Best Practices in Glass Recycling

Saving Energy with Cullet and Preheating

Material: Recycled Glass

Issue: *Glass container manufacturers are using increasing amounts of recycled glass cullet. While reducing the demand for natural resources, the use of cullet is also cost-effective from a manufacturing standpoint. Cullet melts at a lower temperature than raw materials, reducing the demand for energy and lowering production costs. Further energy savings can be achieved by using furnace exhaust gases to preheat the cullet. One method of preheating involves direct transmission of furnace exhaust through a cullet medium. Another approach involves passing the cullet through a vertical funnel that is heated externally by the furnace exhaust. Preheating cullet also helps to promote a longer furnace life. This best practice explains the benefits of using preheated cullet in the manufacturing of glass containers. Preheater designs using direct and indirect heat transmission are also discussed.*

Best Practice: Typical glass container manufacturing furnaces are capable of producing from 100 to 400 tons of glass per day. Because recycled glass melts at lower temperatures than raw batch materials, it requires less furnace energy during production. Studies show that every 10% increase in the amount of cullet used reduces melting energy by about 2%. Reducing the energy input reduces fuel consumption, and ultimately helps reduce the level of nitrogen emissions produced by the furnace.

Preheating cullet with the furnace exhaust gas allows further reduction in the melting energy. The exact energy saved depends on the amount of cullet and the preheat temperature used. Studies show that to achieve notable savings, the cullet must be preheated to at least 650°F. However, if the cullet temperature exceeds about 1025°F it will begin to soften and become difficult to transport. Thus exhaust gas hotter than

Cullet preheating can be achieved by direct transmission of furnace exhaust through a cullet layer. This cullet layer is usually contained in a preheating unit connected to the furnace emission system. One advantage of direct heat transmission is that the cullet also filters dust from the furnace exhaust. During exhaust flow, up to 40% of the dust particles are retained in the cullet and eventually return to the furnace. The resulting gasses require less treatment prior to release into the atmosphere. However, the re-circulated dust may contain alkali sulfates, bisulfates, or pyrosulfates, which should be considered when the sulfur content of the glass composition is evaluated. Air jets may also be necessary in the preheating unit to prevent dust from clogging the cullet. Although heat transfer to the cullet is most efficient at higher exhaust speeds, the dust filtration capacity will be lower. The efficiency of heat transfer also depends on the thickness of the cullet layer. Thicker cullet layers take longer to preheat, as the exhaust cools during transfer. The ideal cullet size for preheating systems of this type is between 1/8- and 1.0-inch. If the amount of material finer than 1/8-inch exceeds 10%, the porosity of the cullet becomes so small that it may cause a reduction in the exhaust velocity, increasing the gas pressure in the filter and furnace. After leaving the preheating unit, the furnace exhaust passes through a conventional filter system and is released to the atmosphere through a stack. The preheated cullet is then transported to the batch charger. Preheating systems of this type reduce furnace energy by up to 12% for cullet contents of 50% or greater.

Cullet can also be preheated with an indirect heat transfer system. These systems generally involve a vertical funnel surrounded by hollow chambers. During operation, cullet is deposited on the top of the unit and funneled downward at a speed of about 10 to 16 feet per hour. Furnace exhaust simultaneously travels up through the adjacent chambers, raising the ambient temperature in the funnel. Once preheated, the cullet is released from the base of the funnel for transport to the batch charger. Systems of this type normally employ an ultrasonic cleaning device to remove furnace dust that accumulates in the exhaust chambers. After leaving the hollow chambers, the furnace exhaust passes through a conventional filter system and is released to the atmosphere. Research suggests that indirect heat transfer systems can reduce furnace energy by up to 20%.

Preheated cullet requires a lower melting temperature than raw material, and requires less variation in furnace temperature during melting. These factors help reduce wear and tear to the furnace, and ultimately lower maintenance costs and prolong furnace life.

Implementation: The design and implementation of the preheating unit should be evaluated with the over-all system configuration. Many technical issues, such as monitoring of the preheating temperature, should be carefully reviewed prior to the implementation.

Benefits: Using preheated cullet in conjunction with raw materials helps container manufacturers lower production costs by reducing energy consumption. This also prolongs the life of the glass furnace and lowers nitrogen emissions. In addition, a direct heat transfer preheating system helps to reduce exhaust treatment by filtering dust from the furnace waste gasses.

Application Sites: Glass container manufacturing facilities.

Contact: For more information about this Best Practice, contact CWC, (206) 443-7746, e-mail info@cwc.org.

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