ASH MANAGEMENT CONSIDERATIONS FOR
REFUSE-FIRED BOILERS

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Discussion by

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First of all, I would like to congratulate the authors for presenting a superior paper and succeeding in covering the major aspects of ash management.

But, being named a discussor and being asked to present a 2-3 min talk, I had to find something, even if I had to use a magnifying glass.

Most of my comments will follow the same route as the paper presented did and are as follows:

Knowing that water usage, transport to disposal site, etc. are becoming more and more an economic problem, I think that, when analyzing the mechanical transport of bottom ash by means of submerged scraper conveyor, attention should be paid to the percentage of water retained in the residue and ways to reduce that by designing the conveyors to operate at optimal speed. The authors should address themselves to this item by giving us their recommendation together with some parameters to be used to come up with the optimal size.

It is mentioned that the siftings' collected under the grate should be transported via a screw conveyor. I feel that the choice for transporting the siftings is wider and the choosing of the right conveyor should be based on the character of the siftings (size, etc.)

Experience has proven that if the siftings contain molten aluminum or other large particles, the screw conveyors are unacceptable.

Belt conveyors are mentioned as a type of conveyor to be used to transport the combination of bottom ash and siftings.

Generally, in a mass burning facility without any separation or classification facility, the ash will contain large amounts of glass and metal, which would damage the belt, shortening its life.

Traditionally, rotary airlock valves have been used as seals in the fly ash handling systems. Due to increased maintenance cost, new methods, such as double dump valves, are entering this field. However, the number of rotary airlock valves or double dump valves needed are identical and where they are placed depends on the baghouse or electrostatic precipitator designer/supplier's hopper design.

When trough hoppers or gas-tight conveyors are used, a rotary airlock valve can be placed in the same position as a double dump valve – and that is at the end of the conveyor.

I think it would be helpful if the authors would elaborate on the recommended maximum length of a screw conveyor used to handle fly ash.

The majority of plants in this country use drag conveyors to handle fly ash because of failures experienced with screws. But the most important factor in designing the fly ash handling system is the starting point. The correct quantities needed to be handled and establishing the correct bulk density are critical in designing a successful system.

We all know that any of the described conveyor sizes are based on volume so the correct bulk density is the most critical number.

It would be interesting to have the authors give us typical bulk densities for all the ash collected at different points.

When covering the pneumatic method of handling fly ash, the use of a silo is mentioned. I think the authors should have gone into a more detailed analysis of the
problems encountered when using a silo such as:

(1) No flow
(2) Sticking
(3) Need of vibrators, air pad, vibrating bin discharger, etc.

Because the fly ash is very dusty — environmentally unacceptable to be handled dry — there is a need to employ an ash conditioner (wetting down mechanism).

All of these items negatively affect the economics of the project because not only do you have to increase your initial capital investment, but also, the use of the ash conditioner requires maintenance, additional manpower, etc.

Adding all these factors together, such as the danger of explosion, increased cost, etc., I think a more firm negative qualification should be given to the pneumatic method — and possibly consider it unacceptable.

In this country, to our knowledge, only a few pneumatic installations have been designed and used, and even those few eventually had to be replaced.

To use belt conveyors to handle fly ash should be considered environmentally unacceptable due to the character of the fly ash which is very dusty, fine, and could not be handled cleanly.

Knowing that in the future some of the installations will require the use of scrubbers, the designers of ash handling systems will have to pay careful attention to the type of ash produced by the scrubbers; chemical characteristics, bulk density, etc.

I think the attendees would have greatly appreciated it if the authors would have touched upon some specific installations with the complementary operating experience.

This represents, in a nutshell, my comments to this paper.

Discussion by

Georg Stabenow
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The authors are to be commended for a well written and concisely prepared paper. A clearly prepared presentation on this subject has been needed for a long time.

It may not be quite correct to state that prepared municipal refuse, also known as RDF, is gaining momentum, as in reality the mass burning systems seem to gain greater prominence at recent installations throughout the U.S.

