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REDUCING THE PROBLEM OF WET COAL:CASE STUDIES IN THERMAL POWER PLANT

FirstName Name*, FirstName Name

Affiliation, Address, Ciry ZIP Code, Country

Abstract
The coal is used as a fuel in thermal power plants on a very large scale. Different grades of coal are used in power plants. The moisture content, volatile nature and ash content determines the grade of the coal. Out of these Moisture plays a very important part as it is present naturally within the coal and is added while handling the coal. So handling of coal becomes the section of prime importance for any power plant. As a result, coal handling units are installed by power plants for careful handling of the coal. This includes unloading, transporting, crushing, blending and conveying. These operations play an important role as the moisture from atmosphere gets added during the run. This paper thus attempts to highlight the issue wet coal with the help of three case studies. The case studies was successfully conducted, the details of which are discussed in this paper.

Keywords: Case Study, wet coal, v-type wiper, thermal power station,

1. Introduction

A power plant consists of various sections out of which Coal Handling Plant can be termed as the heart of the Power Plant. The continuous supply of coal to the boiler throughout the year and especially during rainy season is a very laborious job. The main obstruction in supplying coal continuously is the wet coal receipt. In some of the coal rakes wet and sticky coal is present which causes choke-up of coal-crushers, transfer-chutes and feeders. To remove choke-ups, it takes on an average five to six hours which results in idling of the whole system of coal handling plant. If we can solve these choke-up problems by some method, then it will assist in minimizing the 'no coal supply time' leading to the reduced loss of generation of electricity. The possible means to solve this problem needs to be explored and be implemented to minimize generation losses.

2. Case Study A

2.1 Introduction

A case study was conducted at the ABC thermal power station. ABC Thermal Power Station (ABCTPS) is one of the biggest power stations having the installed capacity of 2340 MW as mentioned in table 1. In this case study the problems due to wet coal were identified and based on the observations certain modifications in the supply system were implemented.

Table 1: Capacities of ABCTPS

Unit no. 1	-	210 mw
Unit no. 2	-	210 mw
Unit no. 3	-	210 mw
Unit no. 4	-	210 mw
Unit no. 5	-	500 mw
Unit no. 6	-	500 mw
Unit no. 7	-	500 mw
Total	-	2340 mw

Table 2: Percentage of Coal Supplied by Coal Companies

Name of the company	Percentage of coal supplied (%)
DEF	60 %
GHI	16 %
JKL	16 %
LMN	8 %

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2.2 Coal Requirement

Total coal requirement of all the seven units is @ 40,000 MT per day. Out of which, @ 16,000 MT of coal is required for 4 nos. of 210 MW units and @24,000 MT of coal is required for 3 nos. of 500 MW units. This coal requirement is fulfilled by coal companies, like DEF, GHI, and JKL and LMN. Being a pit head power station, major portion of coal is supplied by DEF from the nearby underground and opencast mines in central region area.

The coal is received at ABCTPS through various modes of transport as mentioned below.

