A lot of ash is generated in the Boiler and the same is collected at various points –

- Bottom Ash Hopper
- Economizer Hopper
- Air pre-heater Hopper
- Electrostatic Precipitators (ESPs)

This ash has to be transported to various points as per customer requirements either in dry form or wet form.
BOTTOM ASH HANDLING

- **WET MODE**
  - Water Impounded Bottom Ash Hopper + Jet Pump Type system
  - Submerged Scraper Chain Conveyor

- **DRY MODE**
  - Dry Bottom Ash Handling for CFB
  - Dry Bottom Ash Handling for PCB
WET MODE - Water Impounded Bottom Ash Hopper + Jet Pump Type system

System consists of:

- Water Impounded Bottom Ash Hopper
- Bottom Ash Overflow Tank
- Feed gate
- Clinker Grinder
- Jet Pumps
- Associated slurry duty valves
- Pumps to handle bottom ash hopper overflow and drain
Water Impounded Bottom Ash Hopper
Bottom Ash Overflow Tank
Feed gate
Clinker Grinder
Jet Pumping System
Schematic of Water Impounded Bottom Ash Hopper + Jet Pump Type system
Bottom Ash Slurry to Ash Dyke

- Bottom Ash can be combined with Wet Ash from other sources at a common slurry sump and pumped to Ash Dyke by Horizontal Ash Slurry Pumps conveying Slurry in lean phase (30-35% conc. w/w)
Bottom Ash Slurry to Ash Dyke

- Bottom Ash can also be conveyed to Ash Dyke through dense phase (50-60% conc. w/w) directly by Hydraulic Membrane Pumps having specialized materials of construction for handling highly abrasive slurry.
WET MODE – Submerged Scrapper Chain Conveyor

System Consists of:

- Bottom Ash Hopper
- Submerged Scrapper Chain Conveyor
- Belt Conveyor
- Bottom Ash Storage Silo
- Hydraulic Power Pack
Submerged Scrapper Chain Conveyor
Belt Conveyor

Housing of Belt conveyor
Bottom Ash Storage Silo
Hydraulic Power Pack
Schematic of SSC Conveyor
**DRY MODE – Dry Bottom Ash handling for CFB (Magaldi System)**

System Consists of:

- Refractory lined transition chute/hopper
- Ash Cooler Extractor (typical of Magaldi system)
- Primary crusher
- Ash conditioner
- Secondary crusher (as per customer requirement)
- Storage silo

- Pneumatic conveying system can be employed if Ash has been ground fine enough for conveying.
Various arrangements of Magaldi System

1. From the crusher, the bottom ash can be discharged through an ash conditioner into an existing ash conveying system, or into a truck or pit. This kind of configuration can be particularly attractive for retrofits, replacing the existing wet bottom ash extractor by a MAC extractor, whereas the existing downstream conveying system may be maintained. In that way, all benefits of primary extraction by the MAC system are obtained with minimum costs for installation of new equipment.

2. A dry mechanical transport to a silo, without wear, can be provided by a Magaldi Postcooler. The Magaldi Postcooler is a steel belt conveyor inside a sealed casing, providing a significant further cooling of the ash during conveying, with the dependability of the Magaldi technologies.
Various arrangements of Magaldi System

3. By the installation of a second crushing stage after the primary crusher, the ash size is fine enough to enable the transportation by a pneumatic vacuum system. With this configuration, the system can be fitted even in very restricted spaces.

