Swapan Suman, V.K. Saxena, Samardeep Prasad / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 4, Jul-Aug 2013, pp.1004-1018

A Fundamental Concept about Coke Making In Coke Plant with the Help of Coal Preparation Plant

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ABSTRACT

Nowadays more production and for more energy high ash coal washed or prepare in the coal washery plant. 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. It finds useful applications in steel plants, foundries, blast furnaces, soda ash manufacturing, graphite industry & other chemicals. The raw material for making hard coke is low ash coking coal sourced mainly from Australian, Chinese and USA, coal mines.

In this article a introduction or a overview of process of washing of coal and a critical and suitable process of making coke in India.

I. INTRODUCTION

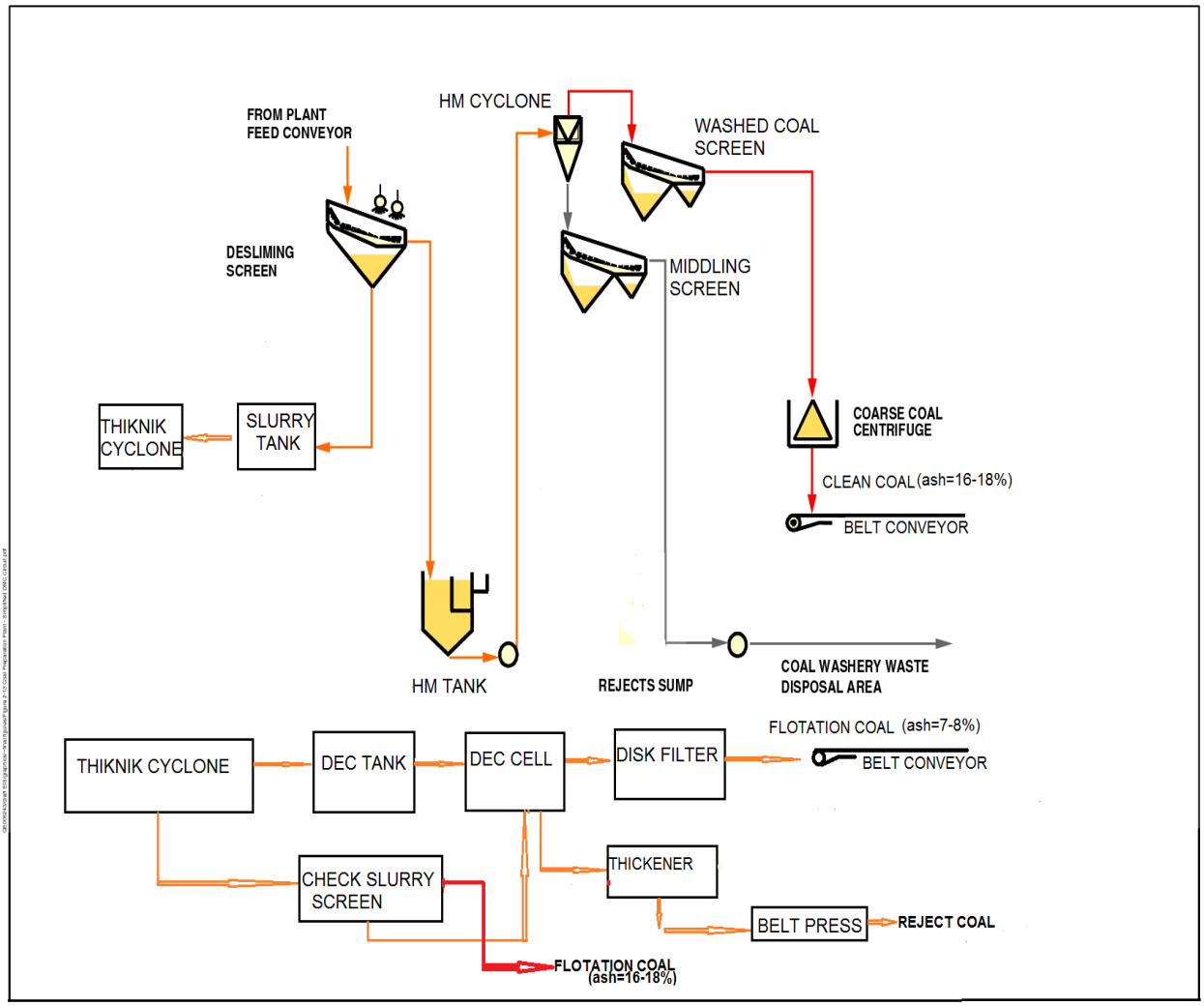
Low ash metallurgical coke (LAMC) of various specifications and sizes, customized to meet the requirements of the clients with whom he maintain long term relationships. With the economy looking very buoyant the demand outlook for superior quality (low ash content) coke is positive and the company strives to bridge the demand supply gap by adding fresh capacity and manufacture high quality coke. Scale provides the company with operating economies, which not only help in amortizing overhead costs across a large production volume, but also help in maximizing profitability during industry peaks. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. It is there to reduce the iron oxide(hematite) in order to collect iron.

