ASH UTILIZATION AND DISPOSAL

by

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ABSTRACT

There are many changes taking place in the utilization and disposal of ash and related materials and each day it seems that there are more restrictions on the disposal of ash. In one project, mass burn ash has been screened to remove the plus one inch pieces and then combined with the fly ash and portland cement to produce a pellet that is non-leaching with all of the heavy metals "fixed".

In the northeastern United States, the ash from circulating fluidized bed combustors needs to be pelletized so it can be transported back to the mine for easy disposal. The ash can also be blended with digested municipal sewage sludge to form a soil additive which contains lime and nutrients.

The new clean air standards are making it necessary for utilities to install sulfur dioxide scrubbers which produce gypsum. This gypsum filter cake can be pelletized so that the pellet produced can be utilized in the final grind of Portland cement or can be disposed of in a non-leaching pile.

We have taken the lead in producing these agglomeration techniques and many more processes which we will describe and show the detailed process flow diagram for each of these methods.

INTRODUCTION

The utilization and disposal of fly ash in a legal and environmentally safe manner is becoming a major engineering challenge because of rapidly changing government laws and regulations.

There are many changes taking place in ash management based on the fact that pellets can be produced which are non-leaching. Pellets can be moved with conventional bulk material handling equipment without producing a dusty environment. The pellets can be disposed of in any type site and do not need to be placed in a lined landfill. In addition, slight modifications to the pelletizing process can produce usable products such as lightweight aggregate or aggregate to be utilized in asphalt.

We see that each situation or plant needs to be treated as a separate problem and a process developed to solve that particular problem. The two key pieces of equipment required to process fly ash are the Ferro-Tech-Turbulator™ (Figure 1) and the Ferro-Tech Disc Pelletizer (Figure 2). The Ferro-Tech-Turbulator™ is a proprietary, intense, highly efficient, agitative agglomeration device. The unit has maximum efficiency because it operates by fluidizing the material and atomizing the injected liquid. Each whirling dust particle is uniformly coated with a very thin layer of water or other binder. These coated dust

particles, moving at a high velocity in suspension, collide and impact with great force with the other coated, spinning particles within the turbulent wake created behind the pins, forming a very uniformly sized and dense particulate or microgranule. The thick, resilient polymer liner in the Turbulator™ combined with critical close pin tip tolerance causes the pins to fully sweep or wipe the liner, eliminating product build-up on the inner casing of the Turbulator™ body. Because of the intensity of the Turbulator™, it can efficiently pre-blend, de-dust, blend, condition, densify, hydrate and micropelletize all types of fine powders, dust, fume and hard-to-wet particulates. The fly ash particles are uniformly coated with water in the Turbulator™ before they are discharged to be pelletized in the disc pelletizer. The conditioning step in the Ferro-Tech-Turbulator™ compensates for the variation in particle size and surface area which is an inherent quality of fly ash, due to changes in combustor operations and variation in fuel.

CIRCULATING FLUIDIZED BED COMBUSTOR ASH AGGLOMERATION

Most of the new cogeneration plants are utilizing a circulating fluidized bed combustor principle which burns coal having reasonable levels of sulfur (up to 3%). The ash from these combustors consists of two fractions, bed drain or bottom ash and fly ash. The bed drain ash is approximately 25 to 30% of the total ash. The best ash systems keep the two ash fractions separated so they can be blended uniformly together for agglomeration. The fly ash can be agglomerated alone, but the bed drain ash must be blended with at least 50% fly ash before quality pellets can be produced.

The basic process flow diagram for producing a 1/4" x 1/2" pellet is shown in Figure 3. This system includes two (2) surge bins with feeders feeding the ash into a Ferro-Tech-Turbulator™ where most of the water required for pelletizing is added. The conditioned ash from the Turbulator™ discharges directly into the disc pelletizer where pellets are formed. This disc pelletizer is designed for this specific agglomeration application. The pellets or green balls from the disc pelletizer have a modest amount of strength so that they can withstand the treatment of the material handling system to the pellet curing area. The pellets require some curing if they are to be moved by normal material handling methods. After curing, a typical 1/2" diameter pellet may require a force of 300 pounds to crush it. These pellets can easily be utilized as road bed material or as aggregate in concrete.

CIRCULATING FLUIDIZED BED COMBUSTOR ASH AGGLOMERATION
(High Sulfur Coal)

When a high sulfur coal (above 3%) is burned in a circulating fluidized bed combustor, this fly ash acts very differently. When water is added to the fly ash in a Ferro-Tech-Turbulator™, the ash very quickly (5 to 10 minutes) gains temperature. A typical temperature is shown in Figure 4 where the temperature rose to 290° F in seven minutes. If enough water has been added to produce pellets, the pellets will quickly heat up and will completely disintegrate becoming an even finer dust than it was in the beginning.

