Manufacture of Lightweight Aggregate (LWA) from Fly Ash

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Summary

Back in the 1960s, there arose a lot of enthusiasm for converting fly ash from a liability into an asset by manufacturing LWA from the ash, thus helping to solve the disposal problem. There were a number of good reasons, still valid today, for thinking this way:

1. Since fly ash is a by-product, no mining is required.
2. Fly ash is already fine enough for sintering. No crushing or grinding is needed.
3. Fuel is "built-in" in the form of unburned carbon.
4. Power plants are located near metropolitan areas, a principal market for LWA.

The market for LWA represents one of the more attractive opportunities for commercial utilization of fly ash without seasonal problems, as LWA can be stored for an unlimited time in open air without losses, environmental problems or damage from the freeze-thaw cycle. To solved the ash disposal problem, emphasis must center on mass applications. Two billion tons of aggregate are produced annually. If, for example, 20 million tons of LWA were to be produced from fly ash in a year, this would represent only about one percent of the annual production of aggregate. Clearly, this is an area where large quantities of fly ash in the form of LWA can be absorbed without causing large market dislocations.

Unfortunately, early efforts by a number of utilities in North America turned out to be failures due to a lack of understanding of the essential features of the sintering process. In Europe, years of intensive research efforts finally led to the development of successful technology. With fly ash properties varying considerably over time, it was realized that the ash had to be homogenized and the carbon content adjusted to a fixed and proper lever prior to pelletizing for the subsequent sintering operation to have any chance for consistent success. Good pelletizing in turn is necessary to achieve adequate permeability of the bed of pelletized charge resting on the grates of the sintering machine to make it possible to pass the required large volume of air through the bed.

The combustion of fuel within the bed is flameless, similar to the burning of tobacco in a cigar. It so happens that air and some other materials, such as slags, ashes and glass have similar heat capacities. That means that for every ton of LWA, one ton or 25,000-30,000 cubic feet of air have to be passed through the sinter apparatus. This volume of air serves not so much as a source of oxygen for combustion, but principally as a medium of heat exchange and as a vehicle to remove water introduced by the pelletizing operation. Fortunately, the sintering process is thermally very efficient as it requires only about four percent carbon in the ash, which is of course highly significant in these days of rising energy prices.

While technical aspects of the manufacturing process for LWA are important, commercial aspects and the ability to generate a profit are at least as important. In his runaway national best-seller, "One Up On Wall Street," Peter Lynch of Fidelity Investments discusses the aggregate industry which he calls a niche business. Due to the fact that aggregate is inherently a freight-sensitive, low-value commodity, hardly anyone can effectively compete. The nearest rival in the next country or state isn't going to haul his aggregate into your territory because the transportation costs would eat up all his profit. If you are the only supplier in your area, you enjoy a virtual monopoly or exclusive franchise, which gives you pricing power. You can raise the price to just below the point where the nearest rival supplier of aggregate might begin to think about competing with you. He determines his price the same way.

The largest potential outlet for LWA manufactured from fly ash is in concrete, concrete products, block and masonry units. LWA offer better thermal and acoustical insulation, high fire resistance, easy cutting, drilling and nailability. The use of LWA offers architects and engineers greater freedom in designing longer spans, larger floor areas and added height. Still other applications for LWA are for example in horticulture, as a stone mulch and as a vehicle arrestor.

In view of all that has been learned over the last 30-40 years, the manufacture of LWA from fly ash deserves another serious look. The problems and difficulties that bedeviled past attempts and led to costly plant failures have been largely solved. The potential certainly exists for disposal of large amount of fly ash in the form of LWA in a constrictive and profitable manner.