PELLETIZING AND RECYCLING OF DUST FROM AND TO A LEAD GLASS FURNACE

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OI-NEG TV PRODUCTS, Columbus, Ohio, is a leading manufacturer of glass funnels for the television picture tube envelope. The Columbus facility produces over 10 million units per year while operating 24 hours per day, 365 days per year.

The picture tube funnels are produced in various sizes up to 35" diagonal dimension. The funnel forming lines are fed from two (2) furnaces. The "F" furnace is a Gas/Oxygen furnace that produces 350 tons per day. The "C" furnace is a Gas/Air furnace that produces 250 tons per day.

To attenuate the radiation emitted from the television gun, the funnels are formed from glass that contains 25% lead. The lead oxide, as Litharge, is introduced to the furnace as a batch ingredient.

The exhaust carryover that is generated during the melting process is collected as a fine dust in Electrostatic Precipitators. The dust collection rate from the two furnaces averages 3,500 pounds per day. A portion of this dust was recycled to the "F" furnace and the remainder was shipped off site for reclaiming by lead smelters.

The primary concerns in regards to the dust, which contains 60 - 80% lead oxide, were the physical handling characteristics, costs associated with the off-site shipping of the dust, transportation risks of possible spillage, raw material losses and worker exposure.

To address these concerns, OI-NEG decided to explore the possibilities of pelletizing the EP dust so that pellets could be recycled to the furnaces.

Previous attempts to recycle the EP dust to the furnaces were of limited success. Only one furnace, "F" furnace, was equipped with a material-handling system that would deliver the dust to the batch feed system. The dust was difficult to control in respect to flow and measuring properties, and it was known that a certain percentage of the dust was recycled to the precipitators through the furnace exhaust system, without the opportunity to be melted. This process allowed for swings in the amount of dust utilized in the furnace and often led to overcompensation to allow for losses.

Since there were some concerns over the success of pelletizing the EP dust for recycling to the furnaces, OI-NEG decided to undertake a testing program to determine the pelletability of the dust and the results of introducing pelletized EP dust to the furnaces.

An additional factor that entered into the recycling program was another source of dust called "Canal Cleanings." This is material that collected in the furnace regenerator bottom where there is low-velocity exhaust gas flow. The Canal Cleanings were removed from the exhaust network on a regular basis and sent off site to a lead smelter for reclaiming. The cost and concerns of this material were similar to the EP dust, but in addition could not be recycled to the furnaces due to limitations of a feeding system and the need for removal of metallic lead prior to charging to the furnaces.

TESTING

Earlier work that was performed at the plant on the pelletizing and recycling of the furnace dust back in the mid 1970s was unsuccessful, in that the pellets did not have sufficient material-handling characteristics to survive recycling to the furnace. Over the subsequent years, several other methods were tried to improve the flowability of the furnace dust but none were the answer to the problem.

Recent successes in the pelletizing of Litharge by a supplier to the OI-NEG plant warranted another look at the process and pelletizing became a candidate again.

Testing that was performed on a Pin Mixer pelletizer proved that the electrostatic precipitator dust could be pelletized into a product that would survive the recycle process with little degradation. The pellets were free flowing and could be handled through the existing batch addition system without any modifications.

Although the success of the pelletizing of the electrostatic precipitator dust was a major step in the resolution of the concerns previously mentioned, a solution to the Canal Cleanings was needed to complete the recycling efforts and to warrant the expenditures of the pelletizing system. Testing was then concentrated on the Canal Cleanings.

The Canal Cleanings particle sizing ranges from fine powder to pieces that are several inches in size. It was determined that the larger pieces contained contaminants that are not desirable to be recharged to the furnaces, and would have to be removed from the finer particles prior to processing. OI-NEG had changed from silica checkers to magnesite checkers to relieve blockage. By doing this they found that over 50% of the Canal Cleanings could be recycled to the furnace.

The ideal sizing of the pellets for recharge would be a size that is comparable to the existing batch ingredients. Above all, the pellets must be able to be handled through the batch feeding system without dusting or degradation.