The process flow diagram necessary to produce pellets from this fly ash on which Ferro-Tech holds a patent is shown in Figure 5. The conditioned fly ash from Turbulator™ No. 1 is discharged directly into a conditioning bin where the fly ash hydrates and the temperature increases to as much as 300° F. The conditioned material from Turbulator™ No. 1 is retained in the conditioning bin until all of the water which was added in Turbulator™ No. 1 has chemically reacted and the fly ash is completely dry. During the hydration phase, the chemical reaction will produce much finer particles with a lower bulk density than the original fly ash. The material from the conditioning bin is fed into Turbulator™ No. 2 where most of the water for pelletizing is added. Again, the material from the Turbulator™ is discharged directly into a disc pelletizer where pellets are formed. The pellets are placed in a curing area where they cure and gain strength.

FLY ASH LIGHTWEIGHT AGGREGATE

One of the better uses for Class F and Class C fly ash from pulverized coal power plants is to produce lightweight aggregate. This aggregate can be utilized to produce lightweight concrete block and other masonry forms. The basic process flow diagram for the process is shown in Figure 6. The aggregate seems to have many advantages over other lightweight aggregates including its spherical shape. The aggregate produced by this process bonds to the mortar with both a mechanical bond and a chemical bond instead of just a mechanical bond as is true of other non-reactive aggregates.

The bulk density of the aggregate is approximately 45 to 50 lbs./cu.ft. The typical sieve analysis (ASTM C136) of the aggregate for concrete block is:

Sieve Size	Product Percent Passing	Specification Percent Passing
1/2"	100	100
3/8"	99	90 - 100
4 mesh	83	65 - 90
8 mesh	49	35 - 65
16 mesh	31	---
50 mesh	19	10 - 25
100 mesh	15	5 - 15

SYNTHETIC GYPSUM & FLY ASH PELLETIZING

One of the major problems at pulverized coal power plants burning high sulfur coal which have a wet line scrubber is how to dispose of the synthetic gypsum slurry. One very simple solution is to produce a pellet by blending dry fly ash with the gypsum filter cake or even with the gypsum slurry. Figure 7 shows the basic process flow diagram for the required system. In this system, the filter cake is metered into the Ferro-Tech-Turbulator™ at a constant rate. The feed rate of the fly ash is controlled by a Ferro-Tech patented moisture control system on the disc pelletizer. This system adjusts the feed rate to maintain a constant surface moisture on the pellets which are about to discharge from the disc pelletizer.

The pellets from the disc pelletizer are placed in a curing pile where they gain strength before being placed in a landfill. The pellets increase in strength quickly and can then be transported in standard material handling equipment.

MASS BURN ASH AGGLOMERATION

The processing of mass burn ash is in a state of change since there is obviously a need to produce a product that has all of the heavy metals "fixed" so they do not leach from a landfill. The requirement is to process both the bottom ash and the fly ash. Processing the bottom ash alone is very difficult because of the extreme variation in the size of the pieces and in the high moisture of the material. A finger screen can be utilized to separate the plus one inch particles from the minus one inch pieces even though the moisture may be as high as 20 to 25% as shown in Figure 7.

Once the oversized pieces are removed, the available fly ash is added uniformly along with 15 to 20% Portland cement. These are all fed directly into a disc pelletizer which is equipped with a reroll ring. Moisture is added to the disc pelletizer through spray nozzles until pellets are produced. It normally requires a total of 16 to 20% moisture to produce pellets.

The completed pellets are discharged from the disc pelletizer pan into the reroll ring where 1 to 3% Portland cement is added to coat the pellets. The coating of the pellets with Portland cement serves two purposes. The first purpose is to seal the surface of the pellets which will assist in eliminating any leaching, the second purpose is to keep the pellets from sticking together as they cure in the tote bin.

After approximately seven days of curing, the heavy metals in the ash are fixed to the point that they will pass the T.C.L.P. leaching test. The pellets will have strength enough to be easily handled and should not crush under normal handling.

CONCLUSION

Essentially any fly ash can be agglomerated into non-dusting and non-leaching agglomerates. The requirements for the agglomerates keep changing and become more restrictive as the regulators try to make the environment safer. Our goal is to assist the customer in developing the best process to fulfill the regulators present and future demands. Many of the processes appear to be simple, but there has been much experience involved in the development. We feel that the simplest process is the best process if it meets all of the customer's goals. We know that each situation is unique and a process must be adapted to the special ash from a specific plant. It is advisable to cooperate with a supplier who has the most experience so you can have confidence in their recommendations.

