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RENOVATION OF JGC-30 COAL FEEDING BELT IN THERMAL POWER PLANT

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Abstract

The coal feeder of our company's pulverizing system adopts JGC-30 weighing metering coal feeder. The raw coal in the raw coal hopper falls onto the coal feeder belt through the coal drop port by its own gravity. The existing design of high belt skirt on both sides is 40mm. A small amount of coal blocks falls off on both sides of the belt during the falling process. Due to the wind force of the coal feeder sealing wind and the operation of the belt, a small amount of coal blocks are scattered and stuck at the coal feeder weighing device. The inaccurate coal quantity measurement leads to large fluctuations in the coal feeding quantity of the pulverizing system, that will makes inducing abnormal vibration of the coal mill, insufficient coal powder output, large amount of slag discharge from the coal mill and other problems, which seriously affect the safe and stable operation of the pulverizing system. In this regard, the coal feeding belt was modified, and the skirts on both sides of the coal feeder were increased to 60mm. After the modification, it can be ensured that the raw coal does not fall from the skirts on both sides during the operation of the coal feeder, thereby solving the problem of inaccurate coal quantity measurement caused by coal blocks stuck in the weighing device. This study aims to address the problem by modifying the coal feeder belt, namely by increasing the skirt height on both sides of the belt from 40mm to 60mm. The method applied was to adjust the belt skirt design directly on the operating coal feeder, followed by operational testing to evaluate the effectiveness of the modification in preventing coal falling from the belt side. Results show that after increasing the height of the skirt belt, there is no more coal falling during coal feeder operation. Coal measurement became more accurate, which had a positive impact on coal feeding stability, reduced vibration in the coal mill, as well as increased fine coal output and reduced the amount of slag produced.

Keywords: coal feeder, Belt, weighing, coal mill, coal blocks

Introduction

The JGC-30 weighing metering coal feeder is the main coal feeding equipment for the boiler pulverizing system of coal-fired thermal power plants. It can realize continuous and uniform coal feeding, accurately weigh and measure during the coal feeding process, and automatically adjust the coal feeding amount according to the needs of the boiler combustion control system to match the actual coal feeding amount with the boiler load (Bisset et al., 2023; Eguchi et al., 2021; Ogmen & Ekmekci, 2022). During the operation of the coal feeder, the raw coal in the raw coal hopper falls to the coal feeder belt through the coal drop port by its own gravity. The coal feeder belt is driven by the active roller to rotate. The belt transports the raw coal so that it is delivered to the coal mill according to the required coal feeding amount for grinding to generate qualified coal

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powder for combustion in the furnace. Therefore, the accuracy of coal feeder weighing and metering is self-evident. In the existing design of coal feeder belt, a small amount of coal blocks falls off on both sides of the belt during the falling process. The coal blocks get stuck in the weighing roller metering device, resulting in inaccurate coal measurement. During the operation of the pulverizing system, the coal feeding amount, hot primary air ratio, and hydraulic loading system loading amount are strictly regulated according to the system design values. When the coal amount is inaccurate, the pulverizing system will cause abnormal operation. If multiple pulverizing systems fail at the same time, there is also a risk of unit shutdown. Therefore, we must solve the problem of a small amount of coal blocks scattering from both sides of the belt.

Working principle, structure and function of JGC-30 coal feeder

the JGC-30 weighing metering coal feeder (as shown in Figure 1) is working, the raw coal enters the upper part of the coal feeder belt from the raw coal hopper through the coal inlet gate , and is transported to the coal outlet of the coal feeder in real time by the metering conveyor belt. The coal feeding belt has the characteristics of low price and strong transportation capacity, and has the advantages of easy maintenance during application, and the maintenance cost is relatively low. Therefore, the coal feeding belt has important application value in the production of electric energy in power plants. The raw coal enters the coal mill through the outlet gate to coal mill. Under the metering conveyor belt, a weighing roller with precise size control is installed to form a weighing metering span. A pair of metering rollers connected to a high-precision dust-proof and explosion-proof weighing sensor are installed in the middle of the weighing metering span. When the transported coal passes through the weighing metering span, the weighing sensor generates an electrical signal proportional to the weight of the coal on the belt. At the same time, a speed detector is installed at the shaft end of the main drive motor, and the speed of the belt is sent to the calculation regulator in the form of a pulse signal. The coal weight signal is amplified and A/D converted, and then sent to the F305 calculation regulator in digital form. After the two signals are processed by the calculation regulator, the instantaneous coal feeding amount and the cumulative coal feeding amount of the weighing type metering coal feeding mechanism can be shown. Accurate coal feeding amount is an important parameter for the safe and stable operation of the pulverizing system.

