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SEGREGATION AND REMOVAL OF MARCASITE CRYSTAL FROM LIGNITE IN LIGNITE HANDLING SYSTEM(LHS)

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Abstract: *In order to run the plant effectively, lignite handling system should be maintained effectively. Therefore, segregation of marcasite are required due to the absence of the pulveriser mill which is because of the boilers used is made of ecofriendly Circulated Fluidized Bed Combustion system. Marcasite is an iron sulphide ore (FeS_2) appears to be pale yellowish green in colour which are much harder than lignite (hardness is 6- 6.5 on Mohs scale), damages the mining and lignite processing equipment. These marcasites are manually picked in stockyard, some are escaped and damages the Lignite Handling Systems. Here our aim is to give a solution to segregate and remove these marcasites from lignite in order to safeguard the equipment of lignite handling system and boiler.*

Keywords- *Lignite handling system, Segregation, Thermal power station, Material Handling, Pulversier*

I. INTRODUCTION

Marcasite is an iron sulphide ore (FeS_2) appears to be pale yellowish green in colour which is less abundant earth material found in few parts of the world. Now it is found in Neyveli Lignite Mine-II in cuddalore district, Tamilnadu between the ligniteseam which is scattered as a layer unevently. It is in the form of thinplatelets,lens,globular,nodular,colloidalgrains,lumps,stalactiticrod-like,wart-like,reniform or oval shaped grains as incrustations in the lignite seams. It shows metallic luster. It hardness around 6.5.it is non-magnetic.it specifies gravity around from 6. Many of the marcasite lump showing lower specific gravities composed of quartz grains under thin sections. Often marcasite is formed with quartz grains with interlocked colloform varieties. Grain size varies from very finite granules to large lumps of more than 30cm.This compressive strength varies around 150 to 800 $Kg/Cm^{2.}$. Segregation of marcasites are required due to the absence if pulveriser mill. This is because of the boilers used in Thermal Power station-II Expansion (TPS-II EXPN) are made of circulated Fluidized Bed Combustion (CFBC) system, lignite of size 12mm is enough for combustion so that the pulverisers are now required .These marcasites are manually picked in stockyard which is deposited at the bottom of the lignite heap due to its heavy weight, some are escaped and damages the various equipment of LHS like roller crusher, hammer mills, drag link chain conveyor, screens, etc…,

II. OVERVIEW OF LHS

System Describtion

The scope of lignite handling system starts at junction tower -5 with receiving lignite from mine conveyor C1.The O&M of contact less type belt weigher and in line magnetic Sepertaor over C1 conveyor at drive end of C1 conveyor is also under the scope of LHS of TPS-II Expn. The scope ends at filling of boiler bunkers of unit I & II of TPS II Expn. The requirement of lignite for plants full capacity generation (500 MW) is 1200 MT.

In Neyveli TPS II Expansion the lignite flow scheme is given below.

