DP CleanTech

Creating value from waste

30MW straw-fired boiler
A retrofit case study

Shangcai Henan Province, China

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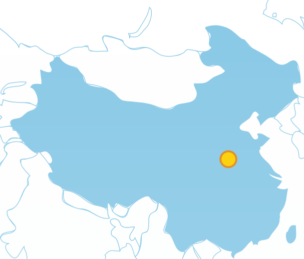


Project Background

Shangcai biomass power plant is located in Henan province, China and is owned and operated by NBE (National BioEnergy) a leading biomass energy operator. The 30MW plant consists of 1x130tph biomass boiler configured for the combustion of corn straw and wheat straw agricultural waste. The project was put into operation in November 2013. However it soon became apparent that performance was being impaired. Upon investigation, some parts of the windward tubes on the heating surfaces were exhibiting abnormal levels of erosion and abrasion. The power plant efficiency was being negatively affected and unplanned shutdowns became more prevalent.

DP dispatched a technical team to work with NBE to thoroughly assess and diagnose the source of the problems. The assessment concluded that the erosion and abrasion levels were directly correlated to fuel quality. With poor or variable quality fuels, the moisture content tends to be much higher, and often there are impurities, such as dirt. The levels of moisture and dirt found in the fuel actually being used were significantly higher than that of the original design fuel. The result of this was a greater volume of flue gas, and a higher ash load than originally designed. Together, these increased the level of abrasion on the superheaters 1 and 2; the economizer and the flue gas cooler, thereby strongly impacting equipment efficiency and product life cycle.

Shangcai Power Plant Challenges

- Frequent erosion and abrasion on the heating surfaces of superheater 1, superheater 2, economizer and flue gas cooler
- Frequent, unplanned shutdowns

DP Problem Solving Approach

It was agreed by DP and NBE that if the fuel quality was going to remain variable and high in moisture and impurities, the best long term solution to address these issues would be a customized retrofit. A feasibility study was conducted to assess the nature and scope of such a retrofit. It was recommended that to reduce the abrasion on heating surfaces and the amount of fly ash, a number of channel-type separators were needed. The effect of these would be to extract most of the larger size dust particles from the flue gas and dispatch them to the #2 slag conveyor; thereby significantly reducing the corrosive and erosive properties of the flue gas and fly ash.

The retrofit took place over seven months, and was successfully completed in May 2014.

Design Solutions

Channel-type separators

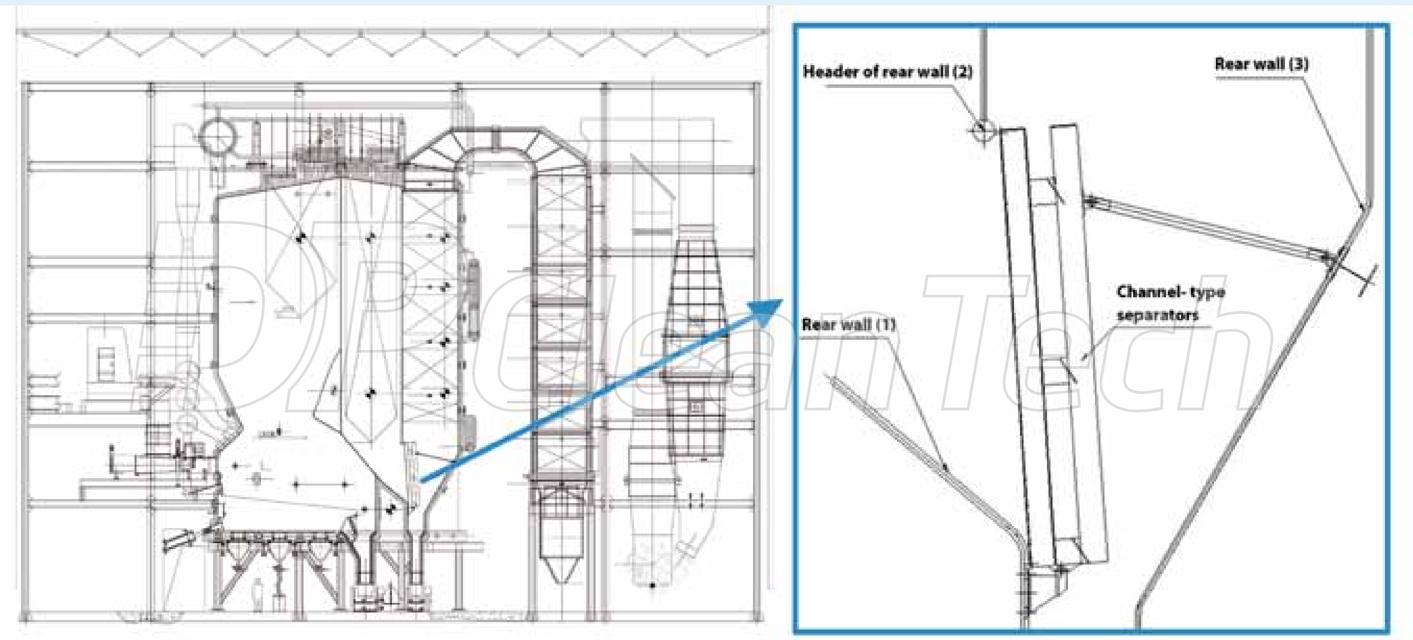
In order to reduce the abrasion to the heating surfaces caused by fly ash, DP proposed an innovative solution to install a group of channel-type separators under superheater 2. Effectively, the direction of the flue gas is changed after impact with the separators. The main gas flow is diverted but the dust particles maintain their original direction. After losing inertia, the dust can be extracted from the main gas flow.