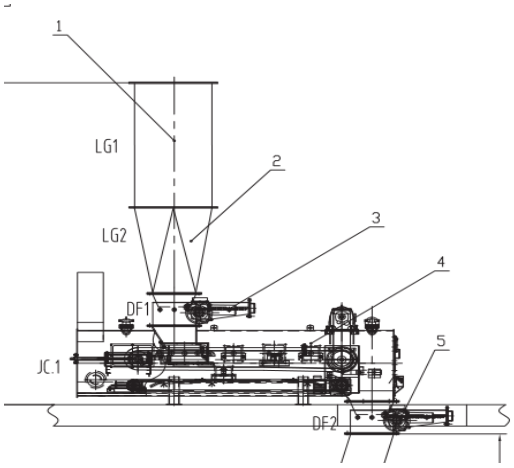

Figure 1. 1) Inlet Coal Feeder, 2) Hopper Coal Feeder, 3) Inlet Gate Valve, 4)Weighing coal feeder, 5)Outlet Gate Coal Feeder

Common problems, phenomena and specific causes of JGC-30 coal feeder belt

1. Common problems and phenomena
   1) A small amount of coal blocks falls from the edge of the coal feeder belt and enter the middle layer of the coal feeder belt. Specifically, the coal blocks are stuck between the coal feeder belt and the driven roller. During the operation of the belt, the protrusion of coal blocks can easily cause damage to the coal feeder belt.
   2) When too much coal is piled up, the driven roller of the coal feeder will get stuck and stop rotating, and the current of the coal feeder belt reducer will increase then unit will shutdown
   3) The coal feeder belt deviates due to different tensions on both sides, or due to the long-term operation of the coal feeder, the different tensions on both sides of the coal feeder belt cause the coal feeder belt to deviate.
   4) As the coal blocks enter the middle layer, the friction between the coal powder, coal blocks and the active roller, driven roller, support roller, weighing roller and tensioning roller increases, resulting in increased wear of the roller shafts, reducing the life time and maintenance cycle.
   5) The abnormal scattering of coal blocks from the coal feeder causes the coal blocks to get stuck in the weighing device, resulting in a large deviation between the actual coal quantity and the coal quantity measured in front of the pan.
2. Common causes
   1) Due to the height problem of the coal feeder belt skirt, the coal blocks accumulated on the belt are scattered from both sides when the coal blocks enter the middle layer of the coal feeder belt.
   2) When the coal blocks fall rapidly from a high place from inlet gate, they are in an unstable state and spread out in all directions, which may cause a large amount of fine materials to fall out from both sides of the skirt.
   3) The coal blocks that fall naturally from the raw coal hopper do not match the speed and width of the coal feeder belt. During the long-term operation of the belt, due

to the high speed of the belt, it may deviate from the track during use. This is common in power plant production, especially long-term movement may reduce its elasticity, leading to more accidents.

4) The outlet sealing air inside the coal feeder is not set properly, and the material in the middle layer of the coal feeder belt cannot be blown off.
5) The cleaning chain of the coal feeder is broken or the cleaning chain of the coal feeder stops operating due to a fault, and coal blocks accumulate at the bottom of the coal feeder and enter the middle layer of the belt.

Solutions to common problems of JGC-30 coal feeder

1. Solutions to Common Problems
   1) The coal feeder belt was modified: a high-strength, wear-resistant, anti-static conveyor belt was used, and the height of the coal feeder skirt was increased from the original 40mm to 60mm to reduce the risk of wear and fire accidents, and reduce the risk of coal blocks falling from both sides of the belt.
   2) Optimize the belt tensioning system: install an automatic tensioning device to keep the belt running at the appropriate tension to prevent slipping and excessive wear. An automatic adjustment device can be added to the running direction of the coal feeder belt to increase the service life of the coal feeder belt.
   3) Install bell cleaners at key locations on the conveyor belt to remove coal dust and debris from the belt and reduce the risk of fire. Note that the additional sweeping device should have a certain strength and should not cause damage to the belt.
   4) Install safety protection devices such as deviation switches and tear detectors to prevent greater losses when the conveyor belt fails.
   5) Strengthen maintenance management: regularly inspect and maintain the coal machine belt to ensure that the equipment is in good operating condition.
   6) Train operators, strengthen training for operators, improve their skill level and safety awareness, and ensure the safe operation of coal machine belts.

   Through the above transformation measures, the operating efficiency, safety and reliability of the coal feeder belt can be improved, improve economic cost and social benefits to the company.