Since smoke-producing constituents are driven off during the coking of coal, coke forms a desirable fuel for stoves and furnaces in which conditions are not suitable for the complete burning of bituminous coal itself. Coke may be burned with little or no smoke under combustion conditions, while bituminous coal would produce much smoke. The most important properties of coke are ash and sulfur content, which are linearly dependent on the coal used for production. Coke with less ash and sulfur content is highly priced on the market. The water content in coke is practically zero at the end of the coking process, but coke is often water quenched to reduce its temperature so that it can be transported inside the blast furnaces. The porous structure of coke absorbs some water, usually 3-6 % of its mass
LAM coke with the following specifications:

- Size : 25mm to 80mm (BF coke)
- Moisture : 6% max.
- Ash : 12%+/- 1%
- VM : 1.5%
- Sulfur: 0.60%
- Phosphorus: 0.045%
- M10 : 7 max
- M40 : 84 min
- CSR : 62
- CRI : 26 for reference.

COALWASHERY

From mines coal comes in washery plant and prepares for making coke.



In this process Raw Coal from the Mine is typically crushed to -50mm and is then delivered to a desliming screen where the fine coal (-0.5mm) is rinsed off and is sent to the floatation circuit. Material, which passes through the screen apertures, is collected in a single under pan mounted below the screen which is called slurry tank and then directed to the next stage of the process flow. The coal size of (+0.5 mm) is rinsed off and sent to clean coal circuit, which passes through the screen which is stored in HM tank.

From HM tank Coal slurry is send to HM Cyclone. The overflow of HM Cyclone is send to washed coal screen , from washed coal screen coal is send to centrifuge here dewater of coal is done after that it is send to coke plant with the help of conveyor belt,

The underflow of HM Cyclone is send to middling screen, from middling screen it is stored as a reject.

The underflow of desliming screen is send to fine tank, from fine tank it is send to thickenik cyclone. The overflow of thickenik cyclone is send to DEC Tank. In DEC Tank coal slurry is mixed with diesel and frother, this

mixture is send to DEC Cell and the over flow of DEC cell is send to disc filter. Where disc filter separates the coal and water and this coal is send to coke plant with the help of conveyor belt.
The under flow of DEC cell is send to thickener from thickener coal slurry is send to belt press. Belt press separate the coal and water, the water is used in coal washery circuit and the reject is send away from the coal washery plant.
The under flow of thickenik cyclone is send to check slurry screen, the over flow of check slurry screen coal is stored and transfer to the coke plant with the help of truck, the under flow of check slurry screen is send to DEC cell.

