. Their disposal cost are increasing because of the problems linked to the sustainable disposal site managing and maintenance. Regulation concerning waste disposal are changing rapidly and differ from country to country. Moreover European regulations are in preparation. These measures will result in an increase in the operating costs for the affected industries. Therefore it would be of prime benefit to the industry if new application fields for glassy combustion residues could be developed and standardized.

Glassy combustion residues contain more than 70% aluminum silicate glass, which makes them a suitable raw material for the manufacturing of inert and functional fillers, absorbents, immobilizers and high value construction materials.

The overall objective of the research assembled under the PROGRES network will be to develop the utilization of glassy combustion residues, which are considered as potentially threatening the environment, for the manufacturing of environmentally sound and economically high value products, of which part can be used to protect the environment.

Research in this field aims to:

- ✓ separation and/or extraction of valuable components from glassy combustion residues
- ✓ separation and/or extraction of environmentally and technically problematic components that hamper the further development of reutilization of these residues
- ✓ conversion of glassy combustion residues into sable and useful mineral phase, e.g. zeolites.

A market study carried out by KEMA in the Netherlands, extrapolated on European level, showed that the economic benefit would be of 200-300 Mecu/year in the European Community. Conversion processes such as the conversion of coal fly ash into zeolites are in principal known, but still gaps exist regarding the improvement of conversion rates, the scaling up to industrial scale and on the improvements of the technical and environmental quality of the products. For this reason, research from different disciplines is brought together in the network to ensure the quickest and most appropriate way of knowledge

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transfer. From the expertise of KEMA and MBEL it become clear that the trend of increasing co-combustion of other residues and biomass in coal-fired power station is among others limited by the impact on the solid combustion residues. New ways of treating those residues or converting them into new products will allow power plant to operate more flexible and increase co-combustion rates.

STATE OF THE ART

Many aspects pf glassy combustion residues have been studied for different purposes: improvement of the combustion process, impact on the environment and properties with reference of their application. Thus, the back ground knowledge has been accumulated in a number of fields:

- ✓ characterization of the glassy residues:
  chemical properties and physical properties of coal combustion residues are well documented and variations depend mainly on the type of coal burned and the combustion technique used. Because of the precipitation of initially volatized elements on the surface of the solidified ash particles, the structure of fly ash consists normally of an exterior reactive shell on the main Si-Al interior glass matrix. This shell contains the majority of the environmental-threatening elements, such as Se, As, Mo, Zn, Sb, V, Cr and S. The MWI residues are much more inhomogeneous and to a lesser degree vitrified compared to the coal residues. This is caused by the variation in composition of the material burned and the relatively low combustion temperature (±850°C).

- ✓ leachability and environmental quality of glassy residues:
  standardized leaching and diffusion tests determine the environmental quality of these residues in granular and bulk form. Following Following the norms, critical elements for the utilization of glassy combustion residues are:

  - coal residues : Mo, Se, Sb, V, Ba
  - MWI residues: Mo, Cu, Pb, Sb, Cd, Se, Zn, S, Cl

- ✓ traditional products and application:
  traditionally, glassy combustion residues are applied in various building materials and civil engineering construction. This application can roughly be divided into "bound" and "bulk" use. In bound form the glassy residue is embedded in a matrix of different material and interaction between the glassy residue and the environment is thus reduced (partially immobilized

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residue). In bulk form the glassy residue is integrally applied for filling and construction. A number of these application have been investigated worldwide, and some have been well established and belong to common practices.

✓ new products and application:
a number of techniques adopted from different disciplines have been and are still being investigated in order to either improve the environmental quality of glassy residues or to make higher quality products out of glassy residues. The most important are:

- Grinding and milling techniques, consisting of micronization of fly ash into an ultra fine product.
- Separation techniques, such as magnetic, electrostatic and flotation methods, which have been successfully used to remove certain particles from coal residues.
- Extraction techniques, consisting of forced leaching, with and without addition of reagents in order to remove the leachable elements and improve quality.
- Conversion of glassy residues into useful minerals, for example conversion of fly ashes into zeolites by means of an alkaline environment.
- Immobilization and vitrification techniques used to fix mobile elements and thus improve the environmental quality of glassy combustion residues.
- Recovery of metals; some metals can be recovered from fly ash, for example Al, Fe, Si, V, Ge, Ga, Ni.

✓ activities outside the EU:
remarkable researches in the field of application of glassy combustion residues have been carried on in Japan (construction, vitrification, conversion into zeolites, materials recovery), USA (metals recovery, industrial fillers, absorbents, waste stabilization), China (recovery of Al, zeolitizzation), Sud Africa (fillers, waste stabilization, separation).

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MAIN INNOVATIONS

The project aims particularly at the development of novel products through separation, extraction and conversion techniques or Combination thereof, with the clear goal of producing high value materials.

The innovative actions of the research network will consist basically of:

- ✓ optimizing cooperation and collaboration between separate research projects within this broad field;
- ✓ transferring knowledge to the industry, promoting scaling-up and pilot testing of proposed processes;
- ✓ continual assessment of the professional knowledge and new products monitoring;
- ✓ identify gaps and overlaps in research activities;
- ✓ formulate new research projects whenever appropriate.

It's intended to stimulate research into the direction of the idea of the "total recovery concept", which avoids advocates maximum recovery of all valuable components of raw materials. This contributes to the conservation of natural resources and minimizes waste generation.

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