2. Feasibility study of treatment measures for common problems

   Through the exploration of the phenomenon, causes and solutions of the problem, and by modifying the coal feeder belt to appropriately increase the height of the belt skirt, the coordination between the upper coal drop port and the coal feeder belt is more stable. During the operation of the coal feeder, after the raw coal on the upper part of the belt falls onto the coal feeder belt, the skirts on both sides of the belt can retain all the coal blocks on the upper part of the belt, thereby preventing the coal blocks from falling into the middle layer of the belt, and also preventing the coal blocks from falling into the weighing device area and causing inaccurate coal measurement, which greatly

enhances the operating stability and safety of the coal feeder and provides a guarantee for the safe and stable operation of the pulverizing system.

Analysis of the effect after the coal feeder belt transformation

1. Transformation effect

By modifying the coal feeder belt, before optimization (as shown in Figure 2-1), the raw coal in the raw coal hopper naturally falls to the upper part of the coal feeder belt through the coal outlet by its own weight. There is a gap between the coal feeder coal outlet and the coal feeder belt. During the operation of the coal feeder belt, due to the certain speed of the belt, the height of the coal feeder belt skirt is not enough, which will cause the coal blocks to fall from both sides of the belt. After optimization (as shown in Figure 2-2), the coal feeder belt edge is raised from 40mm to 60mm. During the falling process, the coal blocks are naturally spread on the upper part of the coal feeder belt. Due to the cooperation of the skirt edge and the coal outlet, all the raw coal on the coal feeder belt is transported to the coal feeder outlet, and the amount of coal blocks falling on both sides of the belt is greatly reduced. This ensures that the coal blocks do not enter the middle layer of the coal feeder belt, and can also solve the problem of inaccurate measurement of the weighing roller caused by the coal blocks entering the weighing device.

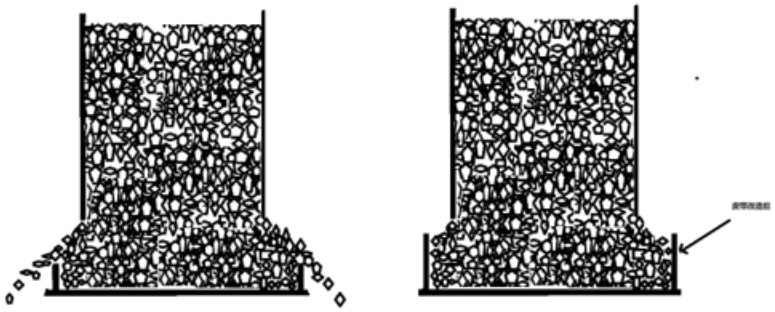

Figure 2-1 Before the coal feeder belt was modified Figure 2-2 After the coal feeder belt was modified

2. Economic Benefits

After the coal feeder belt is modified, the service life of the coal feeder belt is expected to increase from 8,000 hours to 24,000 hours, and the cost of the coal feeder belt can be saved by about 67 million rupiah per year . After the modification, the wear and maintenance cycle of the coal feeder active roller, driven roller, weighing roller, idler roller, and tensioning roller are reduced, and it is estimated that the annual cost can be saved by 115 million rupiah per year. Before the modification, a single unit had 16 defects in the powder making system due to inaccurate weighing and measurement throughout the year, which reduced the number of emergency repairs of the powder making system and increased the safety of maintenance personnel. In summary, a single unit can save 7,2 billion rupiah per year.

Research Method

The study began with a literature review, including an examination of the coal feeder manual, international journal, and other relevant sources. Field visits were conducted to collect operational data on various parameters. During the coal feeder stop, several testing and part condition were inspected. New belt were trialed, followed by an analysis of effects. During normal operation and subsequent stops involved inspections to evaluate the outcomes of the implemented changes.

The following steps were taken to complete the research methodology:

1. Research Location:

   This research was conducted at a Thermal Power Plant utilizing the JGC-30 Weighing metering coal feeder. The research site is located at [PT DSSP Power Kendari, IPP PLTU kendari-3], [Jl. Poros Kdi.- Moramo, Tj. Tiram, Kec. Moramo Utara, Kabupaten Konawe Selatan, Sulawesi Tenggara 93891], [Indonesia]. This location was selected due to the issue of inaccurate measurement of coal weighing and potential coal blocking by coal spillage accumulation from belt, which became the focus of this study.

2. Research Subjects:

   The research subjects were one units of the JGC-30 Weighing metering coal feeder operating at the power plant. These units experienced a significant coal spillage from belt and inaccurate measurement of coal weighing, making them the target for analyzing and resolving this issue.