II. Different parts of coal washery are

- Feed Hopper
- Desliming screen
- Heavy media tank
- Heavy media cyclone
- Washed coal screen
- Middling screen
- Centrifuge
- Slurry tank
- Thickening cyclone
- DEC tank
- DEC cell
- Check slurry screen
- Magnetic separator
- Disc Filter
- Thickener
- Belt Press

FEED HOPPER

Fig.1 Feed Hopper

In feed hopper coal is feed at the rate of 150 tph , the size of coal is maintained between 0-50mm coal is transported through belt conveyor to seizing screen Where -50 mm & +50 mm coal is separated , -50 mm coal is directed to desliming screen and +50 mm coal is goes to crusher after that it mixed with -50 mm coal.

DESLIMING SCREEN

Fig. 2 Desliming screen

A screen used for the removal of slimes from larger particles, usually with the aid of water sprays.

This provides the initial size separation for the larger and fine coal circuits. Water is applied to the material as it passes over the screen decking to assist the separation process. Raw Coal from the Mine is typically crushed to -50mm and is then delivered to a desliming screen where the fine coal (-0.5mm) is rinsed off and is sent to the floatation circuit .Material, which passes through the screen apertures, is collected in a single under pan mounted below the screen which is called slurry tank and then directed to the next stage of the process flow. The coal size of (+0.5 mm)is rinsed off and sent to clean coal circuit, which passes through the screen which is stored in HM tank.

Coal slurry is delivered to desliming screen where water is separated from coal slurry. Desliming screen content 0.5mm screen, 50mm screen and water nozzles. With the help of water spray -0.5mm coal size goes through the 0.5mm screen to slurry tank and rest of coal is goes through 50mm screen to Heavy media tank

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HEAVY MEDIA TANK

Dry Magnetite powder is mixed with water and pumped into the magnetite circuit. A sump containing the suspension at the required density is known as the heavy media tank.

In heavy media tank coal slurry which is coming out from 50mm screen of desliming screen and Magnetic powder is mixed.

The $_{+}$ 0.5mm coal is mixed together with the magnetite suspension in the HM tank, and is pumped to the Heavy Medium Cyclone(s) for separation.

HEAVY MEDIA CYCLONE

Fig.3 HM Cyclone

Coal with particle size larger than 1mm is usually separated from waste material using a dense medium separation process. This process takes advantage of the density differences between the coal (typically RD 1.30 – 1.50) and the gangue materials (RD > 1.75).

A stable medium of a known Relative Density is made up, and in the beneficiation process the coal floats on top of the medium whilst the gangue sinks to the bottom. This gravity process is often sped up by utilizing Dense Medium Cyclones.

A cyclone is conical vessel in which coal along finely ground magnetite is pumped tangentially to tapered inlet and short cylindrical section followed by a conical section where the separation takes place. The higher specific gravity fraction being subjected to greater centrifugal forces pull away from the central core and descend downward towards the apex along the wall of cyclone body and pass out as middling. The lighter particles are caught in an upward stream and pass out as clean coal through the cyclone over flow.

WASHED COAL SCREEN

In washed coal screen, over flow of H M Cyclone is come where coal is pass through the screen sizes 0.5 mm screen and 16 mm screen, after that recovery of magnetite is done.

Washed coal goes to centrifuge for drying.

The under flow of H M Cyclone is goes to the middling screen where middling is separated. The size of middling screen is 50 mm .

