

IN CEMENT, FLY ASH EMERGES AS A CURE TO LIMIT GREENHOUSE GASES
Engineering News-Record December 21, 1998

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Engineering News-Record

December 21, 1998

SECTION: NEWS SITE; Vol. 241, No. 23; Pg. 13

LENGTH: 496 words

HEADLINE: IN CEMENT, FLY ASH EMERGES AS A CURE TO LIMIT GREENHOUSE GASES

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BODY:

GLOBAL WARMING EXPERTS BLAME THE production of portland cement for 7% of humanity's emissions of carbon dioxide. Leading concrete experts agree the industry ought to use less cement and more partial substitutes such as fly ash.

At recent forums, experts complained that each ton of cement contributes to the emission of about one ton of CO₂. Half results from the calcination of limestone, a major raw material of cement, and the rest from the intense use of fossil fuels in cement clinker production.

Global emissions of CO₂ totalled 21.6 billion tons in 1995, according to the International Energy Authority. Cement production contributed about 1.4 billion tons, or nearly 7% of CO₂, figures V.M. Malhotra, program manager of the Advanced Concrete Technology Program at Ottawa-based Natural Resources Canada, which co-sponsored a symposium on the topic in October.

"In concrete-mix design, it's here we can do something about global warming," adds P. Kumar Mehta, a professor emeritus of civil engineering at the University of California at Berkeley, who spoke on the topic at a Dec. 8 forum in San Francisco. And, he says, excellent strength and durability can be achieved by using up to 60% fly ash along with a superplasticizer.

When mixed with water and aggregate, cement reacts to form an excellent binder -- calcium silicate hydrate, relatively insoluble in water. But the reaction also produces calcium hydroxide with a coarse crystalline structure prone to microcracking. Use of fly ash can result in less calcium hydroxide, thereby enhancing durability, experts say.

GLASS BALLS. Fly ash is derived from heated impurities in coal and is lighter in color than cement. It consists of glass spheres just microns in diameter that effectively block

water. Whether due to the ball-bearing shape or inherent electrical charge, fly ash can act as a dispersant, improving workability. Its use also can provide higher ultimate concrete strengths, less permeability, improved resistance to sulfates and seawater, better protection for reinforcing steel, improved pumpability, reduced heat of hydration, lower water/cement ratios and reduced costs. But it may slow down concrete's initial strength gain, so typical construction specifications permit substituting fly ash for just 15% of the cement in a concrete mix. Some experts call for using much more.

"The net benefits outweigh the potential disadvantages," says F. Macgregor Miller, senior principal process scientist at Construction Technologies Laboratory Inc., Skokie, Ill. He recommends using up to 40% of the more limey fly ash, although concrete made with fly ash might lag in strength gain the first week. After 28 days, it typically surpasses conventional concrete in strength, he says.

Often cheaper than cement, fly ash has been used for decades. But today, just 10% of the nation's 60 million tons annually goes into producing concrete. Environmental concerns may increase that soon.

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