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Rising from the ashes

By **Asa Swain**/ Special To The Tab
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When I think about clean energy, I think about wind turbines and solar power. Coal power is certainly not the first thing that comes to mind. But coal power plants provide over a quarter of our energy in Massachusetts (and over half of our energy nationwide). So while researching alternative energy sources is important, cleaning up our existing plants will have a much bigger and more immediate effect on the environment. The Clean Air Act has greatly reduced the amount of aerial pollutants released by coal power plants, but much of it is instead just sent to landfills. So I was intrigued when I learned about a new industry that has sprung up, an industry that uses a waste product from coal power plants to help mix better cement.

Now for most of us, making cement isn't very complicated. When I do backyard cement work, I mix two buckets of sand, one bucket of portland cement, and enough water to hold it all together. And that works just fine for home construction projects. But big industrial projects, like bridges, skyscrapers, and dams, need really high quality cement. There are a wide variety of mixes out there, depending on the kind of concrete required, but most formulas include fly ash: the fine residue created in the combustion of coal.

This is not a new discovery: the Romans made cement with a similar kind of ash, and Americans have been using fly ash for more than half a century. Today fly ash is used to supplement portland cement, as is slag cement, which is ground granulated slag (the byproduct of metal smelting). When portland cement, fly ash and slag cement are combined, the result is cheaper than pure portland cement, more malleable when poured, slower to set, and stronger in its hardened form. Using less portland cement also has an environmental benefit; it reduces the energy use and gas emissions of the mixing process.

Before the passage of the 1990 update to the Clean Air Act, some fly ash was separated for cement production, but most of the ash was just released into the air. This changed in 1990 due to the Clean Air Act's nitrogen oxide restrictions, which mandated that fly ash be filtered out of coal power plant emissions. So instead of releasing it into the air, power plants dispose of their ash in landfills. While this is an improvement, it still has economic and environmental costs.

The good news is that this excess fly ash is a great new supply for cement companies, and power plants would rather sell it than truck it to landfills. But you can't use fly ash straight from power plants, because it is often contaminated with carbon from the burning coal (the carbon interferes with the chemical bonding process of the cement). Some plants use air scrubbers or baghouses to remove the carbon. More recently, several companies have developed a more efficient technique for purifying fly ash, a process called electrostatic separation.

As the fly ash is fed between two oppositely charged electrode plates, the unburned carbon particles take on a positive charge, while the fly ash particles become negatively charged. Particles are attracted to the oppositely charged plates, and mesh conveyer belts carry each type to different destinations. The electrostatic separator can process 40 tons of fly ash an hour and only uses 1-2 KWh of electricity per ton of ash. Besides selling the purified fly ash, coal power plants can also re-burn the leftover carbon, creating additional energy and resulting in almost no waste.

A whole new recycling industry, including one company here in Needham, has developed in the past decade, by installing technology like electrostatic separators in coal power plants and helping to market fly ash to cement companies. Though critics often assert that cleaning up power plants would be too costly and would result in higher electricity prices, this unlikely union between coal power plants and cement companies demonstrates that you can turn a waste product into a useful commodity, and make both economic and environmental sense in the process.

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