CENTRIFUGE

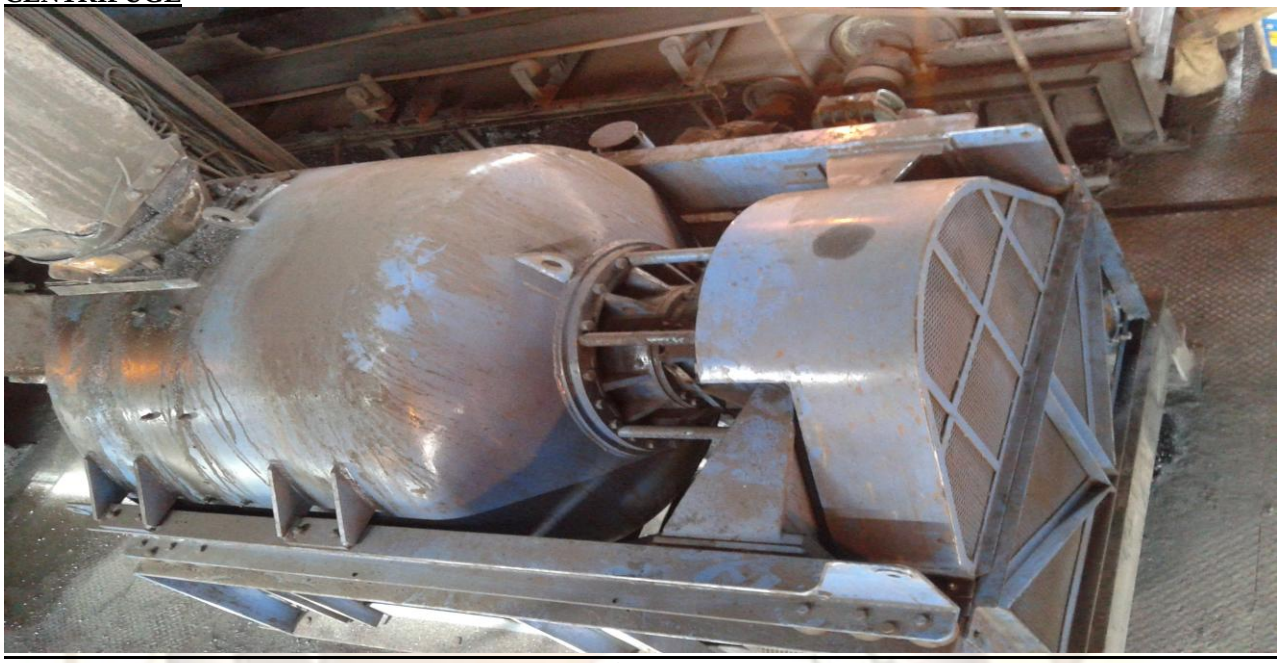


Fig.4 Centrifuge

centrifuges are typically employed to dewater coal from spirals normally in the size range of 0.1mm to 2mm, although all models can accept much larger particle sizes equally well. Fine coal centrifuges are of the horizontally rotating, high gravitational force type. These centrifuges are a continuously operating, scroll/screen basket type in which the slurry solids are retained on the basket and transported from the small diameter end to the large diameter end by means of the angle of inclination of the basket and a scroll. The scroll acts like a screw conveyor spinning at a slightly faster speed than the basket. The coal slurry is fed into the small inner diameter of the scroll and distributed evenly onto the basket through feed ports. The centrifugal force causes the liquid portion of the feed slurry to pass through the screen while the solids form a cake bed which is continuously turned and swept outward. The coal solids are then discharged at the large outer diameter of the screen basket. From centrifuge washed coal goes to coke plant .

THICKENING CYCLONE

Fig. 5 Thickening cyclone

Slurry of coal is coming from slurry tank to thickening cyclone. The overflow of thickening cyclone is goes to DEC cell. The underflow of thickening cyclone is goes to check slurry screen.

DEC TANK AND DEC CELL:

Fig. 6 DEC Cell

The over flow of thickening cyclone is goes to DEC tank . In DEC tank coal slurry is mixed with diesel and frother, this mixed slurry is send to DEC cell. In DEC cell the overflow goes to Disk filter and under flow is goes to thickener.

CHECK SLURRY SCREEN

The underflow of coal slurry is come to check slurry screen from thickening cyclone.

The overflow of check slurry screen gives flotation coal of ash 16-18%, which is stored in the form of heap on the ground, which is send to coke plant with the help of truck. The underflow of check slurry screen send to DEC Cell.