1. Ropeway - 8,000 mt.
2. UTS wagons - 4,000 mt.
3. Road - 2,000 mt.
4. Railway - 26,000 mt

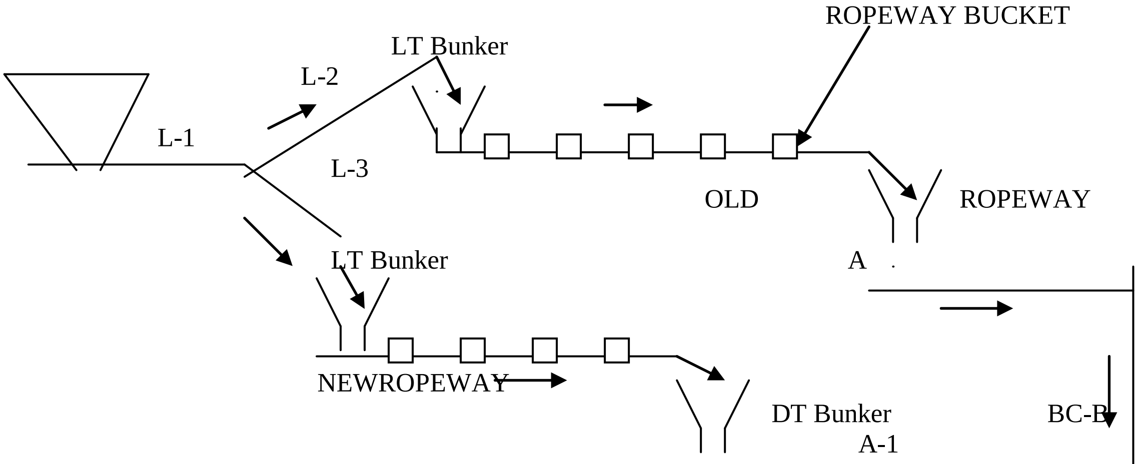
2.3 Ropeway System

Daily, about 8,000 MT of coal is supplied by DEF from Durgapur opencast mine through aerial ropeway. For this purpose, two nos. of aerial ropeways were installed at the time of ropeway construction of four 210 MW Units. (Unit No.1, 2, 3 and4)

Belt conveyor – A (BC-A)

Coal dropped by using wiper

Figure 1: Photograph showing the discharge terminal (dt) of old



Abbreviations:

L-1 - Belt Conveyor L-1
L-2 - Belt Conveyor L-2
LT - Loading Terminal
DT - Discharge Terminal

L-3 - Belt Conveyor L-3

A - Belt Conveyor A, A-2 - Belt Conveyor A-1, BC-B- Belt Conveyor –B

Figure 2: Line diagram of ropeway system

2.4 Problem Identified

In the year 2008, during the rainy season, all the six DEF bunkers were found in choke-up condition due to wet, sticky and muddy coal. Because of frequent choke-up of DEF bunker's mouth, they could not be able to supply the desired quantity of coal. When feeder at the bottom of bunker starts, hardly it could run for 5 minutes because, bunker's mouth get choke-up within 5 minutes. But at the same time they were not accepting their inability to supply the coal as per agreement. Instead of finding the solution to clear the bunkers mouth choke-up, they adopted the following practice. At night hours, they top-up some bunkers with wet coal. Again they add some water in that bunkers from its top and keep allow it for whole night to percolate that water up to the bottom of the bunker. In the morning, they request MAHCO operator to start the L-1 Conveyor and the ropeway system to take the coal receipt. Due to water percolation for whole night, naturally the excessive wet coal in their bunker slides on the L-1 conveyor and the same gets transfer to LT bunker, then DT bunker through ropeway and ultimately to the coal crusher through various belt conveyors. When this excessive wet coal reaches to crusher, it gets choke-up. To remove the crusher choke-up, it is a very tedious job of around 4 to 5 hours. Naturally, the whole ropeway system stops for 4 to 5 hours. The DEF operator informs the fact of 'ropeway down-time' immediately to their officers and the same message immediately transferred to MAHCO officers. Also, the DEF authority conveys this 'down-time' to MAHCO office in writing immediately on second day. Thus, they point out the fact of 'ropeway system down-time' due to crusher choke-up, but at the same time they were not tell a single word to anyone about the fact of adding water during night hours to the bunker for sliding the coal. During the held-up of ropeway system, DEF higher officers visit the site jointly with MAHCO officers and they also pointed out that, "We have sufficient and good quality coal stock at our loading point, but your ropeway system is not in service to lift up the same." At that instance, no doubt, they were managing anyhow to show us the good quality coal stock at loading point. This phenomenon was repeating almost daily. No one from MAHCO side was in a position to hear that, the ropeway system is out only due to excessive wet coal receipt from DEF end.

2.5 Ultimate Solution

After realizing the fact that due to crusher choke-up, we were not in a position to receive the desired quantity of coal through ropeway. It was decided to drop this excessive wet coal on ground before it goes to crusher in order to avoid the crusher choke-up. The historical information was collected regarding any attempt made previously to drop the coal on ground. It was noticed that, one vertical M.S. plate was installed on conveyor belt A-1 for the same purpose. But during the trial run, heavy back thrust was observed on the belt conveyor causing tripping of the belt within 10-15 seconds.

After getting this feedback, I have decided to install the 'V' shaped wiper on the old ropeway discharge conveyor belt i.e. conveyor A.

2.5.1 Wiper Installation

After revealing the facts, it was decided to drop this wet, muddy and sticky coal on ground before it goes to crusher. For this purpose, wiper was installed on BC- A conveyor. As shown in the photograph below, V- Type wiper is nothing but, two M.S. plates welded together to form a 'V-SHAPE'. Two free ends of this 'V' are welded by a round solid M.S. bar (axis) which is ultimately rests on the two vertical angle supports welded on the conveyor structure itself. One conveyor belt strip is fitted on the bottom edge of this wiper with the help of M.S. strip and nut-bolts to avoid any damage to the conveyor.