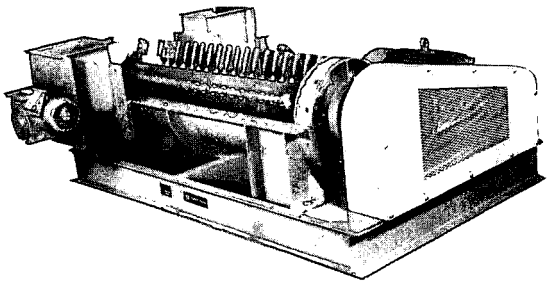


FIGURE 1
FERRO-TECH-TURBULATOR™

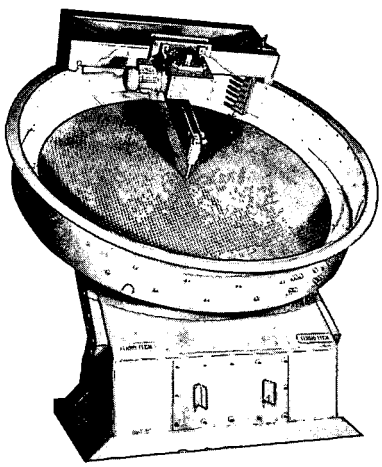
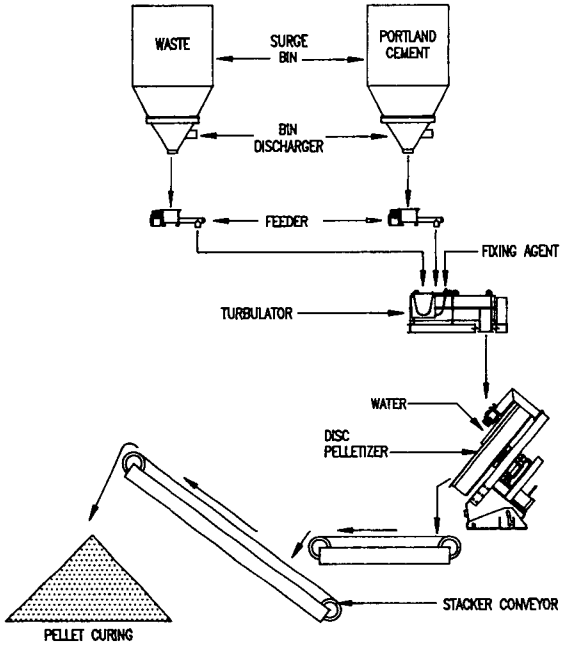
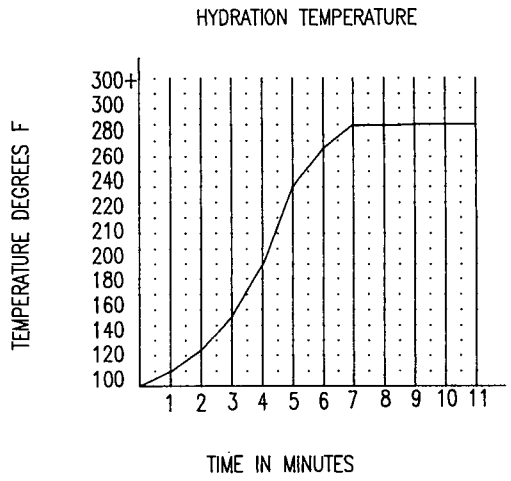