DISC FILTER

Fig.7 Disc Filter

Disc filter are generally used in dewatering of fine coal in coal beneficiation processes. The filter consists of several discs, up to 15 in the larger machines, each made up from sectors which are clamped together to form the disc. The sectors are ribbed towards the neck and designed for a high capacity drainage rate. One of the main features is that the required floor space taken up by disc filters is minimal. During operation each sector enters submergence and a cake is formed on the face of the discs. It then emerges to the drying zone, the liquid drains to a central barrel and from there through a valve to the vacuum receiver. Scraper blades on the side of each disc guide the cake to discharge. which are positioned between adjacent discs and are wide enough to avoid their chock by the falling cake.

THICKENER:

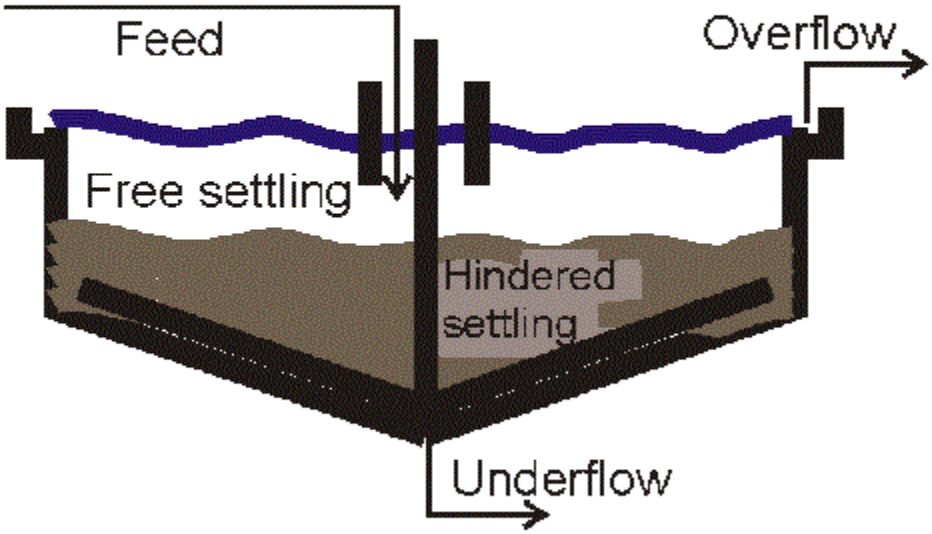


Fig. 8 Thickener

Thickeners are used for dewatering slurries of either tailings or product. A thickener is a large circular tank that is used to settle out the solid material from the water in the feed slurry. The separated water is clarified and reused as process water in the CPP.