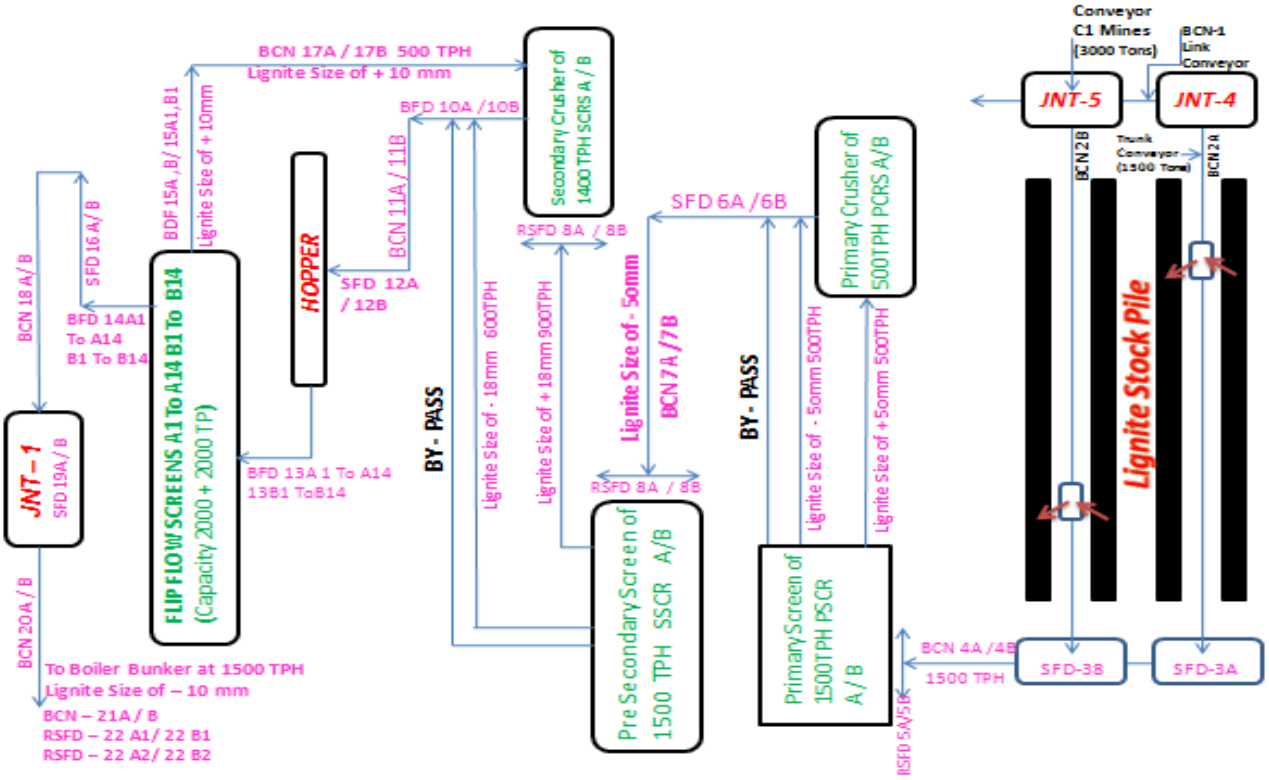

Fig 2.1. Lignite flow scheme

Problems due to maracasite:

- Breaking of hammers in secondary crusher.
- Damages the screens of screen house.
- Downtime of the Boiler lignite feeder increase.
- Conveyor belt damages.
- Damages the refractory lining of boilers.
- Breaking of link in drag-link chain conveyors

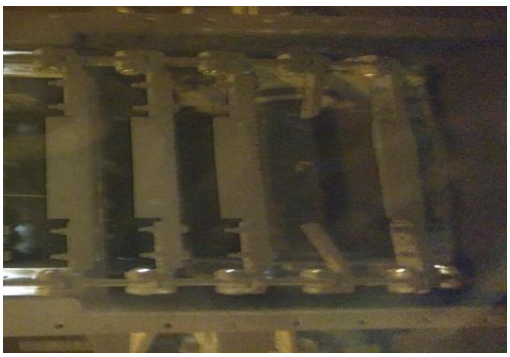

Fig2.2. Damaged drank link chain conveyor

Fig 2.3. Damaged screen of screen house

III. METHODOLOGY

- Manual picking.
- By using metal detectors.
- By using IR rays.
- By mechanical method.
- By reducing grill size
  - By using square shaped grill plates.
  - By using triangular shaped grill plates.

3.1. Manual picking

- The lignite taken from Mine-II usually will have some quantities of marcasite which are fed into the conveyor system.
- Marcasite will be removed from conveyors with the help of workman lined along the side of conveyor system.
- At most cases, Marcasite will get mixed up with lignite and will appear as a large size lignite when viewed through naked eye.
- Its get difficult to remove as the lignite conveyor length increased, as it gets mingled thoroughly.

By this method we can eradicate up to **60 to 70 %** of the marcasite that comes from the mines-II, there by helps in running the plant effectively.

Fig 3.1. Manual picking at stock yard

3.2. By using metal detectors

- The Magnetic suspecibility χ of a natural single crystal of marcasite(FeS_2) , has been measured between 300k down to 4k.
- At room temperature $\chi = 0.3 \times 10^{-5}$ emu/g and it is temperature independent down to 10k. Below 10k it increases up to 1.3×10^{-5} emu/g.
- It is concluded that iron in marcasite is in the Fe^{2+} low spin state and that the 6d electrons occupy the t_{2g} ground state.