Mass burning has the advantage of reduced fly ash carry-over with the combustion gases and consequently eases the separation of the dust burden in the boiler passes and the electrostatic precipitator.

The incinerator fly ash density is not 25-30 lb as shown in Table 4, but only 12-15 lb/ft^3 when collected from the economizer and ESP hoppers in comparison with the density of fly ashes from coal of 35-40 lb/ft^3. This considerably lower fly ash density causes separation and collection difficulties in the ESP unless the gas flow velocity is reduced to less than 2.5 ft/sec.

A low gas velocity creates a large ESP cross section and consequently results in wide fly ash hoppers. Rather than to select a multiplicity of pyramidal hoppers with individual rotary air lock valves, the present trend is toward using trough type hoppers which span the full width of the ESP. These hoppers have internal screw conveyors and only one double dump type valve rather than high maintenance rotary valves as already mentioned in this paper. The trough hoppers are normally not subject to clogging and require less maintenance. The chance for false air infiltration and hopper fires is hereby also greatly reduced.

Separate storing of fly ash in silos has also proven economically unattractive as fly ash is not easily saleable. For this reason, the fly ash is in many cases led back to the stoker discharge chute where it is intimately mixed with the residue from the furnace in a quench bath.

Neither submerged scraper conveyors nor hydraulic transport means of bottom ash have proven to be reliable due to bulky contents.

Ram type residue dischargers with a water reservoir for quenching of the combined stoker grate residue and fly ash is now widely used and has shown to be reliable and requires little maintenance. The ram pushes the residue ash upward above the water level for drainage of excess moisture before being discharged to a dry-run belt conveyor with not more than 15% moisture.

The horizontal single belt conveyor handling the slightly moistened stoker grate residue and fly ash operates dust-free and in many cases discharges to a 15% inclined conveyor which elevates the residue to a free standing 40-50 ft high surge pile. This method eliminates the use of a one-sided concrete bin and allows access from all sides for metal recovery.

The method described is conservative in energy use with a minimum of wear for residue and fly ash handling equipment and can therefore be considered reliable, efficient as well as economical.

The discussor agrees wholeheartedly with the major points of this paper.

AUTHORS' REPLY

To Judith Stelian

The dewatering design of the Submerged Scraper Conveyor is a function of the length of the slope, angle of the
slope and speed of the conveyor. To maximize dewatering of the ash, a variable speed drive is recommended so that the conveyor speed can be matched to the actual ash loading. Use of herringbone-type construction on the dewatering slope has proven effective in allowing water to quickly drain from the flights.

The authors disagree that large particles will become lodged in the siftings conveyor. Unless stoker keys are missing or the boiler backstop is damaged, siftings will consist only of those particles which are small enough to sift through the small spaces between the stoker keys.

A specified length of screw conveyor is prepared by assembling successive conveyor sections consisting of trough, screw, cover and hanger. The overall length of the conveyor is limited by the amount of torque that can be safely transmitted through the screw shaft and couplings. The conveyor manufacturer can best determine the maximum allowable length for a particular set of design conditions.

To Georg Stabenow

The authors agree with Mr. Stabenow that the fly ash densities in Table 4 are too high. The suggested values of 12-15 lb/ft³ are more realistic.

Trough hoppers with internal screw conveyors are well suited to many ESP arrangements but maintenance accessibility can be difficult due to non-isolation between the hopper interior and the conveyor.

In reference to Table 5, the authors believe that a submerged scraper conveyor can be specially designed to convey bottom ash from a mass burning unit. Additionally, side-by-side, wheel-mounted SSC’s can be provided for quick changeover if problems arise. The use of an SSC under a spreader stoker should not present any problems.

The 15% moisture which is discharged from the ram-type discharged seems to be a low figure, especially considering that fly ash is mixed in with the bottom ash. Our experience is that fly ash does not dewater successfully. Depending on the fraction of fly ash which comprises the sample, the actual percent moisture could be as high as 50%.

The authors suggest inclusion of a three-sided bin only for convenience in containment and for environmental reasons. The bin would be a minimal-cost concrete structure.