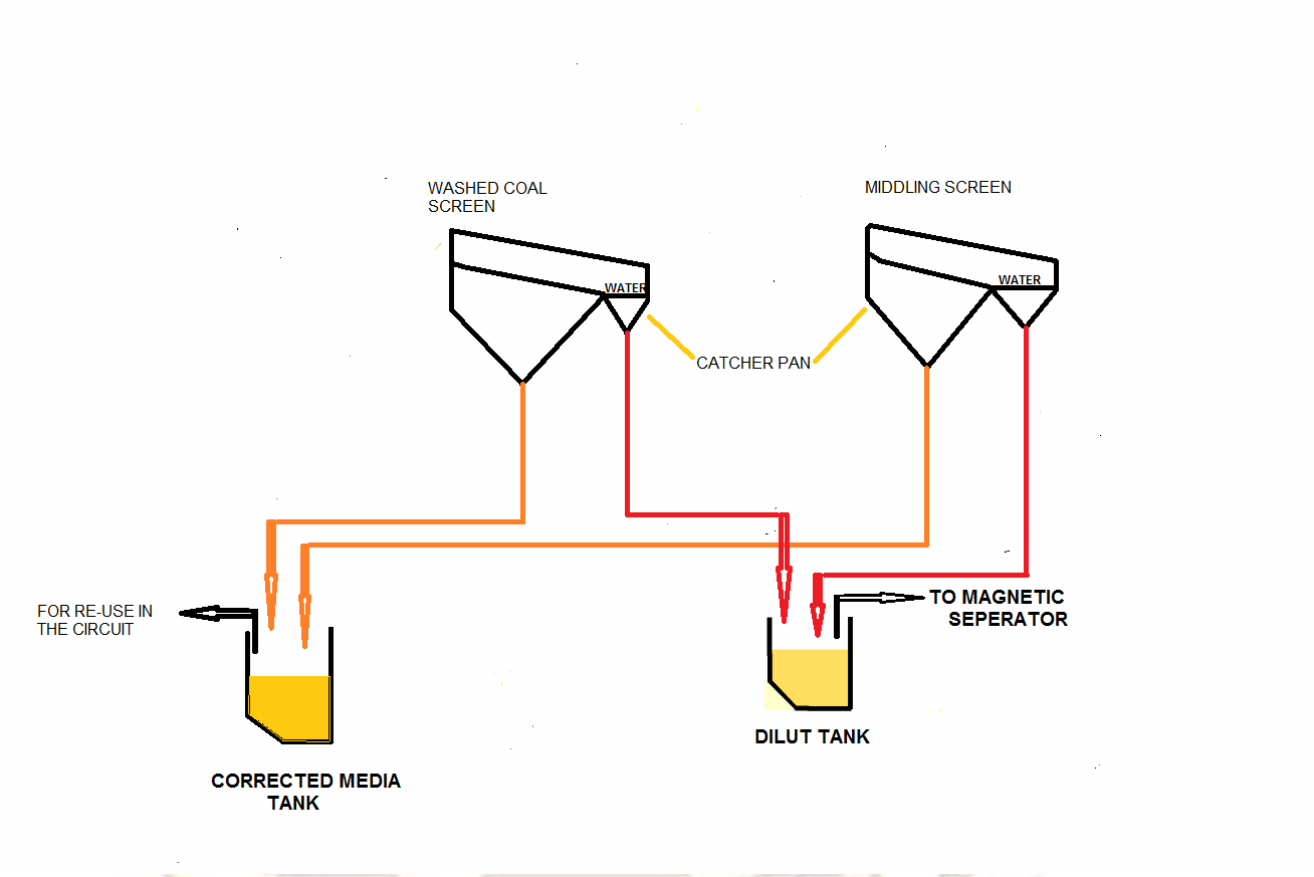
Thickeners are sized according to the volume of feed slurry to be processed. The floor of the thickener is conical, sloping gently down toward the centre.

The feed is pumped into the feedwell, at the centre of the thickener, near the top. The feed is normally dosed with flocculant before delivery to the thickener.

The thickened mass is moved toward the bottom centre of the thickener by large rakes that rotate around the tank. Rotation speed is very slow, and drive torques can be high, especially for larger diameter thickeners. Drive torque is usually monitored continuously, as high densities could cause failure of the rakes and drive equipment. Rakes may have the capacity to be raised to reduce drive torque.

The thickened slurry, also called thickener underflow, is pumped out of the bottom of the thickener. In the case of product coal, further dewatering is usually required before shipment. Thickened tailings can be pumped to a tailings dam, combined with larger sized rejects for disposal (co-disposal), or dewatered further before disposal.

III.RECOVERY OF MAGNATITE



Graph 2. Magnetite Losses

Magnetite losses are usually expressed in kilograms of magnetite per ton raw coal processed (kg/t ROM), although it is becoming more common to express losses in terms of kilograms of magnetite per dry coarse coal feed (kg/t dccf).

Losses of magnetite occur in four main areas:

- With Product Coal
- With Reject material
- Magnetic Separator Effluent
- Leaks & Spillages

As magnetite costs can run into the million of dollars per annum, it is important that the Coal Process Engineer pays attention to this area of the process.

