Waste Materials Used in Concrete Manufacturing

Satish Chandra

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WASTE MATERIALS USED IN CONCRETE MANUFACTURING

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To My Beloved Parents

Preface

One of the most critical problems we face today is acid rain. One of the main causes is the burning of fossil fuels and, as a result, sulfuric acid and carbon dioxide are added to the atmosphere. These pollutant gases have detrimental effect on building materials. Thus there are two problems: 1) to decrease the gas emission, and 2) to produce construction material which is more durable to aggressive pollutant gases and acid rain.

The environmental aspects involved in the production and use of cement, concrete and other building materials are of growing importance. CO_2 emission, for example, is 0.8–1.3 ton per ton of cement production in dry process. SO_2 emission is also very high, depending upon the type of fuel used. Energy consumption is also very high at 100–150 kWT/ton of cement produced. It is costly to erect new cement plants. It costs approximately $230 US per ton of installed capacity in Europe and $230 US in developing countries. Substitution of waste materials will conserve dwindling resources and will avoid the environmental and ecological damages caused by quarrying and exploitation of the raw materials for making cement. To some extent, it will help to solve the problem otherwise encountered in disposing of the wastes. Partial replacement of clinker or Portland cement by slag, fly ash, silica fume, and natural rock minerals illustrates these aspects. Partial replacement by natural materials that require little or no processing, such as pozzolans, calcined clays, etc., saves energy and decreases emission of gases. The annual

production of Portland cement is more than 1000 M tons, while the output of waste materials suitable as cement replacement (slags, fly ashes, silica fumes, rice husk ash, etc.) is more than double this amount.

These waste materials can partly be used, or processed, to produce materials suitable as aggregates or fillers in concrete. These can also be used as clinker raw materials or processed into cementing systems. New grinding and mixing technology will make the use of these secondary materials simpler. Developments in chemical admixtures (superplasticizers, air-entraining agents, etc.) help in controlling production techniques and in achieving the desired properties in concrete.

The use of waste products is not only a partial solution to environmental and ecological problems. It significantly improves the microstructure, and consequently the durability properties of concrete, which are difficult to achieve by the use of pure Portland cement. The aim is not only to make the cements and concrete less expensive, but to provide a blend of tailored properties of waste materials and Portland cements suitable for a specified purpose. This however requires a better understanding of chemistry and materials science.

There is also an increasing demand for better understanding of material properties, as well as better control of the microstructure developing in the construction material, to increase durability. The combination of different binders and modifiers to produce cheaper and more durable building materials will be a factor in solving the ecological and environmental problems.

Göteborg, Sweden
January, 1997

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He is a member of ACI Committees 547 and 548; RILEM Committees TC 105 and 113; a Life member of the Indian Concrete Institute; a Member of the Swedish Chemical Society and Swedish Silicate Society. He has also organized and chaired numerous meetings and seminars in the Cement and Concrete area. Dr. Chandra has contributed to three books and has published sixty-five technical papers in journals of international repute.

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