BACKGROUND MEMO

Approved by the ACI Board of Direction on July 20, 2010

DISCLAIMER

ACI does not express a position on if or how EPA should regulate coal fly ash. Rather, ACI encourages its members and those who use (or may use) coal fly ash to consider the information provided by ACI to develop their own informed opinions on the likely effects of the EPA's alternate proposals.

PREFACE

About the American Concrete Institute:

Founded in 1904 and headquartered in Farmington Hills, Michigan, USA, members of the American Concrete Institute, domestic and foreign, advance concrete knowledge worldwide by producing consensus, concrete-related codes, specifications, guides, and reports; creating and administering certification programs that support individuals in the concrete industry; delivering seminars and distance learning opportunities; publishing *Concrete International* magazine; and producing two peer-reviewed technical journals.

BACKGROUND

Concrete is an essential component of the national and international infrastructure. It is used for buildings, bridges, homes, schools, universities, hospitals, factories, arenas, airports, roads, streets, railroad ties, dams, power plants, foundations for wind turbines and communications towers, water supply and water- and waste-treatment facilities. Concrete is made by blending sand with crushed stone or gravel and binding them together in a paste made with water and the manufactured powder known as portland cement. In recent years, the cement and concrete industries have been effective in reducing both the energy required and the CO_2 released in the production of portland cement. Much of this effort has been spurred by the Kyoto protocols that called for a reduction in greenhouse gases including CO_2, and President Obama's pledge to reduce CO_2 emissions 17% by 2020. Other industrialized nations are looking for U.S. leadership in this effort.

One of the most powerful strategies for reducing the embodied energy and CO_2 footprint of cement and concrete is the substitution of coal fly ash (also referred to as fly ash, coal combustion residuals, and/or coal combustion products) for a significant portion of the portland cement; and the concrete industry has taken advantage of this option for over 50 years. In addition to increasing the sustainability of cement and concrete construction, the resulting concrete has improved properties leading to a more durable, longer-lasting infrastructure. For these reasons coal fly ash is incorporated in a large portion of the concrete produced in the U.S. today, thereby converting an industrial waste product into a valuable resource. According to data from the American Coal Ash Association, 15 million tons of coal fly ash otherwise destined for landfills were incorporated in concrete in 2006, preventing an approximately equivalent amount of CO_2 emissions.

PART I: Short-Form Message

Infrastructure is vital to our country's economy and well-being

- Our national economy, our international competitiveness, and our security depend on a reliable infrastructure that includes transportation systems, public and private buildings, and a complex network of utilities.
- Our health and quality of life depend on safe, clean water; clean air; reliable energy; the ability to safely transport goods, services, and people; and to house, educate, and care for our population.

Concrete is vital to the infrastructure

- It is the world's most widely used building material.
- It can be cast or formed to any shape and utilizes local materials.
- It can be formulated and installed for a long service life.

Coal fly ash contributes significantly to a more sustainable, environmentally responsible infrastructure because its use in concrete can

- reduce concrete's embodied energy and CO_2 footprint;
- lower coal fly ash landfill volumes;
- increase the service life of concrete;
- tie-up trace metals in ash;
- enable the use of local marginal quality sand, crushed stone, and gravel and thus reduce the need to open new quarries and pits; and
- reduce the need and cost for repairs and maintenance.

Coal fly ash is a valuable concrete constituent because it can

- be an effective ingredient in high-strength and high-performance concrete;
- reduce the porosity and penetrability of hardened concrete;
- be an effective ingredient in minimizing corrosion of reinforcing steel;
- be an effective ingredient in resisting severe environmental exposures;
- reduce the heat produced by chemical reaction of the cement; this is critical in dams, bridge piers, and large foundations;
- increase construction quality by making a more compactable concrete;
- lower concrete's initial and life-cycle cost; and
- reduce the need to import cement.

There are no viable replacements for coal fly ash in concrete if its availability is reduced for any reason.

Coal fly ash used by the concrete industry is specified to meet the requirements of ASTM C618 and AASHTO M295 and, therefore, is well understood. The use of coal fly ash is recognized as an option for improving concrete durability in ACI's reference Code and Specification, and coal fly ash is discussed in over 100 of ACI's technical documents.

PART II: Additional Details

1. Coal fly ash is a waste by-product of power plants, but it has many beneficial uses when produced to meet the chemical and physical specification requirements of ASTM C618 and AASHTO M295.

2. The incorporation of coal fly ash can enhance the ability to place, consolidate, and finish fresh concrete; to control the temperature and cracking tendency of recently cast concrete; and to reduce the porosity and penetrability of hardened concrete. These factors result in increased durability that promotes a longer service life and increased sustainability for national infrastructure.

3. Because water and dissolved salt penetrate the pores of hardened concrete more slowly when coal fly ash has been incorporated, the use of coal fly ash in concrete minimizes corrosion of reinforcing steel, which is the primary cause of infrastructure deterioration. It further improves the performance of concrete in a wide range of severe physical and chemical exposure conditions.

4. Incorporation of coal fly ash is one of the most effective methods for making use of marginal, reactive aggregates (certain types of sand, crushed stone, and gravel that can react adversely with the cement). If coal fly ash were not available for this application, some aggregate quarries would have to be closed and new quarries exploited, with consequential environmental effects.

5. When coal fly ash is used to reduce the amount of portland cement required in concrete, that reduction in cement is accompanied by a proportional reduction in both the energy required and CO_2 released to produce the concrete. For every ton of portland cement replaced, approximately one ton of CO_2 release is prevented.

6. The chemical constituents of coal fly ash incorporated in concrete are markedly less mobile and less exposed to the environment than when that same ash is stockpiled in a landfill.

7. Coal fly ash in concrete is not occupying space in a landfill.

8. The use of coal fly ash in concrete almost always reduces the material cost of the concrete.

9. Among the supplementary cementitious materials used in concrete, coal fly ash is used in the greatest quantity by far. If coal fly ash use in concrete decreases, there are no viable alternatives in sufficient volume to meet the demand for concrete with all the benefits previously described.

10. ACI is concerned that the beneficial use of coal fly ash in concrete may be threatened by regulations, or the unintended collateral effects of those regulations, that may associate coal fly ash with a “hazardous” material. Reduced beneficial use may result when consumers fail to distinguish coal ash to be impounded from coal ash for beneficial use.

CONCLUSION

The American Concrete Institute is pleased to have worked with governmental agencies and industrial practitioners for over 100 years to develop building codes, specifications, standards, and guides that protect human safety and guide the design and construction of concrete infrastructure in the U.S. and around the world. Examples include ACI 318, "Building Code Requirements for Structural Concrete and Commentary;" ACI 301, "Specification for Structural Concrete;" ACI 232.2, "Use of Fly Ash in Concrete;" and ACI 229, "Controlled Low-Strength Materials." The ACI Board of Direction, members, and staff are prepared to assist decision makers in selecting the best choices for the effective and responsible use and disposition of coal fly ash.

As a resource to the concrete industry and general public, the American Concrete Institute has populated its Web site, www.flyash.concrete.org, with ACI resources, ACI technical documents, and EPA links regarding the proposed regulation of coal fly ash and other coal combustion residuals.