Utilisation of Pith as Boiler Fuel

Introduction

Bagasse, by a product of sugar industry has new become one of the important cellulose raw material suitable for the production of various grades of paper. The bagasse produced has a substantial amount of pith, a substance with high, moisture and non-fibrous in nature. It is essential to remove pith from the bagasse before sending the bagasse to the paper industry.

This paper highlights the experience of the author in introducing the pith as a fuel along with coal in a conventional coal fired fired boiler, installed in a paper plant located in Tamilnadu.

Pith Characteristics

Bone dried bagasse has a composition of 60% - 65% fibre, 15% - 25% pith, 5% - 10% water solubles. The pith contains 48% - 52% moisture with calorific value around 2000 kcal / kg. The density of the pith with 50% moisture will be approx. 180 Kg/m .

The Project

The pith firing system was designed and supplied for three boilers each rated for a steam output of 45 TPH at 22 kg/cm2 (g) and 310 °C. The coal fired boiler was located very close to a sugar plant. The boilers are conventional travelling grate with mechanical spreaders for firing bituminous coal as the main fuel. The boiler is also provided with oil burners to fire oil as auxiliary fuel.

The bagasse from the sugar plant is depithed near the boiler house before transportation to the paper mill. The quantity of pith from the depithing station is around 18-20 TPH. Since only two (2) boilers will be in operation to meet the steam demand, the pith firing (Fig.2) system for each boiler was designed for a capacity of 9 TPH.

The pith from the depithing station is transferred to the surge hoppers located at the boiler front through slat conveyor system.

System Design

To promote pith combustion it is necessary to provide certain amount of energy as heat from main fuel to reduce the moisture content in the pith. Another requirement is to have sufficient residence time and turbulence in the furnace in order to get stable and efficient

combustion. Moreover in this project with the available quantity of pith the boilers cannot generate the plant's total requirement of steam and hence it was necessary that pith has to be introduced only as an auxiliary fuel along with the main fuel coal.

Pith being non-fibrous high moisture material, it was decided to go in for pneumatic distribution of the fuel over the travelling grate. In the pneumatic distributor (Fig.3) the air jet projects and distributes the fuel over the moving grate. It was ensured that the fuel enters the furnace in thick uniform and widely; disbursed stream. This helps in drying of the pith in suspension. Most of the fuel is burnt in suspension with remaining consumed after falling over the grate. The distributor has facility for adjustment to change the pattern of distribution. To ensure continuous and healthy ignition in furnace, it was decided to introduce high moisture pith only ;when the boiler load is above 50% MCR.

The pith from the surge hopper is fed to the pith distributors through two streams of screw conveyors / air lock feeders. The speed of the screw conveyor could be changed to regulate the fuel feed rate. The air lock feeder was introduced to arrest leakage of air into the feeding system. Two distributors per boiler was considered mainly to increase operational flexibility.

Various alternatives were considered for locating the pneumatic distributor. Considering the furnace configuration, residence time and the existing spreader stoker arrangement, the location of pneumatic distributor on the right side water wall was found to be the correct choice. In the existing arrangement, the stoker travels towards the coal spreader located on the front wall. The pith distributor arrangement was such that the distributors were close to the front water wall to ensure the quantity of pith spread on the cold end of the grate will be minimum. In this arrangement, the distribution of pith was perpendicular to stoker movement.

The quantity of the flue gas generated from pith firing will be on the higher side due to high moisture in the fuel compared to the coal firing. The existing flue gas, air system was studied in detail to locate the bottle-necks. The quantity of pith per boiler that can be fired along with coal was limited to 8 TPH due to limitation from existing ID fans.

A separate fan was envisaged to supply air for the pneumatic distributor and for the over fire air system. The over fire air system was introduced for increasing the combustion efficiency by turbulent mixing with the un-burnt gases. It also reduces cinder carry over.

To accommodate the pneumatic distributor, the right side water wall tube above the grate was modified. The difference in thermal expansion between the water walls and the pith firing system was taken care by introducing expansion joints.

Commissioning

The boiler with pith firing system was commissioning during January 1988. Before starting the actual firing, the spray pattern of the pith distributor with pith was studied without fire in the furnace. It was found that optimum distribution was achieved when the

distribution air pressure was around 350 mm - 450 mm WG. After starting the fire with coal, the boiler load was brought to 50% MCR load and pith firing was introduced. After the initial adjustments, the firing condition inside the furnace was stable and healthy. After consuming the maximum available pith in the boiler, further load increase was done with increasing the quantity of coal.

Several trials were undertaken at various boiler loads and firing was found to be in order. At no point of time the fire was put off because of the high moisture pith. Even with 30% boiler load with coal, it was found that the pith firing could be started and stabilised.

Conclusion

Utilisation of pith as fuel reduced the coal consumption in this project to an extent of 8-10 TPH and hence it became commercially attractive to the customer. Fuel like pith which widely differs in properties can be utilised along with conventional fuels for steam generation. Such conversions to an existing boiler gives maximum flexibility in fuel and also is commercially attractive as the costlier fuel could be saved. Conversion jobs of this nature require for effective utilisation of industrial / agricultural waste as fuel and it requires case to case analysis.

Specification - Bagasse Pith

Proximate Analysis

Moisture	%	50
Ash	%	3.5
Volatile Matter	%	37.6
Fixed Carbon (By difference)	%	8.9
Gross Calorific Value	%	2000 Kcal / kg

Ultimate Analysis

(As calculated)

Carbon	C	%	24.006
Hydrogen	H2	%	2.744
Oxygen	O2	%	19.75
Nitrogen	N2	%	NIL
Sulphur	S	%	NIL
Moisture		%	50
Ash		%	3.5