4. If the dry bottom ash is pulverized by mills to a very fine size, it can be mixed with the fly ash. This can lead to a simplification of the overall ash handling system and increased ash sales revenues. In this configuration, usually a Magaldi Postcooler is used to transport the ash from the crusher to the pulverizers, followed by pneumatic conveying to the fly ash silo.
Magaldi Dry Bottom Ash System

Conveyor from Bottom Ash Hopper

Ash Cooler below Bottom Ash Hopper
Advantages of this system

- All moving parts are inside casing and no manual intervention required during operation.
- No requirement of water thus eliminating pumps, heat exchangers, clarification systems.
- No environmental regulation problems related to water pollution.
- Low wear of belts as relative motion between ash and belt is not there.
Advantages of this system

- Low power consumption as water is not moved, only ash.
- Heat can be recovered from hot ash and resent to boiler, thereby increasing boiler efficiency. This is not possible in wet systems.
- Dry ash has better sales opportunities than wet ash.
DRY MODE – Dry Bottom Ash handling for PCB

System Consists of:

- Bottom Ash Crusher
- Conveying chain drive unit
- Conveyor
- Sweeping chain
- Ash well and shutdown gate
- End tightening unit of conveying chain
- End tightening unit of sweeping chain
Schematic of *Dry Bottom Ash handling for PCB*
List of Self Manufactured and Bought out items of most vendors for Wet Bottom/Coarse Ash handling system

<table>
<thead>
<tr>
<th>S.No</th>
<th>Equipment</th>
<th>SMI/BO</th>
<th>Approx % of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bottom Ash Hopper accessories</td>
<td>SMI</td>
<td>2% * site fabrication cost of BA Hopper not included</td>
</tr>
<tr>
<td>2.</td>
<td>Air Oil Convertor tanks/Feed gate housing/clinker grinders/jet pumps/flushing apparatus</td>
<td>SMI</td>
<td>22%</td>
</tr>
<tr>
<td>3.</td>
<td>ACI Fittings/Sleeve couplings &amp; adaptor couplings/expansion joints/expansion bellows/adopters for hoppers</td>
<td>SMI</td>
<td>6%</td>
</tr>
<tr>
<td>4.</td>
<td>Refractory</td>
<td>BO</td>
<td>10%</td>
</tr>
<tr>
<td>5.</td>
<td>Drives for clinker grinder/BA Overflow pumps</td>
<td>BO</td>
<td>10%</td>
</tr>
<tr>
<td>6.</td>
<td>BA Overflow Pumps</td>
<td>BO</td>
<td>5%</td>
</tr>
<tr>
<td>7.</td>
<td>MS ERW Pipes</td>
<td>BO</td>
<td>30%</td>
</tr>
<tr>
<td>8.</td>
<td>Valves for slurry line application</td>
<td>BO</td>
<td>15%</td>
</tr>
</tbody>
</table>
Present trends in Bottom Ash Handling System

- Suppliers normally do the system engineering.
- Most suppliers self manufacture 60% of the related equipments which amounts to 30% of the cost of the system.
- Equipments like Pumps, specialised valves, drives, refractory and pipes are bought out which account for 70% of the system cost.
- Only M/s Indure self manufactures slurry duty pumps based on Warman design.
FLY ASH HANDLING

- Vacuum-Pressure System
- Pressure-Pressure System
- Pressure Systems
- Air Slide system with pressure conveying
FLY ASH HANDLING

- **Vacuum-Pressure System**
  - 150-200 m can be conveyed through negative pressure upto intermediate silo and 500-600 m can be conveyed through positive pressure system. Most commonly used at present.

- **Pressure-Pressure System**
  - 300-400 m can be conveyed through positive pressure upto intermediate silo and again similar distance through another pressure system upto storage silo.

- **Pressure Systems**
  - 300-400 m can be conveyed with one pressure system.

- **Air Slide System (FLSmidth)**
  - A totally different system which uses fluidized air and gravity for fly ash collection from ESP Hoppers using few specialized but relatively inexpensive equipments.

