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Thrust Bearing Governed Clinker Extraction System in Producer Gas Plant

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Abstract- In the process of Producer Gas Production; clinker/ash is formed as a waste material. This clinker is removed by equipment named as Ash Bowl which rotates on the "Guide Roller" by the application of hydraulic pressure. This process having many problems like formation of large size clinker which require excess hydraulic pressure, guide roller is unable to scatter the hydraulic pressure equally in all the direction on the ash bowl to crush the clinker, more hydraulic pressure is required for the movement of the ash bowl, more time is required to replace the guide roller for its maintenance.

In order to eliminate above mention problems, guide roller has been replaced by the thrust bearing which improves productivity by reducing break down time, reducing total man power required & reducing maintenance cost.

I. INTRODUCTION

Coal is India's primary source of energy. It is the cheapest and easiest fuel available in our country. Efficient use of this fuel makes it more cheaper than other fuels. Coal/coke is transformed to gaseous fuel by various methods. One of them is producer gas plant which manufactures producer gas. There are many type of conventional gas producers widely used in industries in India. One 3.2 M Dia extended gas producer has been installed in JSPL to meet up the increasing demand of producer gas. Producer gas is manufactured in this gas producer in a most modern manner.

About The Producer Gas Plant

Fixed bed Coal Gasifier

For producing **low carbon coal** gas as fuel, generally a **fixed bed gasifier** is recommended. In a fixed bed gasifier, the coal passes downward in counter current direction to gas flow, through various phases of drying, de-volatilisation, gasification, combustion zones and is ultimately converted to ash which is extracted by rotation of a grate.

Mixture of air and steam is introduced in lower part of gasifier through rotating grate.

The basic reaction taking place in a typical fixed bed gasifier is **Coal + Air + Steam → CO2 + CO + H2 + CH4 – (Coal Tar + Ash)**

The gas contains considerable amount of tar and in our specific case, it must be cleaned (de-tarred by passing through an Electrostatic Tar Precipitator (ETP). This produces a cold clean gas. In this process of cleaning the gas looses valuable sensible heat amounting to about 7% of heating value of gas

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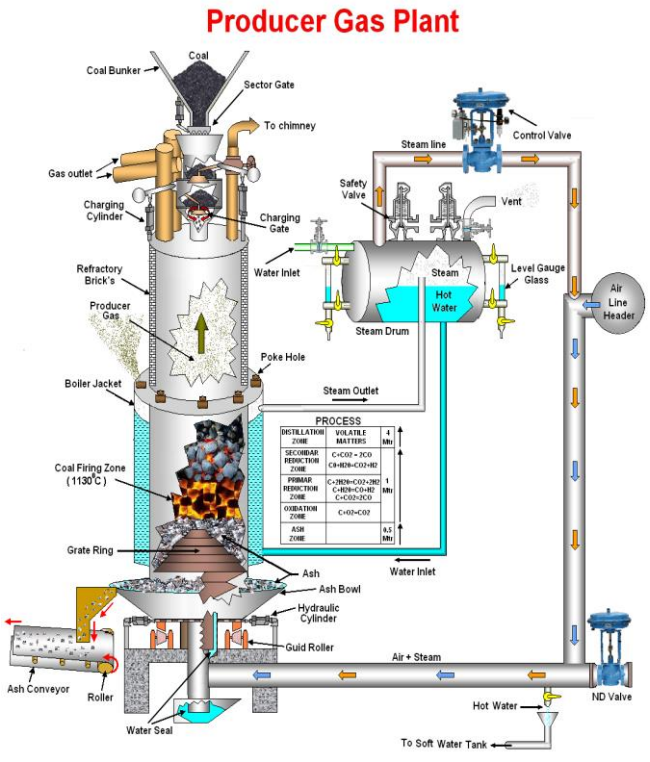
COMPOSITION OF PRODUCER GAS

1) CO=20 -22%,
2) CO_2= 6 -10%,
3) O2= 0.2 - 0.6%,
4) H_2=10 -13%,
5) CH_4= 1.5%,
6) N2 = Balance

PROCESS FLOW DIAGRAM OF PRODUCER GAS PLANT

The process described herein is the "Gasification of bituminous coal" in an extended shaft gas producer. Producer gas is manufactured by blowing a mixture of air and steam through a bed of incandescent fuel and the combustible matter in the fuel is converted to gas. In an extended shaft gasifier the coal is distilled in the upper part and semi coke so produced is completely gasified in the lower part. In the conventional single stage producer, it is not possible to adequately separate the distillation of the volatile matter and gasification reactions between the carbon of the fuel and the oxygen and steam of the air blast. As a result the gaseous products including tar will have to pass through the whole of the fuel bed and this leads the tar getting overheated due to high temperature with consequent disposition of pitch in the auxiliary equipment and pipelines. It become necessary to clean the pipe from time to time which results in



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discontinuity of operation of the plant. This problem is not encountered in this two stage process. In this process, the fuel is heated slowly in the distillation chamber (first stage) and low temperature tar is produced, and the yield of tar is also higher. This tar being a light tar is easily carried by the gas as tar for without setting in the pipelines.

