ELECTRIC POWER RESEARCH INSTITUTE

COAL ASH & TOXICITY, PART 2

What is Coal Ash?

Where does coal ash come from?

Coal ash is a byproduct from the generation of electric power. The amount of coal ash produced at a power plant depends on the amount of coal burned, the amount of mineral matter in the coal, and the combustion conditions. The two main types of coal ash are fly ash and bottom ash. Fly ash refers to lightweight particles that are carried upward by a mixture of hot gases (called flue gases) when the coal is burned. Nearly all fly ash particles are collected by particle separators before the flue gases are released to the atmosphere (see Figure 1). Bottom ash refers to the heavier particles that fall to the bottom of the furnace, where it is collected. Most of the coal ash produced by power plants is fly ash.

What does coal ash look like?

Fly ash particles look like a fine sand that is tan to dark gray in color (see Figure 2). Bottom ash particles look more like coarse black sand or fine gravel with a dull black color and a rough texture.

Figure 2. (Left) Fly ash. (Right) Bottom ash.

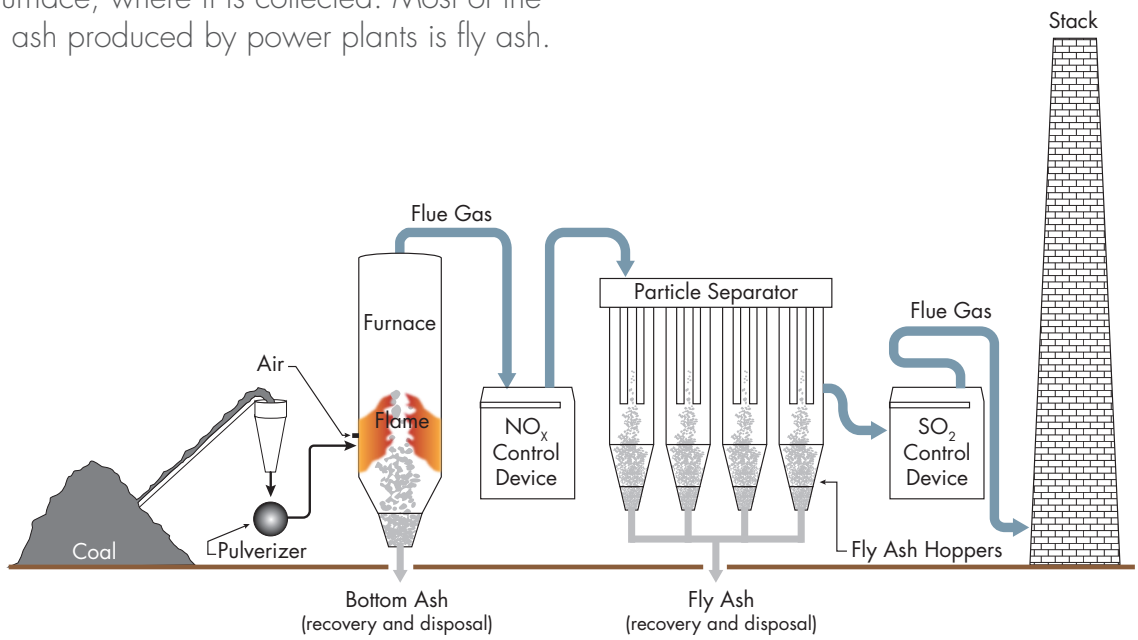

Figure 1. Coal ash generation process.

If you looked at a coal ash particle under a high-powered microscope, you would see a variety of structures and shapes (see Figure 3). This is because, like soil particles, individual coal ash particles contain a mixture of different mineral compounds. Compounds are formed when different elements react and bond together. For example, iron (Fe) and oxygen (O) can react to form iron oxide (Fe_2O_3), also called rust.

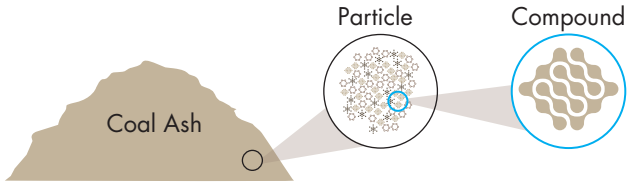

Figure 3. Coal ash particles are composed of many different mineral compounds.

What is bioavailability?

Mineral compounds vary in how easily the elements contained within them will dissolve when in the environment or when in the body. In the environment, fraction of the elements that can be dissolved represents the portion that is **environmentally mobile**. Similarly, the fraction of the elements that can be released and absorbed into the body when a person comes into contact with the compound (through swallowing it, inhaling it, or touching it) is the portion that is **bioavailable**.

