EUROPEAN CONCERTED ACTION
ON

"Sustainable Materials Technologies"

COST 530

Expression of Interest

Title of the project:	Rice husk ash and other eco-efficient materials for concrete
Name of proposer:	Prof. Joana Sousa Coutinho
Address:	FEUP-Faculdade de Engenharia, Universidade do Porto; Rua Dr. Roberto Frias, 4200-465 Porto - PORTUGAL
Telephone:	351 22 508 1936
Fax:	351 22 508 1446
E-mail address:	jcouti@fe.up.pt

Outline of activity to be undertaken

Concrete structures are generally designed for a service life of 50 years, but experience shows that in urban and coastal environments many structures begin to deteriorate in 20 to 30 years or even less time. The lack of durable materials has serious environmental consequences. Increasing the service life of products is a long-term and easy solution for preserving the earth's natural resources.

The world's yearly cement production of 1.6 billion tons accounts for about 7% of the global loading of carbon dioxide into the atmosphere. Portland cement, the principal hydraulic cement in use today, is not only one of the most energy-intensive materials of construction but also is responsible for a large amount of greenhouse gases. Producing a ton of portland cement requires about 4 GJ energy, and portland cement clinker manufacture releases approximately 1 ton of carbon dioxide into the atmosphere. Ordinary concrete typically contains about 12% cement and 80% aggregate by mass.

During the 21st century the increasing demand for cement and concrete must be met by the use of ***mineral cement replacement materials*** (MCRM). Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy/intensive Portland cement.

According to a paper by Davidovits, the cement production rate of the world, is expected to grow exponentially to about 3.5 billion tons/year by 2015. According to a projection by Mehta most of the increase in cement demand will be met by the use of MCRM. Davidovits suggests that this approach is necessary to prevent the possible ecological disaster from global warming. The presence of MCRM in concrete is known to impart significant improvements in workability and durability and high performance concretes with good workability and high durability can be made by a judicious choice of MCRM and concrete mix proportions. Such materials include silica fume, rice husk ash, metakaolin, superfine fly ash and superfine slag. Some of these materials can be

obtained from by-products. The use of by-products is an environmental-friendly method of disposal of large quantities of materials that would otherwise pollute land, water and air.

Rice husk constitutes about one fifth of 300 million tons of rice produced annually in the world. Rice is produced in the southern countries of the EU and the husk is generally considered an agricultural waste. By burning the rice husks under a controlled temperature and atmosphere, a highly reactive rice husk ash (RHA) is obtained which can be used as a MCRM (In a research programme carried out at FEUP, RHA concrete perfomed better that silica fume concrete).

Highly reactive metakaolin is manufactured from adequate kinds of clay.

Other materials should be investigated, including other low-cost or waste materials to be used as CRMC and thus contribute to decreasing cement use and to enhance durability of concrete structures.

The objectives of the project are the following:

- Optimize the RHA (metakaolin and other CRMC materials) incineration method.

- Ascertain properties of concrete made with different percentages of cement replacement by RHA (metakaolin and other CRMC materials) of the same origin and incinerated in the same way (firing length and temperature).

- Investigate other potential CRMC materials such as diatomateous earth, olive oil waste, wood chip ash, etc., which could replace cement in concrete.

Resources available in institution of proposer

The proposer belongs to the Faculdade de Engenharia, Universidade do Porto. This University is well equipped with different laboratories to carry out all aspects concerning physical properties of cementitious materials strength, porosity, permeability fineness, etc., chemical properties such as chemical composition, insoluble residue, etc., durability aspects such as carbonation, chloride penetration resistance etc. and also properties related to microstructure (MIP, SEM, etc).

Any other relevant information:

The proposer is currently involved in a national funded project (FCT) concerning rice husk ash and metakaolin, together with another Portuguese University (UM).

The proposer has published results on research on RHA and metakaolin (and unpublished results on diatomaceous earth):

J. Sampaio, J.S. Coutinho, M.N. Sampaio, “Melhoria do desempenho de betões pelo metacaulino”, IBRACON, 43º congresso brasileiro do Concreto, (CD-Rom), p. 244 – abstract, Foz do Iguaçu, Brasil, 18-23, August 2001

J. Sampaio, J.S. Coutinho, M.N. Sampaio, "Portuguese rice husk ash as a partial cement replacement". Proceeding of the International Conference: Sustainable Construction into the next Millennium: Environmentally friendly and innovative cement based materials, Ed. N.P. Barbosa, R.N. Swamy and C. Lynsdale, pp. 125-137, João Pessoa, Brasil, 2-5 Nov. 2000.

Joana Sousa Coutinho, “Two level method to improve durability of concrete structures: CPF and RHA” – Revised and accepted for publication “Cement and Concrete Composites” Ed. R.N. Swamy and A.E. Naaman, Elsevier, 2002?