To test the Canal Cleanings, the material was first screened through a 1/8" screen. The plus 1/8" material, approximately 40% by volume, was removed and the minus 1/8" material was used for the pelletizing tests. A large portion of the minus 1/ 8" material had the shape of flakes, which was a concern to the testing company since the common feed to the pelletizer is a dry, fine powder. In anticipation of possible problems with the material particle sizing, a portion of the material was hammer milled prior to pelletizing. A comparison of the particle sizing of the milled and nonmilled materials is as follows:

CANAL CLEANINGS
SCREENED MINUS 1/8"

DESCRIPTION	UNMILLED	MILLED
MOISTURE CONTENT:	0.0%	0.0%
BULK DENSITY:		
Deaerated	149.4 PCF	208.0 PCF

SIEVE ANALYSIS

SIEVE SIZE	% RETAINED	% RETAINED
10 mesh	0.8	0.0
45 mesh	39.9	0.0
80 mesh	22.4	0.1
120 mesh	11.7	0.6
200 mesh	11.8	16.2
325 mesh	2.8	26.5
Pan	10.6	56.6
	100.0	100.0

Pelletizing tests were conducted on both materials using a Mars Mineral Pin Mixer, Model 12D54L. This pelletizer was equipped with a chamber area of 12" diameter by 54" long. The inside of the chamber was lined with rubber and the water for binding the pellets was introduced through the top of the chamber, near the material inlet. The unit was driven by a 40 HP variable-speed drive.

Despite the reservations on the ability of the non-milled material to pelletize, it actually performed better than the milled material. The results of the test showed that the flake material produced pellets that were uniform in size and were quite durable. The test results were as follows:

CANAL CLEANINGS
SCREENED MINUS 1/8" – UNMILLED

MOISTURE CONTENT: 3.0 - 3.5% by weight (green pellets)
BULK DENSITY: 228.0 PCF (green pellets)
ATTRITION LOSS: 1.8%

PELLET SIZE DISTRIBUTION:

SIEVE SIZE	% RETAINED	% ACCUMULATIVE
6 mesh	4.4	4.4
10 mesh	26.0	30.4
20 mesh	59.5	89.9
50 mesh	9.5	99.4
80 mesh	0.3	99.7
Pan	0.3	100.0

Based upon this successful test of the Canal Cleanings, the success of the prior recycling of dust to the furnaces, the improved physical characteristics of the pellets over the dust and the improved worker exposure conditions, it was decided to install a pelletizing system.

PELLETIZING SYSTEM REQUIREMENTS

The pelletizing system had to meet certain requirements in regards to product specification, material handling, existing space availability and worker exposure to dust.

PRODUCT SPECIFICATION

The pellets, in order to be added to the batch ingredients, had to be of a particle sizing that is similar to the other constituents of the batch to prevent segregation of materials. The preferred pellet sizing is to be 40 x 200 mesh, with the majority being 70 x 140 mesh.

The pellets must also be less than 1% free moisture when introduced to the furnaces, and be of sufficient strength to survive the handling requirements without degradation.

MATERIAL HANDLING

The dust exits the precipitators at an elevated temperature (approximately 250 - 300 F) and has fair to good flow characteristics as long as the temperature is maintained. As the dust cools to ambient temperature, it becomes very difficult to handle, to the point where it will adhere to a vertical surface.

In order to keep the temperature of the dust elevated through the pelletizing system, all screw conveyors must be insulated and the dust storage bin must be heat traced and insulated.

EXISTING SPACE AVAILABILITY

The pelletizing system had to be installed near the discharge points of the two existing electrostatic precipitators. Available space under one of the precipitators was to be utilized, with an area directly adjacent to the precipitator available if required.

WORKER EXPOSURE

The entire pelletizing system had to meet strict requirements in regards to dust confinement to reduce worker exposure as much as possible. This included the design of the screw conveyors to eliminate internal bearings and of the baghouse to eliminate the requirement for maintenance personnel to enter the baghouse for collector bag maintenance.

