CALCIUM CARBONATE

HuberCrete® Calcium Carbonate as a Partial Replacement for Fly Ash in Concrete

Fly ash is a coal combustion product (CCP) produced in electricity-generating power plants and is typically sourced from "base-loaded" units, i.e., those plants that run continuously and, thereby, generate a consistent and uniform CCP. Fly ash generated during plant start ups and shut downs is inconsistent and not suitable for the production of concrete.

A warm winter coupled with general low economic activity has resulted in less electrical demand. With the ample and extremely inexpensive cost of natural gas as a result of shale gas fracking efforts, utilities have elected to run their natural gas units more and their coal units less and more sporadically. The result is less production of acceptable grades of fly ash for concrete producers.

Other materials can replace fly ash in concrete. The most notable material is blast furnace slag. It is cementitious and pozzolanic, thus, an excellent replacement for fly ash. It suffers from a somewhat limited supply situation also, and usually at an increased cost.

Powdered limestone (HuberCrete® calcium carbonate) has been previously examined as a potential partial replacement for cement. Finely ground limestone with a controlled particle size gives acceptable properties for replacement of up to 20% cement. In addition, it gives higher green strength, reduced permeability, and improved workability. However, powdered limestone is not a pozzolan and reduces compressive strength at higher loadings.

Recently, a number of researchers have investigated the use of powdered limestone as a partial replacement of fly ash due to shortages that have cropped up around the world. Such studies have shown an interesting aspect in that the benefits of both materials are utilized while minimizing the downsides.

A joint study conducted by researchers at the National Institute of Standards and Technology, the National Research Council of Canada and Purdue University focused on adding fine limestone powder to a high fly ash content concrete. The problems with high fly ash concrete include poor green strength, excessive retardation of the hydration reactions, delayed setting times and low strength. The work postulates that extending the mix with fine limestone powder could be a viable solution to these issues, particularly the hydration retardation and setting issues. They drew a conclusion *"the particle sizes of the limestone powders are a key variable influencing their performance as accelerators of reaction and setting; while a nano-limestone is highly efficient in this regard, the 4.4 µm limestone is also effective when used as a 10% volumetric replacement for the fly ash in a blended cement."*[1]

A study conducted by the SINTEF Building and Infrastructure, the Norwegian University of Science and Technology Department of Structural Engineering, and Norcem AS, Heidelberg Cement Group of Norway looked at “Synergy between fly ash and limestone powder in ternary cements.” They concluded the following: “*Limestone powder interacts with the Afm and Aft hydration phases, leading to the formations of carboaluminates at the expense of monosulphate and thereby stabilizing the ettringite. The additional aluminates brought into the system by fly ash during its pozzolanic reaction amplify the effect of limestone powder. The key observation in this study is the confirmation of the synergistic interaction between limestone powder and fly ash and its persistence over time.”*[2]

A third study conducted by the Beijing University of Civil Engineering and Architecture also looked at the synergistic effects of fly ash and limestone powder. Its study indicated that limestone powder is not inert, but can accelerate the hardening process. The ultrafine limestone powder can act as nucleation sites to result in a high probability of dissolved C-S-H encountering and precipitating on solid particles. They concluded *“the fluidity of fresh concrete increases and loss of slump decreases with the ratio of ultrafine limestone powder to fly ash increasing. Also, when the ratio of limestone powder to fly ash increases from 5:5 to 9:1, the W/B (W/C) decreases slightly and the slump of the concrete is stable and the compressive strength of the concrete remains basically unchanged.”*[3]

In summary, due to both environmental and economic reasons, the availability of fly ash suitable for concrete is restricted. This has led to research into the options to extend the fly ash supply in concrete through the use of ultrafine limestone powders. The research has shown the substitution of ultrafine limestone powders for a portion of the fly ash can result in a synergistic effect on properties that will benefit both the concrete producer as well as the end user.

Huber Engineered Materials developed HuberCrete® calcium carbonate specifically as a material for use in situations such as a partial or full replacement for fly ash in concrete. HuberCrete offers a controlled and consistent particle size and color, essential elements for reliable and superior blends in concrete operations. Best of all, the high-performing product is backed by unparalleled technical support and customer service. HuberCrete is produced in fine and ultrafine limestone powders at its strategically-located manufacturing facilities in Marble Falls, Texas; Marble Hill, Georgia; and Quincy, Illinois.

For more information about HuberCrete or to order a sample:

Phone: 866-JMHUBER (866-564-8237)

Click: www.hubermaterials.com

Email: hubermaterials@huber.com

[1]Bentz DP, Taijro S, de la Varga I, Weiss WJ. Fine limestone additions to regulate setting in high volume fly ash mixtures. Cement & Concrete Composites 2012; 34:11-17. [2]De Weerdt K, Kjellsen KO, Sellevold E, Justnes H. Synergy between fly ash and limestone powder in ternary cements. Cement & Concrete Composites 2011; 33:30-38. [3]Wang L, Song S, Yang L. Effects of Ultrafine Limestone Powder (LP) and Fly Ash Complex Adding on the Workability and Strength of Concrete. Advanced Materials Research 2010; v152-153:295-300.