Attributes and Benefits of Using High-LOI Fly Ash in Cement Manufacture –-

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Summary

CEMEX is the second largest distributor of cement, and one of the largest ready mix producers in the United States. The network includes 12 cement plants with an installed capacity of over 12 million tons per year, and more than 90 ready-mix concrete plants. Each cement plant is located near a limestone quarry that provides over 85% of the raw materials. The remaining materials consist of clay, bauxite, silica, and iron ore. Each year CEMEX substitutes approximate 500,000 tons of its raw materials with fly ash from the utility industry. The fly ash used to substitute raw materials contains unburnt carbon that varies between 3-20%. This presentation will discuss the benefits and attributes of using such fly ash containing unburnt carbon in our cement manufacturing facilities. A brief list of the location of CEMEX USA plants follows:

Louisville, KY	Brooksville, FL	Victorville, CA
Odessa, TX	Clinchfield, GA	Lyons, CO
Balcones, TX	Demopolis, AL	Wampum, PA
Charlevoix, MI	Knoxville, TN	Fairborn, OH

The primary driver of substituting fly ash as a raw material is readily available when looking at the chemical analysis of the needed raw materials. The most obvious is the presence of silica, alumina, and iron in fly ash. This enables fly ash to be directly substituted for higher cost traditional raw materials such as shale, clay, sand, and iron ore. This brief table shows the difference in a mix design with and without fly ash that will save on clay costs.

	RAW MATL PROPORTIONS:	
	% in mix	% in mix
Limestone	83.40	83.19
Clay	0.00	12.39
Sand	6.74	0.00
Fly ash	6.71	0.00
Coal Ash	**3.15**	**3.15**
Total	**100.00**	**98.73**

The process of producing cement clinker is extremely energy demanding with temperatures approaching 3000 ^{o}F. This enables the use of high LOI fly ash as the extreme temperatures for manufacturing can readily handle any remaining carbon.

This does not imply, however, that the use of fly ash is an automatic capability. Due to varying feedstocks the percentage of substitution can vary greatly. Even in an ideal

situation the fly ash composition can pose problems with operation. Sulfur is one of the remaining components of fly ash the cement manufacturing facilities are constantly balancing with alkalis. While fly ash can be utilized in small percentages, the high concentrations of SO_3 can cause many adverse conditions in both operation and product quality. Another situation that has become apparent with the use of high LOI fly ash is the inability to utilize this available energy. Fly ash is generally used in conjunction with raw material feed to the kiln, and as the material passes through the process the carbon remaining in fly ash is unable to contribute much to total heat input. A possible reason may be the minor heat available from high carbon fly ash, ~ 500 - 3000 BTU/ton fly ash, compared to the net theoretical heat required to produce a general portland cement of 1.51 MMBTU/ton clinker. This is a situation that is being addressed, but no definite solution has been applied throughout the industry.

In conclusion, fly ash can be a very cost effective material to use in cement manufacture regardless of the remaining carbon percentage. If managed properly adverse effects on manufacture or product will be minimal. There are also additional gains available with the use of high carbon fly ash with additional investigation.