Once separated, the Product and the Middling report to Drain & Rinse screens in order to recover the magnetite. On the first part of the screen, magnetite is drained and reports back to the Correct Media tank for re-use in the circuit. On the second part of the screen, magnetite adhering to the coal particles is rinsed off with water from the process. This rinsed medium reports to a Dilute Medium sump from where it is pumped to Magnetic Separators that recover the magnetite and bleed fine coal out of the system.

Concentrated magnetite from the Magnetic Separators (RD>2.0 typ.) usually reports to an Overdense tank from where it is distributed into the required circuit.

IV.COKE PLANT

After the washery coal preparation coal send to coke plant for making coke.

Different parts of coke plant are:

- FEEDING SYSTEM
- COAL HANDLING
- COKE OVEN
- COKE YARD

FEEDING SYSTEM:

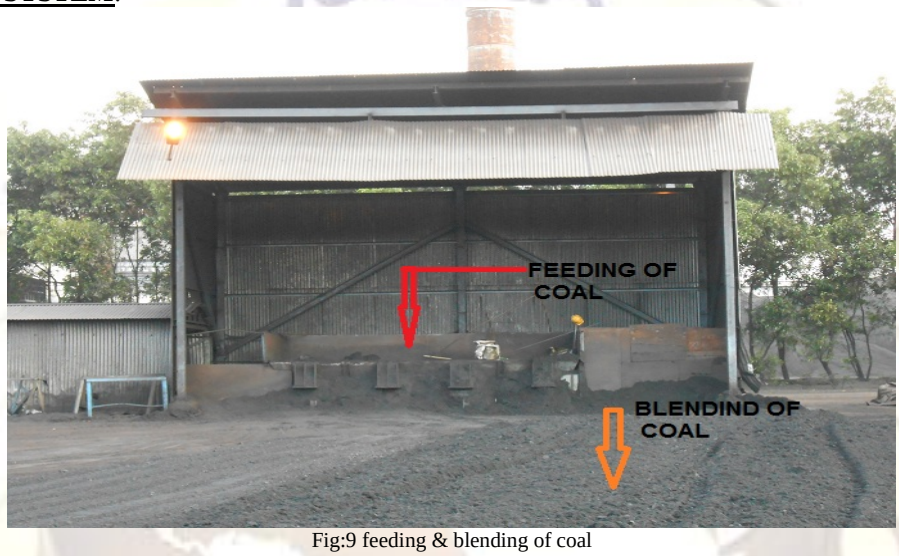


Fig:9 feeding & blending of coal

Fig:10 coal coming from coal washery

Flotation coal and clean coal are coming from coal washery with the help of conveyor belt to the coke plant .flotation coal and clean coal are blended with blender and this blended coal is feed to the Hooper from Hooper coal is send to coal handling with the help of conveyor belt . In blended coal the ratio of floatation coal: clean coal: blender = 70 : 25 : 5

COAL HANDLING:

A **conveyor belt** (or belt conveyor) consists of two or more pulley, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are a number of commercial applications of belt conveyors such transportation of coal. The belt consists of one or more layers of material. They can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. Material flowing over the belt may be weighed in transit using a belt weigher. Conveyors are durable and reliable components used in automated distribution and warehousing. It is considered a labor saving system that allows large volumes to move rapidly through a process, such as here washery to coke plant.

Belt conveyors are the most commonly used powered conveyors because they are the most versatile and the least expensive. Product is conveyed directly on the belt so both regular and irregular shaped objects, large or small, light and heavy, can be transported successfully. These conveyors should use only the highest quality premium belting products, which reduces belt stretch and results in less maintenance for tension adjustments. Belt conveyors can be used to transport product in a straight line or through changes in elevation or direction. In certain applications they can also be used for static accumulation or cartons.

