Chapter 4
Fuels and Combustion
Part 1
Coal Firing

There are varies ways of coal firing:

1. The ancient hand service.
2. The earliest in history mechanical stokers, which is still used for small boilers with low steam flow rates. The problem with this method is the ash handling.
3. Pulverized-coal firing, which was introduced in 1920 and still widely used until today.
4. In late 1930s cyclone-furnace firing was introduced, but still comes after the pulverized firing.
5. The most recent one is the fluidized bed combustion.
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<thead>
<tr>
<th>Method of Firing</th>
<th>Major Advantages</th>
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<tr>
<td>Mechanical Stokers</td>
<td>• Ideal for small boiling application and low steam flow rates.</td>
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<td>Pulverized coal firing</td>
<td>• It is suitable to a wide variety of coal.</td>
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<td>• Ability to use any size coal</td>
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<td>• Good variable load response</td>
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<td>• Lower requirement for excess air for combustion</td>
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<td>• Lower fan consumption</td>
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<td>• Lower carbon loss and higher combustion temperatures</td>
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<td>• Lower operation and maintenance costs</td>
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<td>• Possibility of design for multiple-fuel combustion.</td>
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<td>Cyclone-furnace firing</td>
<td>• Same advantages as the pulverized coal.</td>
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<td>• Savings in pulverizing equipments and reduction in furnace size.</td>
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<td>• Reduction in fly ash content of the flue gases.</td>
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<td>• Coal sizes covers a wide band.</td>
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<td>Fluidized bed combustion</td>
<td>• Ability to desulfurize the fuel during the combustion</td>
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Pulverized-Coal Firing

- Pulverized coal firing means crushing and grounding the coal to such a fine powder that approximately 70% of it will pass a 200-mesh sieve.
- To burn pulverized coal successfully two requirements must be met:
  1. The existence of large quantities of very fine particles of coal that would pass 200 mesh screen.
  2. The existence of minimum quantity of coarser particles to ensure high combustion efficiency.
- If the delivered coal to the plant is very coarse then it is crushed to the required size by mechanical crushers, which are part of the plant coal-handling system.
- The feed size required in pulverizing is designated at 1.25x0 inch and the one for cyclone furnaces is 0.25x0 inch (which means 0.25 or less).
Crushers

- There are several types of commercially available coal crusher:
  1. Ring crusher or granulator
  2. Hammermill
  3. Bradford breaker, which is usually used at the mining area.
  4. Roll crushers, which is a very simple design that is not stable and does not produce uniform coal size.
Figure 4-3 A ring-type coal crusher. (Courtesy Babcock and Wilcox.)

Figure 4-4 A hammer-mill coal crusher. (Courtesy Babcock and Wilcox.)
Figure 4-5 A Bradford breaker. (Courtesy Combustion Engineering, Inc.)
Pulverizers

- Pulverizing process is composed of several stages:
  1. Feeding system, which is controlled automatically to meet the demand of the boiler different pressures and temperatures.
  2. Drying, which is done by using the air preheaters.
  3. Pulverizing. Pulverizers are also called grinding mills. Grinding is accomplished by impact, attrition, crushing, or combination of these.
- There are several commonly used pulverizers, classified by speed:
  1. Low speed (below 75 rpm), the ball-tube mill
  2. Medium-speed (75-225 rpm), the ball-and-race and roll-and race mill
  3. High-speed (above 225 rpm), the impact or hammermill, and the attrition mill
The Pulverized-Coal System

• There are two systems:
  1. Bin system
  2. Direct-firing system.
Figure 4-8 Pulverized-coal direct-firing system. (Courtesy Babcock and Wilcox.)