The pelletizing system had to include sufficient dust collection to equipment to prevent the escape of dust to the atmosphere.

PELLETIZING SYSTEM

The pelletizing system was designed to pelletize both the electrostatic precipitator dust and the Canal Cleanings in a single system.

The EP fines are delivered from the electrostatic precipitators to the pelletizing system by screw conveyors and a bucket elevator. The design of the system is that the screw conveyors and the bucket elevator run continuously, filling a dust storage bin. The capacity of the storage bin allows for a week’s accumulation of dust, to be pelletized one day per week.

The Canal Cleanings are delivered to the system in 55-gallon drums that are placed in a drum-dumping device, screened, then delivered to the dust storage bin.

From the dust storage bin, which is equipped with a vibrating bin bottom, the dust is controlled-fed by a volumetric feeder to the pelletizer. The pelletizer is a Pin Mixer that consists of a single shaft with pins extending radially from the shaft, within a tubular housing. The Pin Mixer has a chamber area of 12" diameter by 54" long and is driven by a 40-hp motor and a fixed-speed belt drive. The inside of the Pin Mixer chamber is lined with natural rubber.

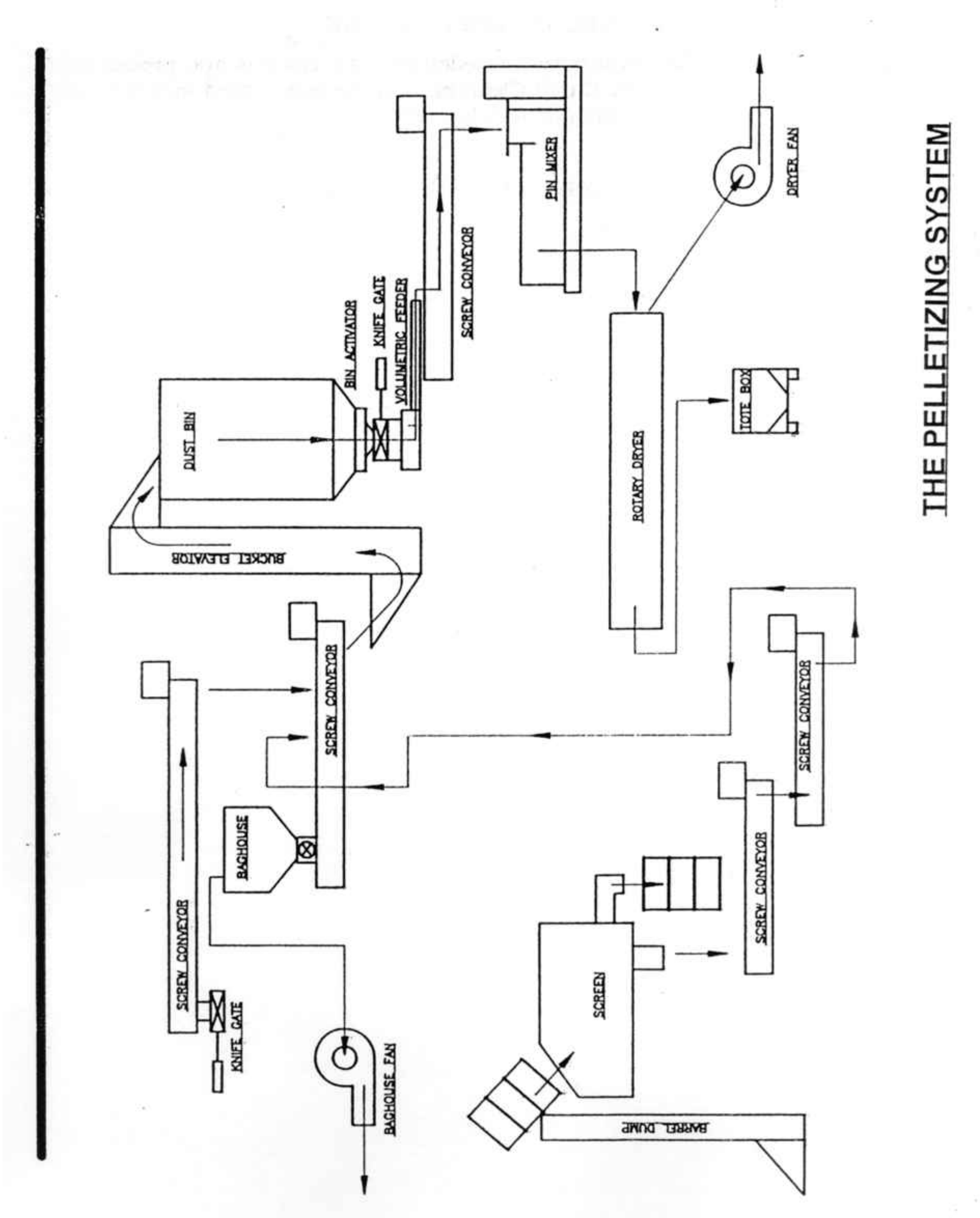
Water is used as the only binder to form the pellets and is introduced through a single port on the upper half of the Pin Mixer chamber.

