

## Diminution of emissions from Coke Oven

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### ABSTRACT

Coke oven gas is used in the industries for power/energy generation. Coke oven gas consists of many impurities. Sulphur is also present in the composition of the coke oven gas as an impurity. Sulphur pollutes the environment. So it is necessary to remove the Sulphur from the coke oven gas. There are several methods for purification of coke oven gas. In this paper the Iron oxide process used for desulphurization of coke oven gas is emphasized. Coke oven gas contains hydrogen sulphide (H<sub>2</sub>S) and other sulphuric compounds like carbon disulphide (CS<sub>2</sub>), carbonyl sulphide (COS), mercaptans etc. The separation of these pollutants is strongly required by environmental protection. In India generally high ash coal (appx. 38%) is found, in that case washing of coal is must require. Through washing of coal about 3-4% ash will be minimized. And after that this washed coal send to the coke plant for making low ash Metallurgical coke (LAMC). Hard coke is actually end product, commonly known as low ash metallurgical coke. Coal gas contains several impurities, in particular dust and H<sub>2</sub>S are the most important ones. Gas cleaning is not only necessary to prevent pollution of the environment, but also to protect the equipment against corrosion. Hence there are not only environmental requirements for desulphurization of coke oven gas there are also technological and safety requirements.

**Keywords:** coke oven gas<sup>1</sup>; desulphurization<sup>2</sup>, H<sub>2</sub>S<sub>3</sub>, purification<sup>4</sup>, Sulphur<sup>5</sup>

### I. INTRODUCTION

Emissions in coke oven The coke oven is a major source of fugitive air emissions. The coking process emits particulate matter (PM); volatile organic compounds (VOCs); polynuclear aromatic hydrocarbons (PAHs); methane, at approximately 100 grams per metric ton (g/t) of coke; ammonia; carbon monoxide; hydrogen sulfide (50–80 g/t of coke from pushing operations); hydrogen cyanide; and sulfur oxides, SO<sub>x</sub> (releasing 30% of sulfur in the feed). Significant amount of VOCs may also be released in by-product recovery operations.

For every ton of coke produced, approximately 0.7 to 7.4 kilograms (kg) of PM, 2.9 kg of SO<sub>x</sub> (ranging from 0.2 to 6.5 kg), 1.4 kg of nitrogen oxides (NO<sub>x</sub>), 0.1 kg of ammonia, and 3 kg of VOCs (including 2 kg of benzene) may be released into the atmosphere if there is no vapor recovery system. Coal charging, coke pushing, and quenching are major sources of dust emissions.

### II. METHODS TO REMOVE SULPHUR FROM COG:

1. Dry Oxidative Process:
  - ✓ Iron oxide
  - ✓ Zinc oxide

2. Wet Oxidative Process:

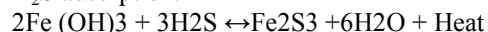
- ✓ Stratford
- ✓ Perox
- ✓ Takahak
- ✓ Thylox
- ✓ Fumaks
- ✓ Lo cat

3. Neutralization Process:

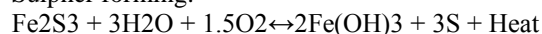
- ✓ Sulfiban
- ✓ Cyclasulf
- ✓ Vacasulf
- ✓ Soda lye scrubbing

The chemistry involved in absorption and regeneration using iron oxide shows that iron sulphides are produced when H<sub>2</sub>S reacts with Fe(OH)<sub>3</sub> with the empirical composition approaching Fe<sub>2</sub>S<sub>3</sub>. The iron used in this process is called BOG iron.

H<sub>2</sub>S adsorption:



Sulphur forming:



Detailed analyses were done on many coke oven batteries and improvements brought in for charging.

- ✓ Stage or sequential charging
- ✓ Double mains

- ✓ Adequate aspiration
- ✓ Inspection and cleaning of goosenecks, standpipes, roof carbon buildup, steam nozzles and liquor sprays
- ✓ Charging car modifications
- ✓ Leveller bar seals

Technology for the Control of Door Leaks Control techniques for coke oven door emissions was based on four categories:

- ✓ Oven door seal technology
- ✓ Pressure differential devices
- ✓ Hoods and sheds over doors
- ✓ Operating and maintenance procedures

To improve the performance of doors, major modifications were carried out in the Koppers & Wilputte doors.

Technology for the Control of Topside Leaks. (Charging hole lids and off-takes)

- ✓ Topside leaks were primarily controlled by Replacement of warped lids
- ✓ Cleaning carbon deposits or other obstructions from the mating surfaces of lids or their seals
- ✓ Patching or replacing of cracked standpipes
- ✓ Sealing lids after a charge or whenever necessary with a slurry mixture of clay, coal and other materials (commonly called lute)
- ✓ Sealing cracks at the base of a standpipe with the same slurry mixture.

In addition, some changes in equipment design were required to keep the leaks sealed. Incorporation of heavier lids, lids with better sealing edges and automatic lid lifters are few of these modifications.

### III. MODERN MEASURES

In addition, modern measures had also been taken in some coke oven batteries either during first installation or during rebuilding for improvement of the performance as well as for reduction of emissions. These are

- ✓ Introduction of ceramic welding technology for repair of oven walls
- ✓ Introduction of dry gunniting technology for repair of oven walls
- ✓ Introduction of High Pressure Liquor Aspiration (HPLA) system for onmain charging of coal
- ✓ Water sealed SP caps
- ✓ Hydro jet door cleaners at end benches
- ✓ Provision of magnetic lid lifting system Pusher cars with leveller muff, door and door frame cleaners
- ✓ Charging cars with screw feeders having telescopic chute for positive sealing
- ✓ Guide cars with door and door frame cleaners
- ✓ Computerized combustion control systems
- ✓ Water jet gooseneck cleaner
- ✓ Charging hole lid compatible magnetic lid lifter
- ✓ Mechanized lid lifting facility

- ✓ Hydraulic controller for regulation of askania
- ✓ Quenching tower with grit arrestor and auxiliary spray system
- ✓ Spillage coke conveyor on the service platform
- ✓ Conversion to double collecting main from single collecting main and vice-versa
- ✓ Steam aspiration system for on-main charging.
- ✓ Provision of additional capacity of decanter compatible with HPLA and
- ✓ double collecting mains
- ✓ Conversion to three charging holes from five charging holes

### IV. CONCLUSION

Iron oxide process is very effective process for desulphurization of coke oven gas. This process Removes 95-98% of the H<sub>2</sub>S from the coke oven gas. By this process elemental sulphur is produced and forms a layer on the iron oxide mass and lowers the activity of the mass. This process is formerly used for desulphurization of coke oven gas. Further research is done for making the process more effective. However this process is not widely used as more developed Processes are developed which are more efficient than this process. Iron oxide process is not more economic and also requires more place but it is more effective than others processes. It also removes the other impurities present in the COG in fewer amounts. Efficiency of the iron oxide process of removing the sulphur from coke oven gas is high this process is widely accepted in the SAIL, plants.

Over the years a large number of emission control measures in the coke ovens have been introduced by our SAIL in the form of water jet cleaning of doors, HPLA system to reduce charging emissions, group wise crushing of coals, new design doors, water sealing of stand pipe lids, introduction of effective combustion control system in coke ovens, etc.

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