2.6 Results Obtained

Following results were obtained through the case study.

2.6.1 Crusher Choke-Up Minimized

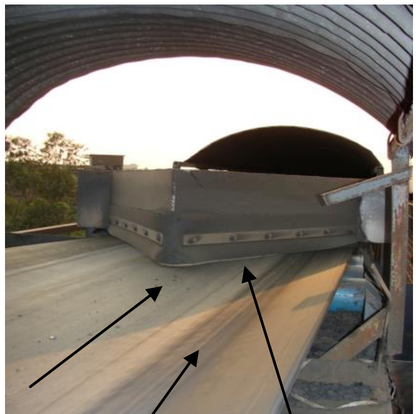
After installation of wiper, whenever the wet and sticky coal received from DEF, the same was dropped on the ground beneath the conveyor BC A. As wet and sticky coal was not passing through the crusher, naturally crusher choke-up problem automatically get minimized. Whenever the good quality (less wet and sticky) coal receives from DEF, at that time, wiper was taken out of service, so as to feed the good quality coal to the crusher and ultimately to the bunker.

2.6.2 Coal Receipt Increased

As we have seen in the line diagram of ropeway that, either old or new ropeway could be kept in service at a time, because the discharge of both ropeways was on the same conveyor i. e. BC-B. But after installation of wiper on BC A, it was possible to run both the ropeways at a time. For this purpose, the following practice was adopted.

Normally, the feed rate from DEF end was kept around 350 MT / hr. BC L-1 discharges this coal either on BC L-2 or BC L-3 in normal practice. But after installation of wiper on BC A-1, the flap gate at the discharge end of BC L-1 was put at the center so as to discharge the coal on both BC L-2 and BC L-3. In that case, the feed rate from DEF was kept in the range of 600 to 650 MT /hr. This coal discharge was bifurcated on two conveyors i. e. BC L-2 and BC L-3. Both the ropeways were kept in service. The discharge of old ropeway was dropped on the ground by putting the wiper in service and the discharge of new ropeway was taken in the normal system through conveyor BC –B.

Thus, by running both the ropeways at a time, it made possible to take more receipt of coal from DEF.



Direction Belt Conv V Type Wiper (M.S. Plate)

Figure 3: Wiper installed on BC

Changing of wiper position was made possible, by welding one lever to the axle of the wiper on each side. Only a single person could be able to do that work with minimum efforts and very less time. Thus, because of wiper installation on

BC A, crusher choke-up problem due to ropeway coal receipt was almost stopped.

2.7 Records of Increased Coal Receipt by Ropeway

Before installation of wiper, due to wet, sticky and muddy coal, coal receipt by ropeway was drastically affected. During the month of August, the coal receipt by ropeway was minimum i. e. 51,100 MT only

After installation of wiper, the coal receipt by ropeway was increased enormously. The figures given in table 3 are self-explanatory

Table 3: Coal Receipts for various months

Month	Coal receipt
August - 2008	51,100 MT
September - 2008	93,600 MT
October - 2008	2,38,400 Mt
November - 2008	2,67,600 Mt
December - 2008	2,80,300 Mt
January - 2009	2,92,400

2.8 Conclusion

This case study highlights the effects of improper handling of wet coal and solutions available that can be implemented to minimize these effects. It is evident that there will be losses due to improper handling of coal and cannot be eliminated completely. However, the losses can be minimized by using techniques like v–type wiper installation. The case study shows that there was gradual increment in the coal receipts after using v-type wipers. Overall delay of the plant was minimized. Many such techniques can be utilized to improve the plant performances and in reduction of demurrage costs. The commercial application of such techniques is still under trial phase. The dedicated efforts towards this sector are sure to yield benefits.

3 Case Study B

The concept of dropping the coal before it moves to the crusher was tested at PN TPS, where only single stream of conveyors is provided. The detailed case study is presented in this section.