'The Pin Mixer is continually fed at a rate of 3,500 pounds per hour and continuously discharges the pellets to a rotary dryer.

The rotary dryer is 22" diameter by 22' long and is equipped with internal flights. The counter current dryer utilizes air from the precipitator discharge air stack that is 250 - 300 F. The dryer is also equipped with a gas-fired burner unit that maintains the dryer exhaust gas temperature to 300 F. to assure thorough drying of the pellets to less than 1% moisture content.

The pellets exit the dryer into tote bins that are transported by forklift to the batch materials storage bins. The pellets are dumped into ground-level hoppers, then transported to the storage bin via screw conveyor and bucket elevator. From the storage hopper, the pellets are weighed and added to the batch materials.

The following illustration shows the material flow through the pelletizing system.



ADVANTAGES OF PELLETIZING

The advantages of pelletizing the electrostatic precipitator fines and the Canal Cleanings can be categorized into Environmental, Operational and Economic.

ENVIRONMENTAL ADVANTAGES

A number of environmental advantages come from pelletizing the dusts:

Waste minimization

Recycling of materials that were once sent off site

No off-site transportation of materials and the related liabilities

Can now report lower SARA 313 quantities

By recycling the dust as pellets there is decreased carryover of dust to the precipitators, less particulate in the gas stream and less loading on equipment

Improved worker exposure conditions

Helped lower lead dusting at the furnace charge point

OPERATIONAL ADVANTAGES

By recharging pellets, the following operational advantages to OI-NEG are:

Trends indicating an increased density of the glass, which means that more lead is being introduced to the glass.

Weighing of the pellets through the normal scale system improved the repeatability, reliability and accountability of EP dust being charged as pellets.

With the improved addition of pellets over dust, the safety margin of lead being added to the batch could be reduced.

The better results of recycling the pellets improved the consistency, which stabilized the quality of the glass.

ECONOMIC ADVANTAGES

By installing the pelletizing system, the following economic advantages are evident:

Direct replacement of pellets for Litharge. Five pounds of pellets are being charged to the furnace which replaces four pounds of Litharge per batch.

Reduced reclaiming fees and transportation costs

Decreased liability associated with transportation of materials off site

Increased stability of the furnaces, which reduces raw material costs.

PELLETIZING SYSTEM OPERATION

The pelletizing system was installed in the Fall of 1992 and placed on-line in December 1992.

The pelletizing system has been in daily operation since that time to deplete the drummed Canal Cleanings and precipitator dust, as well as the ongoing production of dust.

In early 1993, the "F" furnace was converted from a Gas/Air to a Gas/Oxygen fuel, which practically eliminated the collection of Canal Cleanings for that furnace.