Consequently iron in marcasite is not magnetic in agreement with our mossbauer spectra recorder at 4.2k in an external magnetic field up to 39.9KOe and also has impurities like Fe, Na, Mg, Ca, etc.. yielded in mass spectroscopic analysis.

3.3. By using IR Rays

- When marcasite passes through the monitoring unit along with the lignite in the moving conveyor system, it produces some sort of electrical signal because of different crystallographic structure of lignite and marcasite.
- The signal will be passed to the control unit to alert the computer to run the motor. Motor starts and power is transferred to the gearbox.
- The gear box is used to give the variable output torque to the system from which the power is transferred to the bucket wheel system and it starts pick up the marcasite stone along with some amount of lignite.
- After segregation of marcasite from lignite, then lignite is fed into the conveyor.

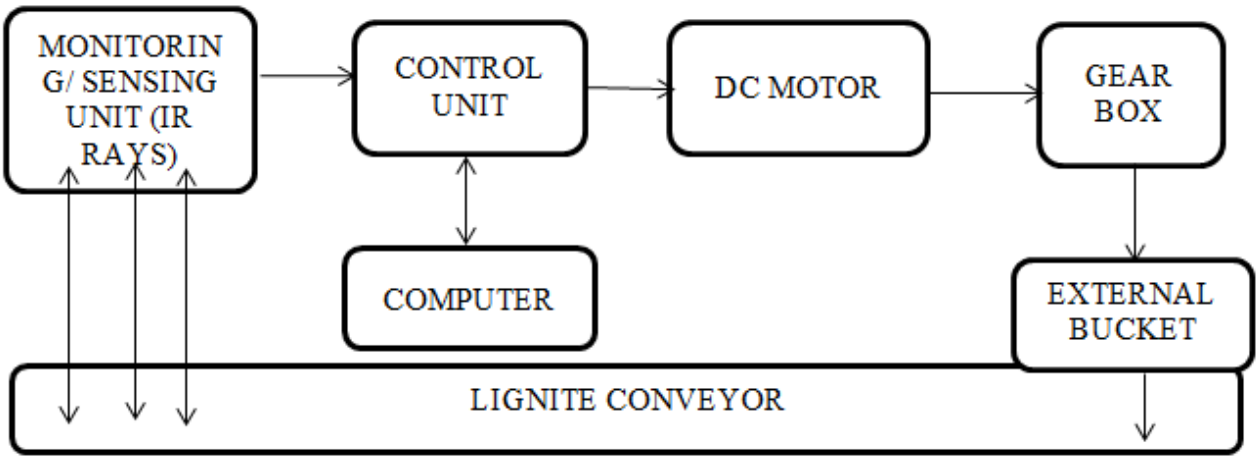

Fig 3.2. Flow Chart

3.4. By using mechanical method

When harder material is entered into the primary crusher, the adjustable roller is slightly moved and allows the harder material. The push button is placed in the adjustable roller, gets activated and sends signal to the PLC circuit. Output of the PLC is given to the solenoid valve to activate the pneumatic cylinder. When the piston extends, the rubber plate closes the chute path and divert the material flow to the hopper. After that, the time delay (say 1sec) is given to the single acting cylinder to retract to its original position so that the rubber plate comes to its original position and opens the chute path for the lignite flow. After segregation of harder material from lignite, the lignite will again fed to the external belt conveyor system.

