



## MAINTENANCE OF ASH HANDLING IN GAS PLANT BY REPLACEMENT OF THRUST BEARING

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 In order to eliminate above mention problems, guide roller has been replaced by the thrust ball bearing which improves productivity by reducing break down time, reducing total man power required & reducing maintenance cost.

### 1. Introduction

The concept of using rolling elements to reduce friction can be traced back to ancient times when an arrangement of tree trunks laid down under sleds was used to overcome the friction inherent in moving heavy loads along the ground. This method was used by the Egyptians to facilitate the transportation of the huge blocks of stone used to build the pyramids. Originally, bearings were made of wood, stone, leather or bone. The first plain and rolling element bearings were made of wood. An example of a

wooden ball bearing supporting a rotating table was retrieved from the remains of one of the Roman Emperor Caligula’s ships found at the bottom of Lake Nemi in Italy.

1. Ignited torches are introduced through all the poke holes at the middle part of the generator and the firewood is lighted.
2. Ensure sufficient smoke is coming out through the vent pipe as well flame stack and poke holes, watch the temperature of vent pipe.
3. On ensuring the fire wood burning properly, after a period of half hour, the ash pan water could be filled up to the level of 4”below the flange joints of the dip ring and jacket boiler.
4. When the wood burns uniformly, some quality of coke should be changed.

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5. During started up, charging system is to be operated on semiautomatic mode and coke to be charged into the producer of and when required.
6. The producer should be put on natural draught by opening the N/D flap or auto valve. So that there exists a slight over pressure of 5mm at the middle part of the producer.
7. If fire has tendency of getting extinguished, air blower is to be switched "on", N/D flapping or valves to be closed, air valves to be opened and blast valves is to be opened slightly so that there exist a slight over pressure (5 mm) at the producer exit. The temperature at vent pipe is to be maintained under constant vigil. The vent temperature should not go above 95<sup>0</sup> c. Blast valves to be closed and air blower is to be stopped when ignition of fire bed becomes uniform. No section shall be created in the producer.
8. Fire in producer should be observed through poke holes. When the wood burns uniformly coke will be charged. If the coke burns irregularly (one side gloving stronger) then air to be injected.

The hot gas leaving through the vent pipe dries the brick work in the producer. For this reason, the level of coke in the producer should be kept low (i.e. below the top of jacket boiler).

### **Thrust Bearing**

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. 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.

### **Power failure for a short time**

1. If gas pressure of the main gas collecting header falls below 10mmWC, water seal of mixed gas seal pot to be filled with

water and vent valve of producer to be opened to such an extent that the pressure is only about 10mmWC at the producer top vent.

2. Maintain the overflow in the main water seal pot by opening the process water valve. Nothing to be reversed at the producer, charging discontinued, poking holes will be kept closed.
3. The furnace Personnel are to be informed and the burners at the furnace to be closed.
4. If the producer is out of operation for a longer period, the steam valves are to be closed and N/D to be opened.
5. The vent valve will be adjusted in such a way that a slight perceptible suction at the N/D flap will be obtained and a slight positive pressure is maintained in the producer.

Steam flushing to be carried out for a period of 4 to 5 minute after and interval of 4 hours.

### **Disturbances of the Ash discharg**

Brought down to 900 m<sup>3</sup>/hr. and B.S.T. to be increased may be up to 70<sup>0</sup>C and the frequency and duration of poking should be increased until normal conditions are restored. But it should be noted that poking should not be done continuously. Poke the producer with B.S.T. and low air for period of 2 hours and stop for 2 hours and repeat. In the event of the ash does not come out through the plough uniformly and if the ash discharge is poor, in that case the producer should be brought to the natural draft and manual scooping of ash and clinker to be carried out.

Tiago Cousseau, Beatriz Graça, (2011), thrust ball bearings lubricated with several different greases were tested on a modified Four-Ball Machine, where the Four-Ball arrangement was replaced by a bearing assembly. Z. Ren, J. Wang, F. Guo, (2014), using a custom-made optical interferometer, the waviness values on the raceway of the washer of two thrust ball bearings are obtained by applying the Hertzian contact theory. Carlos M.C.G. Fernandes, (2013), six fully formulated wind turbines gear oils with the same viscosity grade and different formulations were selected and their physical properties were determined. Thrust ball bearing

friction torque tests were performed on a modified Four-Ball Machine at a constant temperature of 80 °C under the following operating conditions: speed between 75 and 1200 rpm and two loads (700 N and 7000 N).