Channel-type separators during operation

After installation of the channel-type separators most of the large size dust particles are now effectively extracted to #2 slag conveyor and the amount of ash discharged has been significantly increased. The impact of fly ash on back-end heating surfaces has therefore been reduced. The separators are considered to be highly effective in reducing the abrasion caused by fly ash.

The test data shows that separation efficiency reached 35% after installation of the separators, whilst the addition of the channel separators has not increased flue gas resistance to any great extent. Comparison of data before and after the retrofit reveals that the output and power consumption rate of the induced draft fan has not been significantly increased, there has been no added resistance along the flue pipe; nor any negative pressure at the heating surfaces.

An additional benefit of the separators is that through the extraction of fly dust particles, the service life of the filters is extended, and the work load of the cyclone filter is reduced.



Location of channel-type separators

Main Customer and Plant Performance Benefits

Plant performance improvements

Item	Unit	Design performance	Before Retrofit	After Retrofit
Daily output	MW	720	691.3	694.3
ID fan inlet negative pressure	-kPa	4.785	2.66	2.63
Fuel heat value	kJ/kg	10940	9603.01	9624.69
Fuel moisture	%	35	30.4	33.22
Fuel ash content	%	4.29	7.15	7.76
Daily ash	tonnes	4.8	18	38.4
Daily fly ash (dry ash)	tonnes	15.3	5	4

The practical and effective solutions to the problems at Shangcai powerplant demonstrate the typical problem solving and collaborative approach DP uses in its pursuit of excellence. DP's fuel knowledge and technical capabilities were successfully used to identify and deliver a number of operational solutions which have subsequently delivered significant economic benefits for NBE.

Customer benefits

√ Increasing the separation efficiency of dust particles to 35%

√ Reduction in the work load of the cyclone filter and bag filter

√ Extension of the equipment service life

√ Reduce the power plant maintenance cost

Customer Feedback

"The channel-type separators extract quite a lot of fly dust particles and effectively reduce the abrasion on heating surfaces without any obvious negative effect to the powerplant operation. The separators can also improve the filter service life by reducing the work load of the cyclone filter.

By protecting the heating surfaces the channel-type separators improve the powerplant operation stability. We are very grateful to DP for providing the retrofit solution. "

Shang Yanwei

Production Dept.

NBE Shangcai Power Plant

Ongoing Development

The problem arising from fuel quality at Shangcai is fairly typical for many biomass power plants in China. However, as well as tackling specific issues, DP's commitment to customers extends to an ongoing programme for continuous improvement. This programme is an important part of DP's virtuous circle of knowledge and future product development.