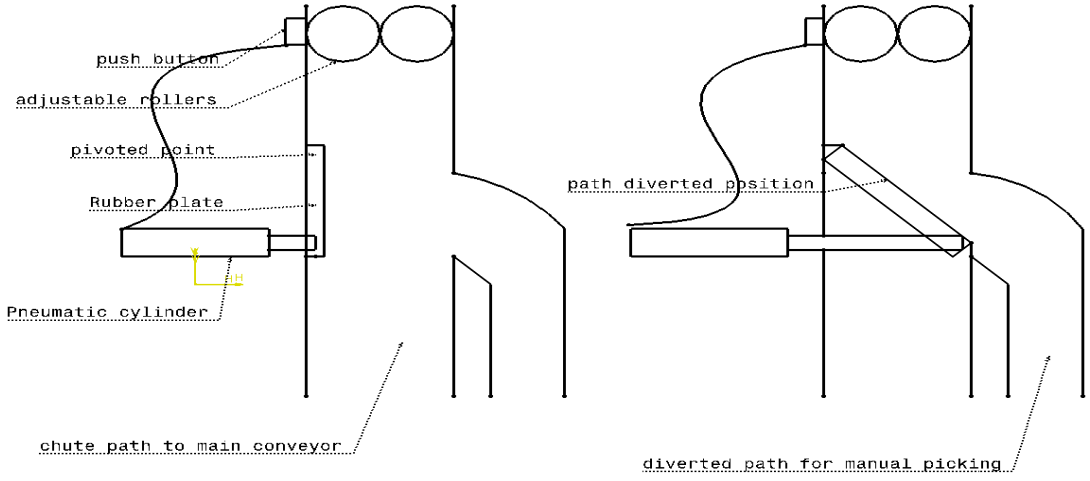

Fig 3.3. Overview of mechanical method

3.5. By reducing grill size

➢ **By using Square shaped Grill Plates:**

- In screen house 14 mini bunkers are covered by the grill plates through which lignite is filled by reverse shuttle feed drive.
- These grill plates have a square hole of size **250X250mm.** Marcasite can easily pass through these holes and moves to the next stages.
- Generally, marcasites comes at screen house has a normalized size which is less than the hole size.
- In order to capture these marcasites the grillhole size has been reduced to **90X90 mm**. The grill. Later these marcasites are removed manually by the workman

Fig 3.4. Before grill size

Fig 3.5. After reducing the grill siz

Table 1 Comparison table

METHODS / FACTORS	MANUAL PICKING	IR RAYS	MAGNETIC SEPERATOR	MECHANICAL METHOD	MODIFIED GRILL PLATES
RISK	HIGH	AVAERAGE	LOW	MEDIUM	LOW
COST	LOW	HIGH	HIGH	AVERAGE	LOW
SEGERATION RATE	LOW	AVERAGE	HIGH	HIGH	LOW
MAINTENANCE	LOW	AVERAGE	HIGH	HIGH	HIGH

IV. OBSERVATION OF MODIFYING GRILL SIZE PLATE

- Manual picking and the modified grill plate (90X90) at mini bunker is the feasible solution that can be implemented immediately in the TPS-II Expansion
- At mini bunker the marcasite can be trapped between the reduced grill plates.
- Based on the data that collected on 13 days, around 85-90 % of total marcasite has been segregated.
- Based on the data, graph has been plotted between,

1. Lignite (in tons) and marcasite (in nos) Vs days.

2. Total marcasite and marcasite collected at mini bunker and bunker vs days.

Table 2. Data Collected for 13 days

DAY	MARCASITE (in Nos)			LIGNITE (in TONS)
	MINI BUNKER	BUNKER	TOTAL	
1	67	20	87	4726
2	77	35	112	4422
3	48	19	67	4212
4	45	13	58	5478
5	54	27	81	8793
6	218	49	267	8081
7	60	46	106	9027
8	130	41	171	8785
9	88	22	110	4356
10	30	14	44	4128
11	108	15	123	4808
12	14	7	21	4476
13	167	42	209	5112