**2. Objectives of Work**

This guide roller; used in producer gas plant in ash removal process; has been replaced by the thrust ball 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. With a view of past researches; once motivated to eliminate problems occurring due to guide roller in ash removal process in producer gas plant. A study is done on different bearing and found thrust ball bearing as appropriate replacement of guide roller.

**3. Application**

The Oil, natural gas, raw coal, LPG firing could have been an ideal source of energy if only the oil prices had been within the range that was prevailing in sixties and earlier. But from mid-seventies onwards, due to global energy crisis, the prices of various petro fuels jumped up by leaps and bounds and the oil intensive industries in the country are now in a total jeopardy with respect to erosion of their profitability. Crushed coal of the specified quality and size is carried to the top of the bunker by means of Bucket Elevator and is put to the bunker. Coal from the bunker is fed into the Extended Shaft of the Gasifier through a Sector Gate and two Bell Cones operated by pneumatic power cylinders which open out the Sector Gate and Bell.



Figure 1: Ash bowl arrangement with guide roller

When the coal enters through the generator bottom shaft, reaction between coal and (air + steam) occurs and following reactions take place from bottom oxidation zone to top reduction zones. Cones sequentially after getting Fed coal travels downwards and gets dried first and then gradually preheated up to a distillation temperature of about 450°C by the product gas moving upwards which itself gets gradually cooled down and picks up the volatile matter of coal and gets auto-carbureted to a much higher calorific value before it comes out to the L.T.C off take pipes.

**Dimension of thrust ball bearing**

|                       |   |         |
|-----------------------|---|---------|
| Inner diameter        | = | 2900 mm |
| Outside diameter      | = | 3100 mm |
| Pitch circle diameter | = | 3000 mm |
| Ball diameter         | = | 1000 mm |
| Number of balls       | = | 104     |

There is a base plate of mild steel having thickness of 16 mm on which lower race of the bearing is fixed. Upper race of the bearing is bolted with the base of the ash bowl consequently ash bowl rotates with the thrust bearing mechanism. Rotation of Ash Bowl and slightly eccentrically positioned rotating grate helps removal of ash from the system. As reaction proceeds, coal bed moves down, oxidized and ash granules from the burnt coal gradually comes out to the ash pan after getting crushed by the eccentric rotation of the grate against the gasifier shell.

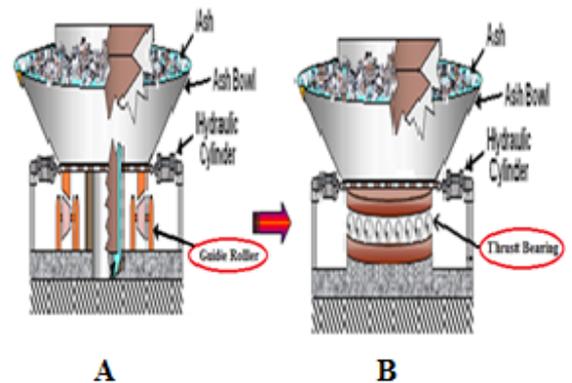


Fig.2: Ash bowl arrangement with (A) Guide roller and (B) Thrust bearing

**4. Cost saving factors:**

A study is done on different bearing and found thrust ball bearing as a appropriate replacement of guide roller. This guide roller; used in

producer gas plant in ash removal process; has been replaced by the thrust ball bearing which is a type of single direction with flat housing washer. This improves productivity by reducing different factors like break down time, total man power required, maintenance cost etc. The proposed modification methodology consists of following cost savings:

- Man power Cost =Rs. 120 / day /person
- Cost of furnace oil = Rs. 20 / liter
- 8 NM<sup>3</sup> producer gas =1 liter furnace oil

### 5. Conclusion

The foregoing experimentation deals with the increasing the bearing capacity, washer action of two thrust ball bearing, oils with the same viscosity grade and different formulations to be used in bearing, friction torque and operating temperatures in a thrust ball bearing. These experiments could not avoid the problems occurring in ash removal system of producer gas plant. For further different type of bearing material can be used with the same material to find out the maximum bearing life. Consider different bearing properties. Implement other optimization techniques or methods of modification to find out optimum condition for current experiment.

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