Coal Ash

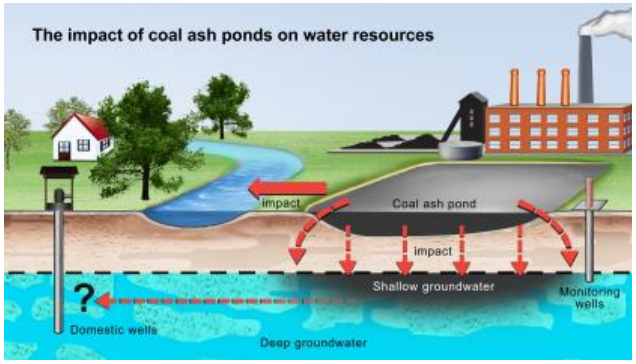
One of the great challenges is the ever-expanding accumulation of waste (created by humans and industrial processes) and its consequences on humans, nature, and our planet. One such waste examined here is coal ash waste generated by coal burning electric power plants.

The main objective of utility power companies is to provide a continuous and un-interrupted supply of electric power to its customers. Utility companies depend on mix of power sources so that they meet their obligations. Coal is one of the sources and continues to be one because of its power density and abundance of good quality coal in U.S. and other countries around the world. Even today 25% of the power in the U.S. comes from coal.

Once it is ground and burned, 5% - 15% of the coal weight remains as coal combustion residuals, namely, fly ash, bottom ash and boiler slag, and sometimes gypsum is also generated. The amount of residuals depends on the coal source and the efficiency of the power plant. The residuals are considered to be a waste and disposal is a challenge. Among the three, fly ash forms the largest component - about 60% of the residuals. Fly ash is fine powder of size ranging from sub to 300 microns, which has the potential to be air borne (see the "Open Air Pits" picture below) and can penetrate into soil when the ash comes in contact with water. Utility companies use various methods to dispose ash such as land and pond fills, including beneficial use such as in concrete (the largest use of coal fly ash), soil stabilization, land and mine-fills, etc.

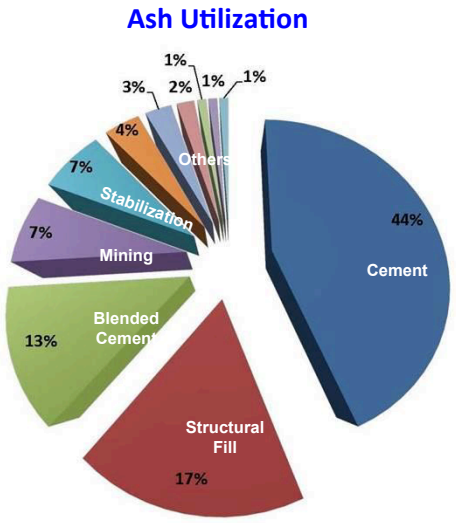
Open Air Pits

The U.S. produced an average of 90 MMT of coal ash per year during 2000-2013 from coal burning electric power plants; about 50% was used in beneficial use and the rest was stored in ponds and landfills. The amount of stored ash exceeds a billion metric tons within U.S. and much more around the world. China and India are the two major producers of power from coal. Air pollution in open-air ash pits, ground water pollution, and even the ash filled road base are pollution sites in these countries.



Fly ash contains primarily oxides of Si, Al, Fe, Ca, Zn, Ti (> 85% by weight), which are among the most chemically and thermally stable, hard, and insect- and fire-resistant materials on earth

and considered to be the raw materials for many commercial products. But the secondary elements such as As, Sb, B, Be, Mo, Se, Tl, and V in fly ash can dissolve or be suspended in water (submicron size) and can cause groundwater contamination due to seepage and runoff. The fly ash that has < 6% carbon can be used in concrete (according to an ASTM standard), the rest is unused. Excess fly ash produced by power plants along with other power plant wastes are dumped in ponds. Over time, naturally occurring animals, fish, and vegetation accumulate and make the pond ash unusable. The ponds may continue to drain the hazardous minerals into ground water, which could continue to contaminate drinking water.



Fly ash contains inorganic oxides that are very finely powdered, which accelerates their ability to dissolve or disperse in water and potentially exceeds the EPA's maximum contaminant limit (MCL) and can cause human health problems. Many electric power plants are located near rivers, streams and lakes to meet the demand for cooling turbines, so this dictates the location ash dumps. Unfortunately, economically weaker communities tend to live in these areas and ground well water may be their only source for household use. The drinking water issue came to public awareness after the 2014 Dan River coal ash spill in Eden, NC.

Another challenge of using fly/pond ash is it is heavier (bulk density 1.4 g/cc) compared to wood and wood-based products (0.4 to 1.2 g/cc), a successful modification of fly/pond ash is therefore essential to be used in ash engineered products. That Ash-Composite technology was developed to convert a power plant waste into a revenue-producing stream.

This Ash-Composites and their products are lightweight, strong, stiff, and fire- and insect-resistant. It uses self-generated chemical energy for curing, there is no waste produced, the Ash-Composite products can be recycled, and the products can be locally manufactured at the ash site.