Coal preparation

Pulverizers
Unit 17

3.1 Types of PF Systems

1. Direct fired system (commonly used)
2. Semi-direct system (occasionally used)
3. Storage systems (rarely used)
3.1.2 Storage system

Coal preparation train

1.1 Hammer Mill

- A set of hammer hits the coal to crush lump coal to smaller pieces

1.2 Drag Link Feeder
(feeds crushed coal to mill)
2.1 Ball or Tube Mill

- Suitable for hard abrasive coal

2.0 Types of pulverizing mills

1. Ball Mills (Tube Mills)
2. Vertical roller Mills (Bowl & Race Mill)
3. Impact (rarely used) (Beater/ Hammer)

3.2 Coal-pipe –Burner arrangement
(conveys coal from mill to furnace)

2.1 Ball Mills
(steel balls rotates in a drum with coal)
Coal properties affecting pulverization

a) Coal fineness.
Coal should have a minimum amount of both coarse and a fines.

b) Grindability
Hardgrove grindability index is the amount of coal that can be ground in a test mill to specified fineness consuming specified power.

c) Moisture
It agglomerates the fines. So, sufficient hot air is necessary for a mill.

d) Abrasiveness
Abrasiveness index determines the mill wear during grinding.

Fineness requirement depends on coal type

<table>
<thead>
<tr>
<th>Fuel</th>
<th>High rank coal (% below 74 micron)</th>
<th>Low rank coal (% below 74 micron)</th>
<th>Fixed carbon %</th>
<th>Heating value, kJ/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>98-86</td>
<td>85.9-78</td>
<td>77.9-69</td>
<td>&gt;30240</td>
</tr>
<tr>
<td>Water-cooled furnace</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>65</td>
</tr>
<tr>
<td>Cement kiln</td>
<td>90</td>
<td>85</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>
**Mill Characteristics**

Mill output reduces with increasing moisture and fineness.

Conveying air temperature $T_2$

The amount depends on moisture content & temperature. (air velocity in burner tube ~15-20 m/s)

**Maximum temperature of drying air at mill inlet, $T_i$**

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Anthracite</th>
<th>Sub-Bitum</th>
<th>Brown coal</th>
<th>Bituminous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hot air dry</td>
<td>Fuel drying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet temp.</td>
<td>380-430</td>
<td>330-380</td>
<td>350-380</td>
<td>300-350</td>
</tr>
</tbody>
</table>

The drying air should not be too hot to cause premature ignition of coal fines. Reactive coal ignites at a lower temperature than less reactive coal. This sets the temperature limit.

**Maximum temperature of Conveying air at mill exit**

Conveying air should be warm enough to avoid condensation of moisture but also avoid self ignition.

<table>
<thead>
<tr>
<th>System</th>
<th>Storage</th>
<th>direct</th>
<th>Semi-direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>High rank, high VM Bit.</td>
<td>54</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Low-rank, High VM Bit.</td>
<td>54</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>High-rank, Low VM Bit.</td>
<td>57</td>
<td>82</td>
<td>82</td>
</tr>
<tr>
<td>Lignite</td>
<td>43</td>
<td>43-60</td>
<td>49-60</td>
</tr>
<tr>
<td>Anthracite</td>
<td>93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petroleum coke delayed</td>
<td>57</td>
<td>82-93</td>
<td>82-92</td>
</tr>
</tbody>
</table>
Design of Pulverizing system

1. Select the type of storage system (Direct, Semi-direct, Storage)
2. Select type of pulverizer (Tube Mill, Vertical spindle, Impact Mill)
3. Choose capacity & number of pulverizer
4. Calculate air flow & air temperature
5. Select fan & design air-pipe system
6. Select coal feeder to suit the pulverizer
7. Select coal crusher
8. Design coal bunker

Heat balance

- Heat given by drying air, $M_a$ is $H_a = M_a(T_i - T_o) C_p$
- Heat absorbed by the coal = $H_c$
  where $M_d$ dry coal feed, $M_m$ moisture with feed and $Re_m$ fraction of the moisture removed
- $H_a = H_c = M_a(T_i - T_o) C_p = M_d(T_o - T_{rc}) C_c + M_m(T_o - T_{rc}) C_m + M_m Re_m L_m$
- Hot air is a product of preheated air and cold air
  $(T_i - T_{pre}) = R_h(T_{pre} - T_o)$
where $R_h$ is fraction of preheated air in the mixture