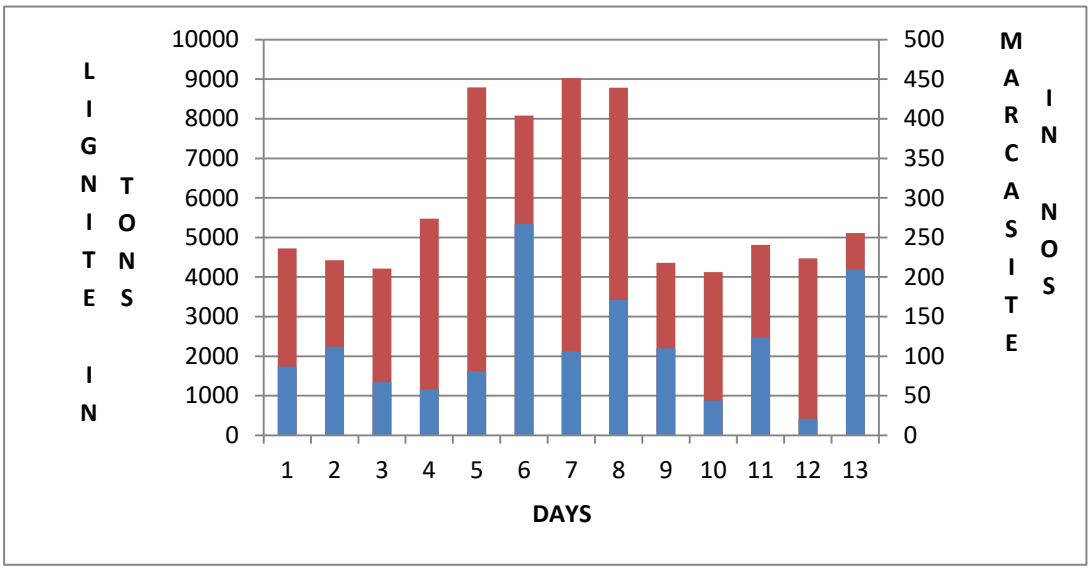

Fig 4.1. Lignite (in tons) and Marcasite (in nos) Vs days

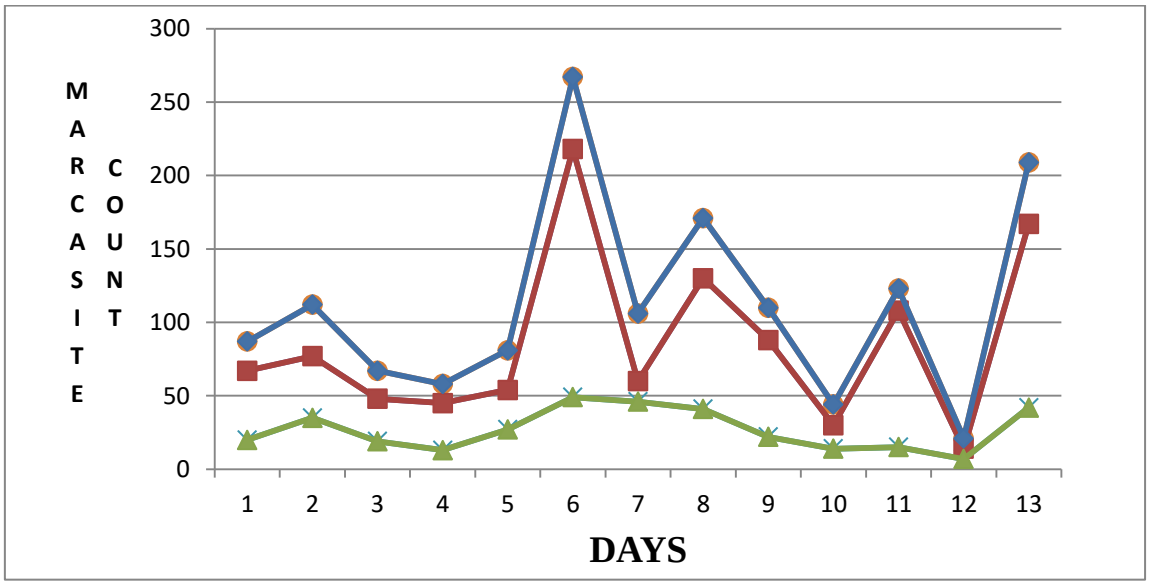

Fig 4.2. Total marcasite and marcasite collected at mini bunker and bunker Vs days

Benefits of segregation and removal of marcasite

- Downtime of the Boiler lignite feeder decreases, and its availability increases.
- Assures marcasite free lignite for firing in the boiler.
- Reduce the damages that caused to the equipment of lignite handling system.
- Ease in lignite processing and decrease in time of processing.
- Momentary benefits by selling marcasite to outside customers

V. CONCLUSION

With our technical knowledge and innovative ideas, we have come out with possible solutions for segregation and removal of marcasite from lignite handling system. A smaller marcasite stone which escapes through all these systems doesn't harm the equipment much. They will automatically disintegrate in the boiler due to the high temperature. From the above-mentioned methods, modified grill plates are implemented, due to its simplicity and feasibility. Further modifications can be implemented in the future for complete removal of marcasite.

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