COKE OVENS:

Fig:11 open coke oven

Fig:12 coke oven at working condition

Coke is the solid carbonaceous material derived from destructive distillation of low-ash, low-sulfur bituminous coal. Cokes from coal are grey, hard, and porous .coke is produced in coke oven it takes 48 hr.The coke oven are made of silica bricks which are preferred to firebricks mainly because of the higher stability at the temperature of combustion chamber of about 1350^{o}c - 1450^{o}c .

Specification (approx.):

- Length of coke oven = 1.8 m
- Height of coke oven = 0.8m
- Length of coke produced = 1.7m
- Height of coke produced = 0.7m

COKE PRODUCTION:

Blended coal is coming from coal handling plant to hopper with the help of conveyor belt .from Hooper coal is send to charging car .in charging car blending of coal is done with the help of ram stamping of coal is done due to stamping cake of coal is produced this cake is pushed to coke oven with the help of pusher and allow for 48 hrs for coke making .the exhaust gas is escape to the atmosphere through chimney. After coke production the doors are opened and the glowing coke mass is discharge by the machine driven coke pusher into the coke quenching car. The empty oven is made ready for a fresh charge according to a properly maintained scheduled. Coke is cooled with the help of water spray, this process is called quenching. After quenched coke is send to coke yard.

Fig:13 hot coke

Fig:14 Quenching of coke

COKE YARD:

In coke yard, quenched coke is coming from coke oven with the help of truck and the sizing and storage of coke is done.

First of all the quenched coke which is coming from coke oven is stored in the form of heap, with the help of trolley the coke is feed in the hopper. From hopper, through the conveyor belt coke is send to sizing screen with the help of sizing screen different size of coke is obtained.

V. CONCLUSION

Coke is more energic fuel than coal. Coke have high heat capacity and low ash coal. From uses of coke gives higher production rates.

VI. IMPORT OF METCOKE

	Import of Subject Metcoke 1999-2002			
		Japan	**Other countries**	**Total**
1999-2000				
	Quantity	329472	1989931	2319403
	In MT			
	Value	1119654298	6793571892	7913236690
	in Rupees			
	Rate	3398	3414	3412
	Rs/PMT			
2000-2001				
	Quantity	200309	2184129	2384438

	In MT			
	Value	86190399	8187752510	9849655809
	in Rupees			

	Rate	4303	4115	4131
	Rs/PMT			
2001-2002				
	Quantity	371018	1912991	2284009
	In MT			
	Value	1494552853	7670211501	9170764354
	in Rupees			
	Rate	4028	4013	4015
	Rs/PMT			

VII. Metallurgical coke – its applications

The met coke is used in those products which require high performance carbon and high resilience factor. For instance, the metallurgical coke is used in drilling applications, conductive flooring, electrolytic process, frictional materials, corrosion materials, iron ore refining, reducing agents, ceramic packing, foundry carbon raiser, and heat treatment and foundry coatings. The met coke is also beneficial in the production of carbon electrodes, elemental phosphorus, calcium carbide. One of the primary reasons why met coke is so useful is because of its stable burning temperature which makes the production of metal products and other metal applications easier. It is a key ingredient used in the production of steel where it is used as a reducing agent. The steel and the iron industries consume 90 percent of the metallurgical coke produced every year.

Metallurgical coke – future use

presently, 500MT of met coke is produced globally where it is used by the steel industries of USA, Europe, Brazil, India and China. However, experts reveal that if there is a reduction in the export output of China, it will negatively affect the steel industry and alter the global balance.

Due to its extensive usage, met coke will continue to be produced in the future and used in the creation of various metal products.

REFERANCE

[1] http://www.indiamart.com/austral-coke-projects/products.html
[2] http://www.metdaq.com/en/press-centre/articles/metallurgical-coke-its-definition-and-application.html
[3] http://www.hindustanproduceco.com/steam-coal-cooking-coal-lam-coke-foundry-coke.html
[4] http:/www.gujrat nre coke ltd.in
[5] http://commerce.nic.in/adpref_metcoke_japan.htm
[6] http://www.indiamart.com/gopal-industries/products.html