Various systems are provided based on customer requirements and layout.
Vacuum-Pressure System

System consists of:

- Air intake valves
- Fly Ash line valves
- Mechanical Exhausters
- Bag Filters
- Pipes
- Intermediate Storage Towers
- Ash Transporter Vessel
- Conveying Compressors
- Storage Silos
Pressure-Pressure System

System consists of:

- Fly Ash line valves
- Bag Filters at intermediate & storage silos
- Pipes
- Intermediate Silos
- Ash Transporter Vessel
- Conveying Compressors (same compressors maybe used for both pressure systems)
- Storage Silos
Pressure System

System consists of:

- Fly Ash line valves
- Bag Filters storage silos
- Pipes
- Ash Transporter Vessel
- Conveying Compressors
- Storage Silos
Air Compressors
Vacuum Pumps
Common Equipments and Structures for Fly Ash Handling through pneumatic conveying

ASH INLET VALVES

VACUUM BREAKER
Common Equipments and Structures for Fly Ash Handling

BAG FILTER ASSEMBLY

FILTER BAGS
Common Equipments and Structures for Fly Ash Handling

FLY ASH SILO  
ASH TRANSPORTER VESSEL
Air Slide System (FL Smidth)

- Fly Ash from ESP Hoppers is collected by means of Air slides as shown.
Material Conveying

- The air slides are divided into 2 chambers – air plenum and material plenum. The divider is a 5-ply porous membrane having a life of minimum 10 years.
Pump Line Charger

- It is a special equipment required for this system to inject bulk material (ash) into pressurized conveying line. Conveying till silo is carried out by normal air compressors.
Advantages of this system

- Nearly maintenance free. However this testimony remains to be validated in Indian conditions where water & other impurities may enter the air slide line.
- Only 2 moving pieces between ash collection hoppers and storage.
- 50% reduction in capital costs by eliminating expensive vacuum pumps, ash line valves and structures like intermediate ash storage hoppers/towers.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Equipment</th>
<th>SMI/BOI</th>
<th>Approx % of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Wetting head/collector tank/air washer/fluidizing pads/buffer hoppers/air lock tanks</td>
<td>SMI</td>
<td>10%</td>
</tr>
<tr>
<td>2.</td>
<td>Material line valves/pressure relief valves/vacuum breakers/air receivers/rotary feeder/ash conditioner</td>
<td>SMI</td>
<td>20%</td>
</tr>
<tr>
<td>3.</td>
<td>ACI Fittings/Sleeve couplings &amp; adaptor couplings/flanges</td>
<td>SMI</td>
<td>10%</td>
</tr>
<tr>
<td>4.</td>
<td>Air line valves/bag filters/vacuum pumps/blowers/heaters/ash conditioner pumps/drain pumps</td>
<td>BOI</td>
<td>22%</td>
</tr>
<tr>
<td>5.</td>
<td>MS ERW/CI Pipes</td>
<td>BOI</td>
<td>38%</td>
</tr>
</tbody>
</table>
Present trends in Fly Ash Handling System

- Suppliers do the system engineering.
- 35% of the items are bought out by the supplier which account for 60% of the total cost of Pneumatic Conveying system.
- 65% of the items are self manufactured by the vendor which account for 40% of the total cost of Pneumatic Conveying system.
Break-Up of SM and BO Items for Wet Bottom/Coarse Ash Handling and Fly Ash Handling Systems

<table>
<thead>
<tr>
<th>S.No</th>
<th>Equipments</th>
<th>Approx % of total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Bought out items</td>
<td>62%</td>
</tr>
<tr>
<td>2.</td>
<td>Self Manufactured items</td>
<td>38%</td>
</tr>
</tbody>
</table>
Major suppliers of Ash Handling Systems in India

- Macawber Beekay Pvt Ltd. (BSBK group), NOIDA
- McNally Bharat Engineering, Kolkata
- The Indure Pvt Ltd, New Delhi
- Energo
- Tecpro-Ashtech Systems, Pune
- DC industrial Plant Services, Kolkata
- FLSmidth, Chennai
- United Conveyor Corporation, Pune
- Magaldi, Italy
- MELCON, Faridabad
Major suppliers of Ash Handling Systems in India

- New players have also entered the market through means of JVs with other companies together providing complete Ash handling package.

- Some of the players are:
  - UCC - L&T
  - Sinofinn (China) - TRF