What's in coal ash?

Coal ash is largely derived from the inorganic (non-carbon-containing) minerals found in coal, such as quartz, feldspars, clays, and metal oxides, which are also found in soil and rock. As is the case with soil, oxides of silicon, aluminum, iron, and calcium make up over 90% of coal ash.

The content of coal ash can vary, depending on the coal being burned and the combustion conditions. The average makeup of fly ash is shown in Figure 4.

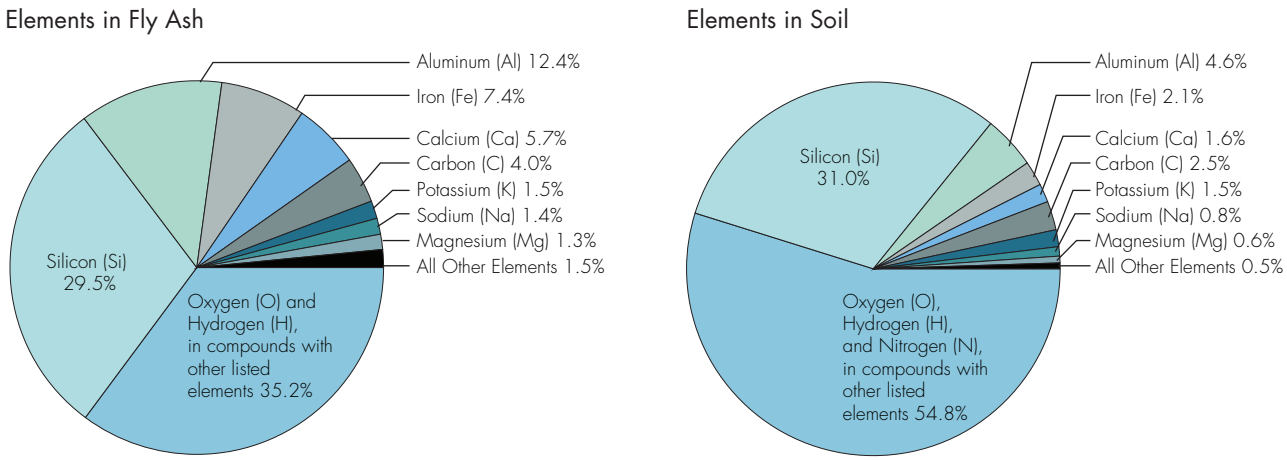

Figure 4. Comparison of composition of fly ash and soil, by element.

(Note: Oxygen, hydrogen, and nitrogen are present as part of compounds with other listed mineral elements. Their concentration was calculated rather than being measured.)

Is coal ash toxic?

The substances that make up coal ash (see Figure 4) vary in toxicity. Over 98% of the content of coal ash consists of elements with relatively low toxicity: oxygen, hydrogen, silicon, aluminum, iron, calcium, carbon, potassium, sodium, and magnesium. Coal ash, like soil, also contains small amounts of many other elements ("All Other Elements" in Figure 4) that vary in toxicity, such as arsenic and chromium. *See Coal Ash & Toxicity* Parts 1 and 3 for more information about how understanding both toxicity and exposure is needed to determine whether or not there is a potential risk to health. *Coal Ash & Toxicity* Part 4 provides additional detail about how risk assessment can help determine when action is needed to protect health.

Is coal ash hazardous waste?

Coal ash is not listed as a hazardous waste by the U.S. Environmental Protection Agency (EPA), and it does not meet the EPA criteria for hazardous waste. Coal ash is regulated as a non-hazardous waste.

Is coal ash radioactive?

Like all rocks and soils, both coal and coal ash contain naturally occurring **radionuclides** (radioactive elements). According to the U.S. Geological Survey (USGS), coal ash is not significantly enriched in radioactivity compared to soil, rocks, or conventional concrete or building materials. Even for someone working outdoors full time at an ash storage site, radiation exposure from fly ash is extremely low,

What happens to the coal ash created by power plants?

Historically, power plants have either transported dry coal ash to landfills (dry management) or mixed the ash with water to form a slurry (wet management) and transferred it to retention ponds called impoundments. The industry is currently phasing out wet management.

Currently, more than half of the coal ash produced in the United States is recycled into a variety of beneficial uses. For example, fly ash is used in concrete because it improves performance while replacing more costly and carbon-intensive portland cement. Other beneficial uses include replacing mined aggregates and fillers in many construction and industrial products.

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