3. Data Collection Techniques:
   a. Direct Observation: Operational data were collected through direct observation and recording of coal feeder performance parameters during operation. Recorded parameters included coal weighing measurement, number of coal falling from belt, coal amount discharge from coal mill, the roller condition and belt tension, and data from various sensors and switch contact.
   b. Sensor Data: Continuous data were collected from coal weighing measurement, including the sensor and switch of coal blocking indication and vibration of coal mill. Coal Weighing monitored the measurement of coal amount entering to the coal mill, capturing fluctuations related accuration of coal weighing.

4. Data Analysis
   a. Trend Analysis: Historical data on coal weighing measurement and amount of coal spillage from belt were analyzed to identify patterns or trends associated with changes of side skirt belt coal feeder. This analysis helps distinguish between long-term issues and transient fluctuations.
   b. Comparative Analysis: A comparison of key parameters before and after corrective actions, such as coal amount measurement and coal spillage from belt,

was used to measure the effectiveness of the technical interventions. This includes evaluating the impact of increase side skirt height from 40mm to 60mm.

c. Root Cause Analysis: Root cause analysis was conducted to identify the primary factors contributing to the inaccurate of coal measurement. By evaluating field inspection data and expert input, the analysis revealed specific issues such as insufficient belt height and multiple spills that could potentially cause coal blocking.

5. Research Instruments:
   a. Coal Weighing Sensors: Coal Weighing sensors were placed at middle points within the JGC-30 Weighing metering coal feeder. These sensors were used to monitor amount of coal which passes through the coal feeder in real time.
   b. Coal Blocking Sensor: Blocking sensor were used to known condition inside coal feeder. These blocking sensor were made to optimize heat distribution within the furnace.
   c. Pressure Measurement Devices: Pressure measurement devices were used to measure the pressure differential of exhaust gas across the economizer and preheater.
6. Field Visits and Inspections

   During coal feeder operate and stop, conditions within the coal flow and spillage were thoroughly inspected. Inspections were conducted to identify potential blockages, inaccurate coal flow, and other issues that might affect the operational coal feeder.
7. New Belt for Coal Feeder

   Trials of new Belt installed by implementing suggested changes to height of side skirt. The effects of the changes were monitored and analyzed to evaluate their impact on inaccurate of coal flow. Evaluations were performed during coal feeder into operated to assess the outcomes of the inaccurate of coal flow and coal blocking.

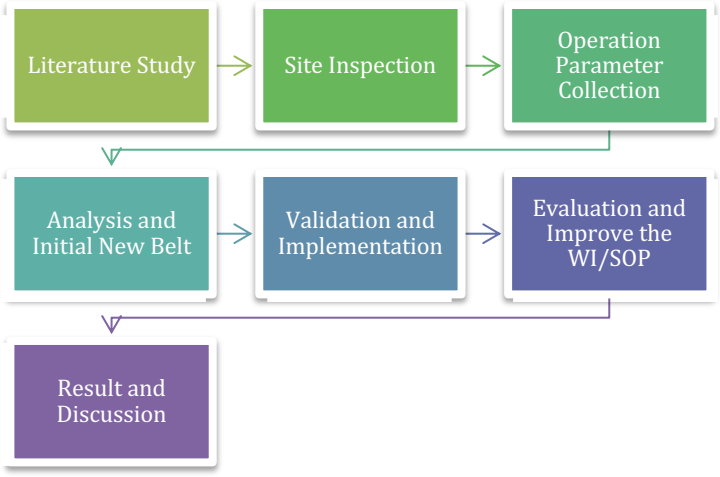

Figure 3. Research Flow

The study involved a detailed analysis of coal feeder with new height side skirt of belt. Coal weighing and blocking sensors were placed throughout the coal feeder to monitor inaccurate coal flow, and coal blocking were used to adjust the effectiveness of new height side skirt of belt. Experimental methods were employed to evaluate the effectiveness of implementing new belt.

Results and Discussion

The corrective measures for inaccurate coal flow and coal blocking in the coal feeder resulted in significant improvements. Initial issues included inaccurate coal flow, coal falling from belt and potential coal blocking under of belt.

1. Replaced new belt was performed to ensure no coal blocking and minimize the inaccurate data of coal flow. Increase the side skirt wall of belt from 40mm to 60m. This adjustment addressed the issue of inaccurate coal flow and coal blocking.