This extended shaft gasifier, consists of a distillation retort, super imposed above the main shell of the conventional single stage gasifier. In this gasifier, coal is gasified in the first stage (distillation zone) by possing the gas produced in the second stage (gasificative zone) through the distillation chamber. This gas degasifies the incoming coal with the sensible heat and comes out of the distillation gas at temperature of about 120^0c to 150 ^{0} c which is known as low temperature carbonization gas (L.T.C). The first stage consists of the coal drying zone, coal preheating zone and the distillation zone.

In the second stage; the Semi coke produced in the first stage is completely gasified by air saturated with steam. The second stage consists of the preheating zone, reduction zone, oxidation zone, ash zone and ash cooling zone.

The LTC gas from the two top off takes of the producer is through a water seal pot where gas is cooled and cleaned by water sprays and the thick tar (tar mixed with coal dust) settles. The LTC gas, free from coal dust so produced goes to the gas collecting main gas header from where it is distributed to the gas consuming furnaces.

One pressure controller maintain a constant desired pressure in the gas collecting main by regulating the air flow to the producer. It is recommended that non coking bituminous coal having a swelling index of 0.5 BS (max) and ash fusion temperature of 1200 ^{0}c (min) should be selected as feed stock for gasification.

As the fuel travel down words by gravity, it gets heated gradually due to exchange of heat from the hot gas moving up words. In the distillation zone, volatile matters, in the fuel are vaporized and transferred into the out going hot producer gas adding to its calorific value due to the pressure of hydrocarbons. The heat released in the oxidation zone considerably cooled down in the primary and secondary reduction zones due to the endothermic reactions. The thickness of the primary and secondary reduction zones are supposed to be of the order of 300mm 450mm respectively. The oxidation zone has the highest temperature due to the exothermic reaction and is believed to be comparatively a thin one with 75-150 mm thickness.

THRUST BEARING TYPES

Thrust ball bearings

Single direction

With flat housing washer
With sphered housing washer and seating ring

Double direction

With flat housing washer
With sphered housing washer and seating ring

Angular contact thrust ball bearings

Single direction
Double direction
Cylindrical roller thrust bearings
Needle roller thrust bearings
Spherical roller thrust bearings
Taper roller thrust bearings

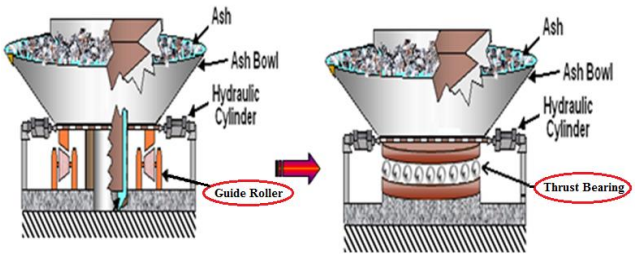
SELECTION OF BEARING TYPES

Each type of bearing displays characteristic properties which depend on its design and which make it more, or less, appropriate for a given application. Important criteria to be observed when designing a bearing arrangement- load carrying capacity and life, friction, permissible speeds, bearing internal clearance or preload, lubrication, sealing etc.

METHODOLOGY

In order to eliminate problems occurring due to guide roller, it has been replaced by the thrust bearing which is a type of single direction with flat housing washer. This improves productivity by reducing break down time, reducing total man power required & by reducing maintenance cost.

Idea: Replacing guide roller and installation of Thrust bearing system.



ANALYSIS

Following points were of consideration before installation of thrust bearing.

1. Hydraulic power pack; used to move guide roller; performance was not efficient.
2. Hydraulic pressure was high for the movement of ash bowl.
3. We were facing the manpower loss.
4. Guide roller maintenance cost was high.

In the process of producer gas production; clinker/ash is formed as a waste material. This clinker is removed by equipment named as Ash Bowl which rotates on the “Guide Roller” by the application of hydraulic pressure. This process having following problems:

1. Formation of Big size clinker which require excess hydraulic pressure.
2. Guide Roller is unable to scatter the hydraulic pressure equally in all the direction on the Ash Bowl to crush the clinker.
3. More hydraulic pressure is required for the movement of ash bowl.
4. More time is required to change the guide roller.

RESULTS & DISCUSSION

Major Findings
1. Reduced break down time.
2. Reduced hydraulic cylinder working pressure.
3. Reduced total man power required.
4. Reduced maintenance cost.

Thrust Bearing
Guide Roller
Brake down time - 0 Hours/month

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Brake down time – 142
Hours/month
Hydraulic Cylinder
Hydraulic Cylinder
Working Pressure – 90 Kg/cm2
Working Pressure - 120 Kg/cm2
Total Man Power
Total Man Power
Required - 0.5 Man Hour / Day
Required - 8 Man Hour / Day

ADVANTAGES

By applying thrust bearing; following advantages have been obtained:

- Reduced break down time.
- Reduced Hydraulic Cylinder Working Pressure – 90 Kg/cm2
- Reduced Total Man Power Required – ½ Man Hour / Day
- Reduced power consumption.
- Saved total maintenance cost = Rs. 3775/day
- Improved hydraulic power pack life.

SUMMARY & CONCLUSION

By replacing the guide roller & using the thrust bearing; we have obtained following major benefits:

1. Reduced break down time.
2. Reduced hydraulic Cylinder Working Pressure.
3. Reduced total man power required.
4. Reduced maintenance cost.

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