WESTERN NORTH CAROLINA PROGRAM SEPARATES ASH FOR COMMERCIAL, SUSTAINABLE USE

By Elaine Marten, Ph.D., (retired) Waste Reduction Partners

In 2000 retired volunteers from Waste Reduction Partners teamed with North Carolina State University Minerals Research Laboratory (MRL) to study options for separating coal ash for commercial uses in western North Carolina. The program has made a successful transition from bench to pilot scale testing to create "Carolina Ash Products." The work is supported by a consortium of representatives from the power generation, paper mill, byproduct recycling, and concrete block manufacturing industries, as well as a technical manager from the North Carolina Department of Pollution Prevention and Environmental Assistance.

Carolina Ash Products team members

A wet ash pond offered ample, local supply. About 73 percent of the pond's content was low-carbon fly ash, ideal for ready-mix concrete; bottom ash, fit for concrete block manufacture, amounted to about 8 percent; while unburned carbon was recovered at about 5 percent yield and could be burned to give an average of approximately 10,000 Btu/lb. All materials were isolated in multiple drum quantities ample for testing and marketing purposes. Toxicity leaching tests (TCLP) showed that separation processes produced ash free of heavy metal content.

The fly ash had a coarser size distribution than expected, likely because it was excavated from a well-settled section of the pond after years of storage. Therefore, it would need to be ground before processing to meet the percent fineness requirement for ASTM C-618, a standard industry specification for the use of fly ash in concrete. Additional screening removed coarse particle sizes, which contained minimal carbon, e.g. no greater than 2 percent loss-on-ignition or "LOI." Some parameters were adjusted from laboratory experiments. This demonstrated the process' flexibility in accommodating various ash compositions from utilities throughout North Carolina.

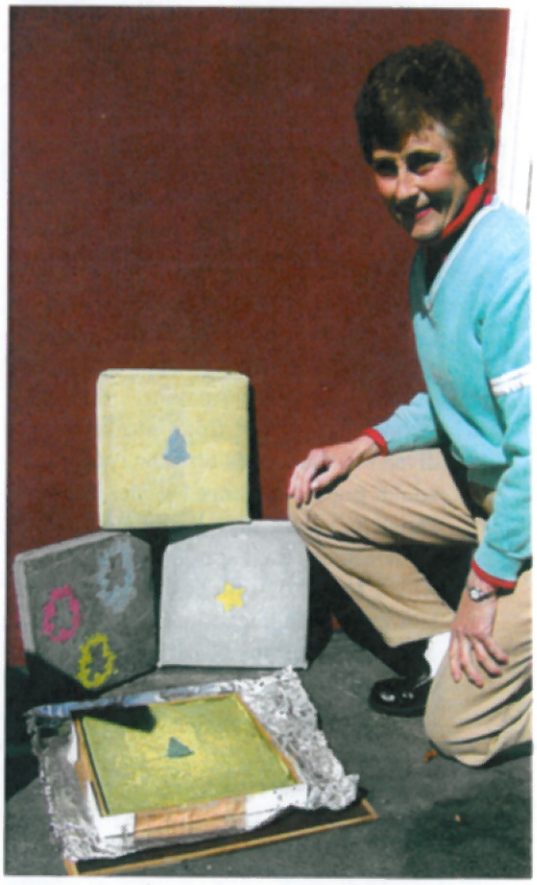
Lightweight aggregate (LWA) was produced in scaled up quantities, combining raw ash with paper mill biosolids and a tiny amount of binder. The ash biosolids mixtures were compressed in pelletizing or briquetting equipment then fired in batches in various high-temperature

furnaces. Results from testing for Standard Specification for LWA for Structural Concrete (ASTM C-330) gave a 28-day compressive strength of more than 4,900 psi. Additional testing to meet ASTM requirements for toxicity leaching residues (TCLP) showed no heavy metals above regulatory levels. Likewise, the standard test for staining materials (ASTM C-461-98) showed no stain. Resistance to degradation (LA Abrasion) (ASTM C-131-03) showed an abrasion loss of 29 percent. Loose density was less than 50 pounds per cubic foot. The same quality LWA could also be made from fractions of the separation mixture outside concrete product specifications, plus biosolids and binder. This conversion accomplished the original aim to process all the raw ash into usable products with a near-quantitative mass balance. It further demonstrated the wide latitude and flexibility of the process.

The remaining 10 percent of ash unsuitable for ready-mix or concrete block applications was blended with industrial byproducts to make stepping stones. The mixture contains 85 percent byproduct, including western North Carolina feldspar (mining), acrylic resins (paints), and a small amount of portland cement. The attractive, 12-inch-square stepping stones were cast and hardened in a variety of colors, performed well in outdoor use tests, and are lightweight for easy handling. This application requires more development work to optimize a process for commercial manufacture.

A preliminary market feasibility study was carried out by a specialist in mineral processing and manufacture of industrial ceramics. This investigation included discussions with high-volume consumers of the ash isolation products in mass produced building materials. Interviews with members of university departments, specializing in coal ash research, also contributed valuable insights into commercialization plans. The concept to be validated was the design of a plant for separation of the ash components on a manufacturing scale – bottom ash, fly ash, and carbon – and for carrying out the stages of LWA preparation. Conclusions from the data collected in this study all pointed toward establishing a viable business. Ash from the western part of North Carolina would support a substantial manufacturing facility, which could be sited in proximity to the ash supplies. The technical results from this extensive development work will be made available to any business interested in starting up. ❖

Elaine Marten, Ph.D. Waste Reduction Partners retired volunteer, and Robert Mensah-Biney, Ph.D., NCSU Minerals Research Laboratory, lead scientist. The photo was taken in the pilot plant of the Minerals Research Laboratory in Asheville, N.C., by Terry Albrecht, Director of Waste Reduction Partners, September 2005.



Marten displays stepping stones containing a blend of fly ash and industrial byproducts from western North Carolina.

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