Table 1. Coal Mill Parameters Before Renovation (April 2022)

Parameter	Unit	Coal Mill A	Coal Mill B
Amount of coal block falls	T/h	0.35	0.28
Inaccurate Coal Flow (Diff. Coal Feeder Flow vs Coal Conveyor)	%	+0.87	+0.98
Vibration of the Coal Mill (avg)	mm/s	8.5	9.85
Amount discharge from coal mill	T/h	0.012	0.008

Table 2. Coal Mill Parameters After Renovation (June 2022)

Parameter	Unit	Coal Mill A	Coal Mill B
Amount of coal block falls	T/h	0.12	0.15
Inaccurate Coal Flow (Diff. Coal Feeder Flow vs Coal Conveyor)	%	+0.32	+0.43
Vibration of the Coal Mill (avg)	mm/s	7.5	7.85
Amount discharge from coal mill	T/h	0.010	0.007

2. Routine Inspection and Cleaning for Coal Feeder : During Coal Mill Stop, several preventive maintenance conducted to increase the accuracy of coal flow by cleaning the weighing sensor.
3. Routine Validation and Calibration for Coal Feeder: After conduct coal weighing cleaning in coal feeder, validation or calibration has carry out to verify the accuracy of coal flow.
4. Belt side skirt inspection : As part of preventive maintenance, inspection of belt wear and rubber condition carry out every coal mill in stop position or stand-by.

Discussion

The improvements recorded in this study align with many findings from previous studies that have examined the coal blocking in coal feeder system. For example, modification in coal feeder system, which reduced potential coal blocking, confirms similar results found (Dermawan & Ridal, 2024a; Nugroho & Sunarto, 2017; Tangko et al., 2022; Tian et al., 2015) who reported that several modification carry out to prevent coal blocking in coal feeder. Also noted that modification in coal feeder can prevent coal blocking happen in coal mill system which improve reliability of boiler system by reduce potential coal blocking. Therefore, these findings not only support the existing theoretical framework but also demonstrate the relevance of this solution in the broader context of industrial boilers.

The theoretical principle behind the increase side wall relates to optimizing accuracy of coal feeder and can increase the relibility of unit and coal feeder. The renovation decrease the coal falling at coal feeder also discharge from coal mill. Based on this renovation, the stability of coal flow bring the vibration of coal mill reduce stable in the range and as a result the coal mill maintenance level decreased along with the increasing reliability of the equipment (Abdul et al., 2022; Ardiansyah & Hartati, 2022; Putra et al., 2023; Ramadhani & Putra, n.d.).

Additional improvements, By increasing the height of the side skirt belt coal feeder shows the results of disturbances in coal weighing due to coal spills has improved the coal weighing instrumentation system (Rahmadana et al., 2024) in terms of reading accuracy. In addition, highlights the importance of on-line monitoring of the coal flow conditions in the coal feeder after changes in the height of the side wall and ensuring that the anti-blocking pressure switch (Dermawan & Ridal, 2024b) is activated as a tool to identify potential blocking in the coal feeder. In their research, several steps to prevent coal blocking in coal feeders such as installing screens to classify coal entering the coal feeder. Similar coal blocking prevention measures are also in renovating the height of the belt which can prevent coal blocking in the coal feeder (Nugroho & Sunarto, 2017; Tangko et al., 2022).

Overall, the results obtained in this study are consistent with the existing literature, supporting the idea that implement improvement to prevent coal blocking at coal feeder can increase reliability unit. However, this study also highlights the importance of managing other often-overlooked factors in the literature, such as vibration at coal mill and amount of discharge from coal mill, which also contribute to overall coal mill performance degradation. Therefore, a more comprehensive approach to managing coal blocking and inaccurate coal flow could be adopted to mitigate broader issues in industrial coal feeding systems (Jagtap et al., 2020; Niu et al., 2015; Winarta, 2023)

In summary, this study's adjustments and improvements align with the literature and strengthen our understanding of operational mechanisms that influence coal feeding in pulverized coal boilers. Further research could explore integrating control systems with advanced optimization technologies in various industrial coal feeding settings to enhance reliability and stability of coal feeding into boiler.

Conclusion

By optimizing and modifying the coal feeder belt and increasing the height of the coal feeder belt skirt, the problem of coal blocks falling off from both sides of the belt can be effectively solved, the wear of various internal components of the coal feeder can be reduced, and the service life of the coal feeder can be increased. This can effectively

solve the problem of inaccurate coal measurement caused by coal blocks falling and jamming the weighing device. This optimization and modification has great promotion value within the same industry. It improves the safety and stability of the pulverizing system operation, and can effectively prevent technical problems such as coal feeder belt deviation, abnormal increase in feeder intensive current, coal feeder belt damage, and bearing wear. This method has a wide range of promotion and application value.

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