FIGURE 2
DISC PELLETIZER



C.F.B. Ash Pelletizing System
Figure #3



Temperature Curve
Figure #4

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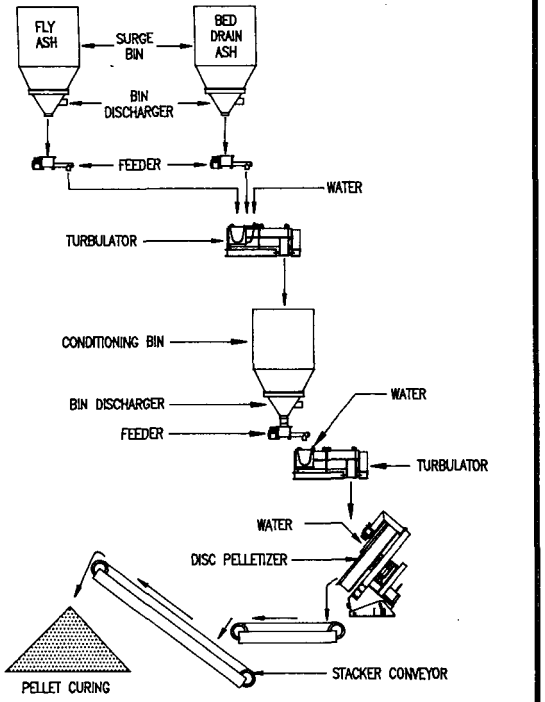
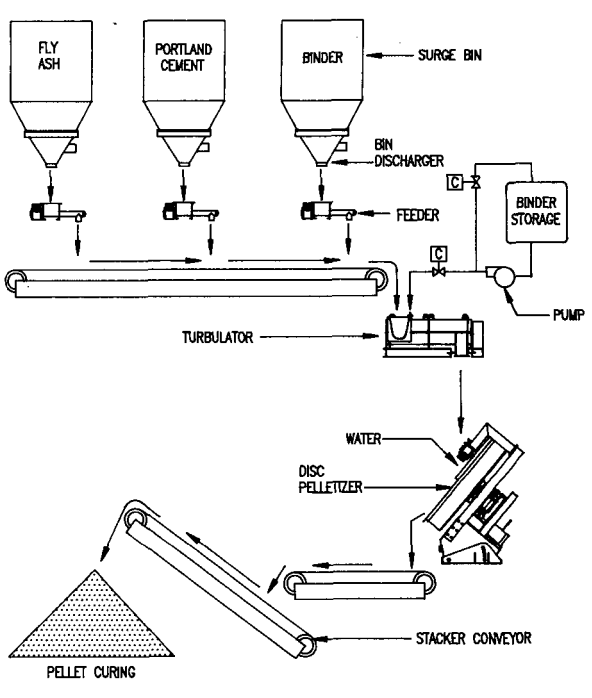


C.F.B. Ash Pelletizing System
High Sulphur Coal
Figure #5



Fly Ash Light-Weight Aggregate
Figure #6

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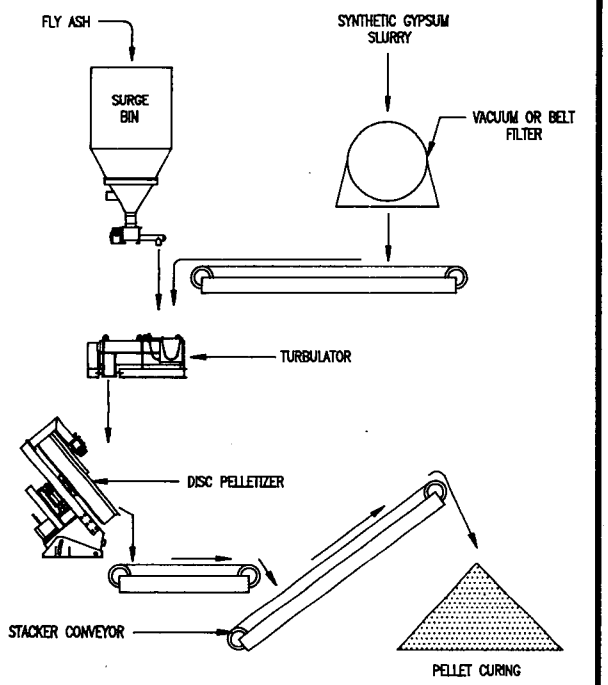
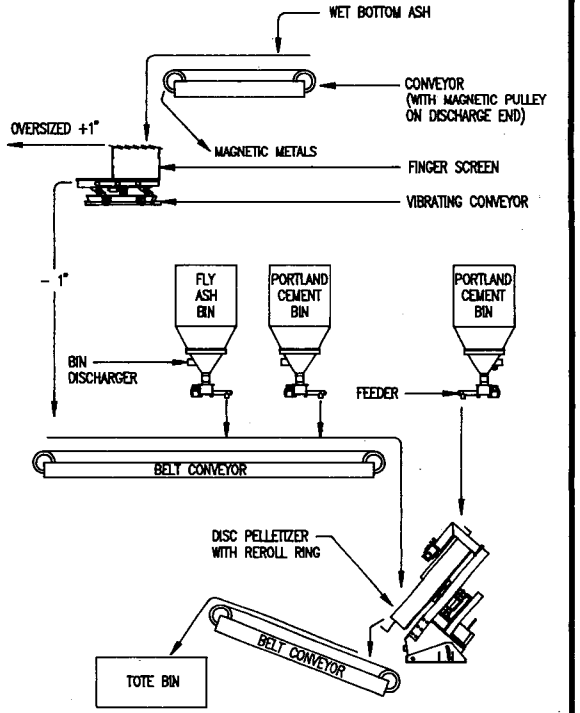


Synthetic Gypsum & Fly Ash Pelletizing
Figure #7



Mass Burn Ash Agglomeration
Figure #8

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