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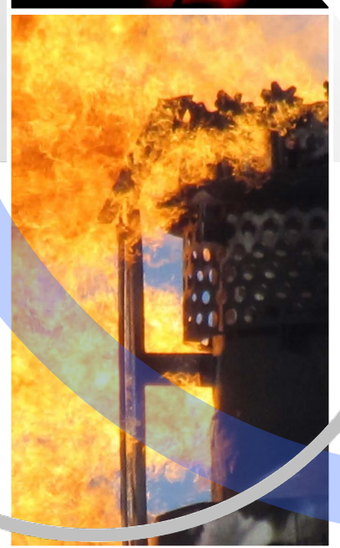
Email: info@aquilogic.com
Telephone: +1.714.770.8040

Coal Combustion Residuals



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Coal Combustion Residuals

Coal combustion residuals (CCRs) are a mixture of fly ash, bottom ash, boiler slag, and scrubber sludge left over from burning ground or powdered coal. Coal-burning power plants are generally the largest producers of CCRs.

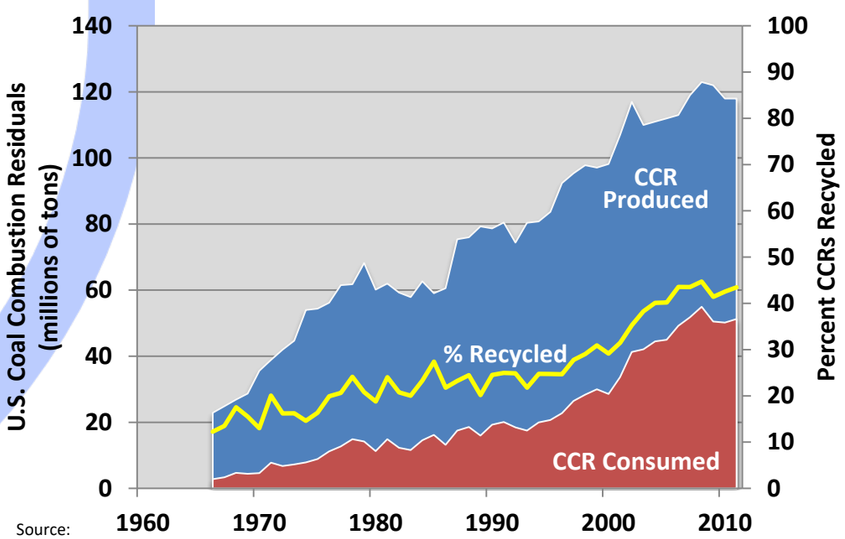
Fly ash is a fine, powdery material composed mostly of silica. Bottom ash is a coarse, angular ash particle that is too large to be carried up into the smoke stacks. Boiler slag is molten bottom ash that forms pellets that have a smooth glassy appearance after being cooled with water. Scrubber sludge is a material leftover from the process of reducing sulfur dioxide emissions from a coal-fired boiler that can be a wet sludge consisting of calcium sulfite or calcium sulfate or a dry powered material that is a mixture of sulfites and sulfates.

The main constituents in CCRs are oxides of silicon, aluminum, iron, and calcium, with lesser amounts of magnesium, sulfur, sodium, and potassium. Of significant environmental concerns, trace quantities of the following metals may be present in CCRs:

- Arsenic
- Beryllium
- Boron
- Cadmium
- Chromium
- Cobalt
- Lead
- Manganese
- Mercury
- Molybdenum
- Selenium
- Strontium
- Thallium, and
- Vanadium

Additionally, polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals formed during the incomplete burning of coal, or other organic materials. The following PAHs have also been reported in CCRs:

- Naphthalene
- Anthracene
- Phenanthrene
- Benzo(k)anthracene
- Fluoroanthene
- Chrysene
- Dibenzofuran
- Fluorene
- Benzo(a)pyrene, and
- Benzo(a)Fluoroanthene



Source:
U.S. Geological Survey. (2013). Historical Statistics for Mineral and Material Commodities in the United States. U.S. Geological Survey Data Series 140.

Range of Concentrations for Selected Trace Metals in CCRs and Soils

Location	Matrix	Arsenic	Barium	Chromium	Lead	Mercury	Selenium
		milligrams per kilogram (mg/kg)					
Indiana	Fly Ash	20.2 – 56.3	336 – 422	78.2 – 984	22.1 – 293	0.01 – 0.10	4.06 – 22.5
New Mexico	Fly Ash	16.8 – 22.2	1,230 – 1,950	33.7 – 45.9	53.8 – 67.5	0.06 – 0.26	1.03 – 12.2
Ohio	Fly Ash	33.7 – 93.8	464 – 608	118 – 181	21.4 – 50.4	0.02 – 0.06	3.49 – 5.47
Wyoming	Fly Ash	14.6 – 22	2,980 – 3,370	54.1 – 102	25 – 33.1	0.02 – 0.97	11.2 – 13.5
Alaska	Fly Ash	7.3 – 32.9	4,290 – 5,730	247 – 925	14.4 – 77	0.12 – 1.15	1.25 – 7.14
Western U.S.	Soil	<0.10 – 97	70 – 4,000	3 – 2,000	<10 – 700	<0.01 – 4.6	<0.1 – 4.3
Eastern U.S.	Soil	<0.10 – 73	10 – 1,500	1 – 1,000	<10 – 300	0.01 – 3.4	<0.1 – 3.9

Sources:
U.S. Geological Survey. (2011). Geochemical database of feed coal and coal combustion products (CCPs) from five power plants in the United States: U.S. Geological Survey Data Series 635 and pamphlet.
U.S. Geological Survey. (1984). Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. Professional Paper 1270.

Coal-fired power plants produce approximately 118 million tons of waste CCRs per year, making these wastes one of the largest industrial waste streams in the U.S. Of the CCRs produced, slightly more than 40% are consumed, or recycled, into other products, such as :

- Cement and Concrete
- Flowable Fill
- Porous Pavement
- Structural Fill/Embankments
- Aggregate
- Mine Reclamation
- Soil Stabilization
- Road Base
- Snow and Ice Control
- Blasting Grit
- Roofing Granules
- Gypsum Panel Products
- Waste Stabilization/Solidification
- Agricultural/Soil Amendments

Of the millions of tons of waste stream CCRs that are currently not utilized in other processes or products, excess CCRs are typically stored in surface waste ponds, impoundments, abandoned mines, and quarries. The U.S. Environmental Protection Agency (EPA) has identified approximately 600 CCR waste impoundments split roughly equal between landfills and surface impoundments. As of 2007, of the 85 CCRs waste storage sites evaluated by the U.S. EPA, damages to the environment by CCRs have been confirmed at 24 sites. At an additional 43 waste CCRs storage sites, environmental damage by CCRs was also considered likely, but had not been confirmed. That is, at 67 of 85 CCR waste sites evaluated by the U.S. EPA (nearly 80%) environmental damages were either proven or likely.

As CCRs come into contact with water, whether due to infiltration from rainfall, runoff, or in direct contact with groundwater, components of the CCRs, including trace metals, can leach out of the stored waste and contaminate groundwater and surface water. Groundwater has been impacted at 16 of the 24 sites where the U.S. EPA has identified environmental damages from the stored waste CCRs.

The EPA Administrator signed the Disposal of Coal Combustion Residuals from Electric Utilities final rule on December 19, 2014, and it was published in the *Federal Register* (FR) on April 17, 2015. This rule finalized national regulations to provide a comprehensive set of requirements for the safe disposal of CCRs. However, efforts are underway to weaken these regulations.

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