Eco-friendly Concrete

Why do you think historians divided the saga of human development down the ages into 'the stone age', 'the bronze age', 'the iron age', etc.? It was named after the material or the metal that played the most dominating role in man's life during the period. Following the pattern, the modern era is the 'concrete age'.

The world population consumes concrete at the rate of 12,000 million tonnes a year. We do not consume any other material in such tremendous quantities, next to water. The production of one tonne of cement, used in the production of concrete, consumes about 1.5 tonnes of limestone and releases one tonne of carbondioxide (CO_2) into the atmosphere. The CO_2 released by cement industries contributes about seven per cent of the total CO_2 released worldwide through various processes.
Even after 183 years of the advent of the traditional Ordinary Portland Cement (OPC), no alternative cement has been found. Hence, the best way to reduce the emission of CO_2 by the cement industry is sustainability in concrete construction.

Sustainable Eco Concrete

For sustainable development, concrete shall be eco-friendly and durable. It will also eventually reduce the frequency and postponement of natural disasters. 'Sustainability' has been defined from various perspectives but the definition by Dr. Gro Harlem Brundtland, Director General, WHO, is the most accepted, "the ability of humanity to ensure that it meets the needs of the present generation without compromising the ability of the future generations to meet their own needs". Sustainability also means converting waste into resource of energy. 'Eco-friendly' materials are those that do not pose, create or produce environmental problems. Eco-friendly concrete is one which does not produce environmental problems, i.e. use of less OPC, fewer natural resources, less energy, less calcinations and minimal CO_2 emissions through the use of supplementary or complementary cementing material.

To achieve durability and sustainability, the basic requirements are :
* very low porosity through the development of a tight and
  refined pore structure
* low heat of hydration
* high resistance to chemical attack
* high early strength and continued strength development
*low water/binder ratio
* high workability and control of slump loss
*low bleeding and plastic shrinkage.

With the advent of super plasticisers, achieving high workability with low water/binder ratio has become easy. The use of high volume flyash facilitates achieving low heat of hydration. The use of mineral admixtures like flyash, silica fume, blast furnace slag, reduce bleeding and plastic shrinkage. Hence, these requirements that seem to be exorbitant can be met with.

To make concrete eco-friendly, all the by-products should be conveniently and effectively used for its manufacture. More importantly, the structures should be designed to have multifold life cycle spans. It is only the optimum utilisation of the available technology by the present generation that can bequeath a rich legacy to the coming generations.

The chief binding material in major quantities of the world's concrete is the OPC. About 1.5 tonnes of limestone is required for the production of one tonne of OPC. The limestone deposits in India are estimated at 1,69,941 million tonnes of which 21,861 million tonnes are proven deposits. The total production of cement in India is about 136 million tonnes a year. If the limestone is used in the same quantities and proportions for the manufacture of cement in India, the total lime deposits will be exhausted by the next hundred years.

To increase the resource efficiency of the concrete industry by a factor 10, most of the concrete structures being built today ought to be designed for a service life of 500 years instead of the conventional 50 years.

Source : Environment Pollution Control Journal (Nov.-Dec. 2007), 'Eco-friendly and Durable Concrete for Sustainable Development' by Narayana, Kumara Swamy and Abaiab