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Recycling Spent Aluminum Oxide

Washington Mills has developed a process that enables it to collect spent aluminum oxide and recycle it back into the manufacturing process.

Over 150,000 tons of fused aluminum oxide is consumed annually in the U.S., and only a very small portion of that tonnage is recycled. Prices for the raw materials used in manufacturing fused aluminum oxide have spiked to historically high levels. For example, bauxite has become increasingly more difficult to source, and prices have more than doubled in the past year alone. China, a major supplier of bauxite, has experienced a mix of pivotal events that have directly contributed to upward pressure on bauxite prices: soaring Chinese power costs, increased Chinese domestic demand for bauxite in the aluminum industry, stricter environmental controls on calcined bauxite, plant closures, and increased transportation costs. This paradigm shift in the global commodities market has strengthened the economic case for the recycling of aluminum oxide.

Traditionally, spent aluminum oxide is brought to a landfill for final disposal, but rising landfill costs, tighter landfill regulations and higher freight costs are causing businesses to rethink their waste disposal practices. As one of the largest manufacturers of aluminum oxide in the U.S., Washington Mills is aware of the growing need to find better ways to dispose of spent abrasive grain. In an effort to address this need, Washington Mills has worked with large-volume users of its BLASTITE® BT abrasive blasting grain to collect the spent aluminum oxide and recycle it back into the manufacturing process.

Closed-Loop System

Washington Mills has invested significant research and development resources to make its aluminum oxide manufacturing process a completely closed-loop manufacturing system. When other industry players closed down their aluminum oxide furnaces and opted to produce or source from China, Washington Mills made the strategic decision to continue manufacturing fused aluminum oxide in North America. Today, as the only manufacturer of fused aluminum oxide in North America operating its own furnace plants, Washington Mills is able to reintroduce the spent aluminum oxide back into its furnace operation.

In Washington Mills' recycling program, the spent aluminum oxide grit is reused as an ingredient for making new fused alu-



Blasting grain produced by crushing chunks of fused alumina.

minum oxide. The spent aluminum oxide is blended with new bauxite, and this mixture is fed into specially designed furnaces that melt and purify the liquid abrasive. The company's furnace expertise enables it to transform the spent aluminum oxide back into raw materials used to make pure fused aluminum oxide. Recycling used aluminum oxide by putting it back into the furnace that it originally came from and using it to make new fused aluminum oxide is a 100% closed-loop manufacturing system.

The perpetual recycling loop produces no waste and reduces dependency on new raw materials. Washington Mills successfully makes pure fused aluminum oxide from recycled material that has the same chemistry and crystal structure as fused aluminum oxide made from new raw materials.

Recycling Challenges

Washington Mills has worked over the years to modify its furnace operations to accommodate the use of spent aluminum oxide. Furnacing aluminum oxide is not a simple process. It requires charging the furnace with a raw material mix that has the correct chemistry and stability for the materials to effectively and safely fuse together. When introducing non-virgin raw materials, such as spent aluminum oxide, the chemistry of the raw material mix is constantly changing. The furnace process just can't reduce certain chemistries, so it is important to be diligent about testing the recycled materials and mixing together the right ratio of materials to achieve the desired chemistry.

Washington Mills has a strict testing program for all spent aluminum oxide before the grit can be accepted for recycling. The company tests the chemistry of the material until it is certain that

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An electrode supplies power (center) while raw materials are added to a furnace via feed chute (right).



A furnace operator takes a sample before pouring the liquid aluminum oxide.

Case in Point

One heavy manufacturing company was using around 500 tons of fused aluminum oxide grit per year for a blasting application. With a landfill cost of \$60 a ton (costs differ depending on the location), the company was spending \$30,000 per year to put the spent aluminum oxide into the ground. The company contacted Washington Mills to investigate whether it could recycle the material. Washington Mills tested the spent grit and determined it suitable for recycling.

The company developed a simple collection system to gather the spent grit and started sending the material back to Washington Mills for reuse in its recycling program. The manufacturer was able to eliminate its landfill costs, and both parties reduced their impact on the environment. Additionally, Washington Mills made a step toward reducing its raw material costs, which, in the face of rising raw material prices, is a step toward controlling costs for the benefit of both the manufacturer and the customer.

Ready, Set, Blast

A primary consumer of fused aluminum oxide is the metal preparation and finishing industry, which uses it as an abrasive blasting media. In this application, the fused aluminum oxide grains, when propelled by air pressure, become powerful multi-edged abrasive tools that penetrate workpieces and leave clean, etched surfaces in their wake. The abrasive particles remove contaminants and unwanted substances from the metal's surface to give it the desired finish. Blasting with fused aluminum oxide is a highly effective method for either material removal or surface preparation on many different surfaces, including metals, alloys, glass, ceramics, marble, granite, and other stone.

Washington Mills' BLASTITE BT blasting grain is an abrasive grain used in the blasting industry. In pressure blasting, a pressurized stream of compressed air is directed through a nozzle and onto a workpiece to create a uniform surface. The blasting is done either in a blast cabinet or in a large blast room that contains and collects the aluminum oxide after it has been blasted onto the part.

Depending on the piece being blasted or the desired surface profile, the aluminum oxide may be collected and re-used for multiple passes through the blasting system in order to maximize the abrasive life of the grain. Once the abrasive particles have been reduced in size, the aluminum oxide is either disposed of in a landfill or sent to Washington Mills for recycling.

the spent material will work in the furnace process. Depending on the surface that was being blasted, the spent abrasive grain may contain different metals or other elements that were picked up in the blasting process. In many applications, the small amount of debris in the spent grain does not pose a problem, but in others where perhaps lead, cadmium or other elements were taken off in the blasting process, the material would not be used for recycling.

Since the recipe changes with each new recycling shipment, a sophisticated technical process was developed to enable the company to handle the various chemical compositions and particle sizes of the spent material. Washington Mills continually improves how it manages the materials and adapts the raw material mix to suit the furnace process. The company believes that innovation through the adaptation of the process to work with alternative sources of raw materials gives it a manufacturing edge.

Unlike new raw materials, the spent material is often returned in much finer particle sizes. The material handling capabilities needed to manage materials of very fine particle sizes, as well as myriad packing types, is a sizable challenge. Finer materials are more difficult to handle and must often be agglomerated before being fed into the furnace. Very fine material does not move well or release easily into the furnace, so a considerable amount of work must be done to prepare the material before use.

In addition, the material is returned in many different types of packages, from sacks to drums to bulk, which makes operating an efficient material handling system a challenge.

Widespread Benefits

Despite the challenges, the hard work devoted to recycling programs pays real benefits in terms of offering a greater level of service to customers, and in manufacturing a high-quality product in North America at competitive prices. In today's world of soaring raw material and electricity costs, and the declining quality of raw material inputs, a recycling program that reduces dependency on expensive raw materials to control costs offers real value to fused aluminum oxide users.

Washington Mills believes it is helping its customers break out of the one-way landfill trap of rising disposal costs by continuing to refine its closed-loop recycling program. By bringing the spent material back into the furnace and transforming it into fused aluminum oxide, the company aims to maximize the customer experience while innovating itself away from rising manufacturing costs. 🌐

For additional information regarding the recycling of spent aluminum oxide, contact Anne Williams, Washington Mills, 1801 Buffalo Ave., Niagara Falls, NY 14302; (508) 839-6511, ext. 256; e-mail awilliams@washingtonmills.com; or visit www.washingtonmills.com.