THERMOMECHANICAL TREATMENT Ash Residue

Nearly all downstream waste processes, including recycling and energy recovery generate residues that must be managed. Thermomechanical Treatment Facilities (TTFs) generate ash residue composed of noncombustible material in waste streams, and to a lesser extent, materials added for air quality control, such as lime. Most of the ash consists of non-combustible materials like ceramics, rock, soil materials, and glass and is called "bottom ash".[1] The remaining "fly ash" is captured through the air quality control equipment.[2] In the U.S., these two streams are handled together as a combined ash.

Is TTF ash hazardous?

Combined ash from TTFs is routinely tested to confirm that it is non-hazardous per U.S. EPA regulations.[3] To comply with U.S. EPA regulations, ash is regularly tested using the Toxicity Characteristic Leaching Procedure (TCLP) defined by U.S. EPA Method 1311. The TCLP test uses an acid solution to simulate worst-case leaching conditions that might occur in a landfill containing decaying waste streams. No ash from Reworld's operating U.S. TTFs has ever been determined to be a hazardous waste.

> ***"Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP) (Method 1311). The TCLP helps identify wastes likely to leach concentrations of contaminants that may be harmful to human health or the environment."[4]***
> USEPA on Toxicity

In practice, ash does not biodegrade in a landfill the way that municipal solid waste (MSW) does and has been demonstrated to be more stable and resistant to leaching than regular MSW.[5,6] Over time, pozzolanic reactions in the ash cause it to harden and bind metals and other contaminants into stable compounds. A prominent study involving both the U.S. EPA and Marion County, Oregon, monitored leachate characteristics from an Oregon ash monofill (a non-hazardous waste landfill that contains only ash) over a four-year period and found average contaminant levels in leachate more than 92% below TCLP limits.[7] When compared to typical leachate from MSW landfills, leachate from ash monofills contains much lower levels of organic compounds and heavy metals.[8]

Where does the ash go?

Roughly two thirds of the ash generated at Reworld TTFs is managed in traditional MSW (Subtitle D) landfills with almost half of that used as daily cover, reducing the need for virgin soil and saving landfill space.[9] The remainder is placed in ash monofills (Figure 1).

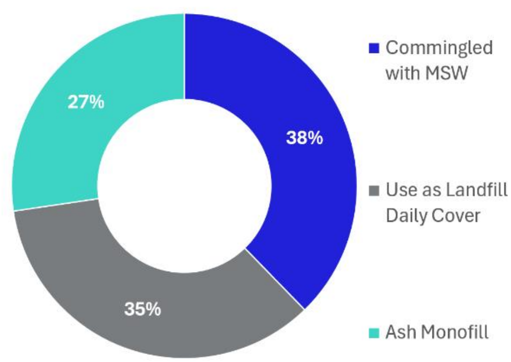

Figure 1. *Ash disposal options*

How much ash is generated from TTFs?

Nearly all waste management processes, including energy recovery and recycling, generate a residue that require further treatment or disposal. For example, for every ton of office paper recycled, 60% is reused, while the remaining 40% is discarded (See Figure 2).

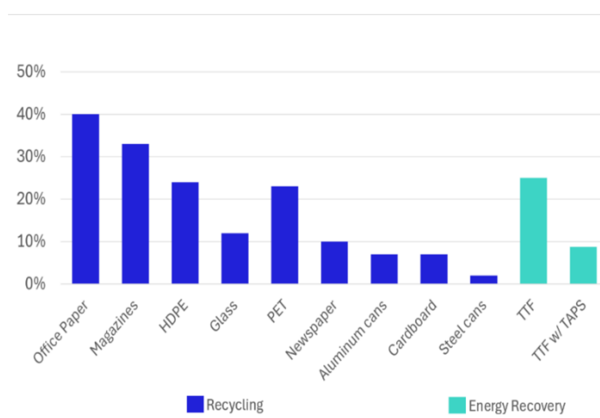

Figure 2. *Discard rate for recycling and energy recovery options[10]*

Currently, ash from Reworld TTFs represents about 10% of the volume and 25% of the weight of the initial MSW processed. Efforts underway to recover additional materials from the residual ash have the potential to decrease residues even further.

Can ash be reused or recycled?

Yes. Reworld TTFs separately recover both, ferrous (iron) and non-ferrous, metals for recycling from ash. Ferrous metals are separated using advanced industrial magnets, while non-ferrous metals – namely aluminum, copper, and brass – are recovered using eddy current separators. Metal recycling reduces emissions and impacts associated with the mining and refining of virgin ore. Annually, Reworld recycles over 500,000 tons of ferrous and non-ferrous metals – enough metal to build five Golden Gate Bridges.

Recovery and use of additional materials from ash remains a key objective for thermally treated waste globally.[11] Reworld is working towards establishing an innovative Total Ash Processing System (TAPS) at its H-Power TTF in Honolulu, Hawaii to significantly reduce landfilled ash on the island. TAPS is a unique technology that recovers more metals and aggregate from TTF ash to make the remaining residue available as construction material. Installing TAPS will reduce the volume of ash requiring landfill disposal by as much as 65%.

Figure 3. *Ash recycling and reuse pathways*

Additionally, The U.S. Department of Energy (DOE) launched two research projects aimed at harvesting metals and other strategic materials from TTF ash through its Advanced Research Projects Agency - Energy (ARPA-E).[12] The DOE projects recognize the role TTFs play in returning materials back into the economy.

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