3.1 Introduction

In most of the old power stations of MAHCO, the coal handling plant are of old design and possess micro-sized coal chutes and large number of transfer points with “Z” chutes, which increases the potential at various points till the wet coal arrives at the coal mill. CHP of Units 3 and 4 at PN and units 5 and 6 at PR TPS are provided with single unloading lines and as such without any redundancy and shuts down if any problem occurs in the existing line. One of the major cons of the single line of unloading is that, whenever reclaiming of coal from stack-yard is in progress, a single wagon at the wagon tippler cannot be unloaded. On the other hand, even if you have a drier coal available in the stack-yard, one has to unload and accumulate the wet coal essentially in order to recharge the bunker levels and to reduce the delay in the unloading of wagons, which results in bunker choke-ups. At New PN TPS, single line of conveyors is provided in CHP. This single line has some disadvantages as mentioned below:

- Planning a work is difficult.
- Either stacking or bunkering is possible at a time.
- Any minor or major problem in system

- Calls complete plant idling and may result in generation loss, demurrage etc.
- Plant outage is required for cleaning purpose on daily basis.
- Replacement of Steel cord belt require more time which may result in generation loss.

After removing the feeder/crusher choke-up, when this wet coal is introduced in to the bunkers then it again results in bunker choke-up. Because of this, when it was moved to stack yard, the bunkering gets affected due to single line constraint resulting into generation loss because of poor bunker levels or empty bunkers. Therefore neither this wet coal could be bunkered directly nor could it be stacked, causing held-up of wagon unloading.

3.2 Problems Identified:

In monsoon season, wet, muddy and sticky coal is received in some coal wagons. When this coal was unloaded by wagon tippler and fed in to the crusher through wobbler feeder, either the feeder or the crusher choked-up. Then there was bunkering of the drier coal available in stack yard in order to reduce the generation losses. In that case, wagon unloading remains idle because of single line of conveyors which results in heavy penal demurrage levied by railways.

Summary of Problems identified:

- Frequent feeder choke-up.
- Frequent bunker choke-up.
- Inability to unload coal wagons

  Until clearing the crusher/feeder

  choke-up.
- Frequent transfer chutes choke-up.
- Frequent crushers choke-up.

3.3 Methodology

If we succeed to avoid or reduce these choke-up problems by some means, then it will help in reducing the ‘no coal supply time’ to the boiler and ultimately the loss of generation of electricity will be avoided or minimized.

Figure 4: Photograph showing manual unloading of wagons

The possible methods to solve this problem need to be explored and the most practicable solution is to be resolved in order to avoid significant generation loss and improve the productivity.

3.4 Solution

Keeping in mind the inability of supplying the dry/less-wet coal by DEF and the time consuming methods, like manual crusher choke-up removal and manual unloading of wagons, the only option remains is that of unloading this wet and sticky coal before it goes to the crusher by applying some means or technique in order to avoid the heavy penal demurrage as well as the loss of generation due to wet coal.

After revealing the facts, it was decided to drop this wet, muddy and sticky coal on ground before it goes to crusher. For this purpose, wiper was installed on BC-2 conveyor. As shown in the photograph (fig 3), V- Type wiper is nothing but, two M.S. plates welded together to form a ‘V-SHAPE’. Two free ends of this ‘V’ are welded by a round solid M.S. bar which is ultimately rests on the two vertical angle supports welded on the conveyor structure itself. One conveyor belt strip is fitted on the bottom edge of this wiper with the help of M.S. strip and nut-bolts to avoid any damage to the conveyor.

3.5 Results Obtained

After installing of wiper on BC-2, it became

possible to unload the wagons even while the bunkering from stacker reclaimer was in progress, which was not possible earlier with single line. (fig 5 and 6) Because of unloading the wet coal on the ground by putting the wiper in operation, frequent choke-up of transfer chutes, wobblers, feeder and crusher was reduced drastically. With this arrangement of wiper, the idling time of wagons and hence the coal rakes was reduced considerably. During some instances of break -downs in conveyor system after crusher, the unloading of wagons was not idle, which was the case earlier prior to installation of wiper. After installation of wiper on BC-2, 250 numbers of wagons from various coal rakes are unloaded on ground by putting the wiper in operation just within 15 days. These 254 wagons were contributed to 12 number of coal rakes. That means, the penal demurrage of 12 number of coal rakes which otherwise would have been levied by railways, has been saved. If we calculate the saved demurrage, the calculation might be as below in table 4.

Table 4: Calculation of Demmurage

Number of coal rakes on which demurrage saved =	12
Approximate hours of demurrage per rake .	12 hrs
Rate of penal demurrage for one rake per hour	Rs. 36000/-
So, penal demurrage for one rake for 10 hrs	Rs. (36000*10)
(72 wagons * Rs.500 per wagon)	
	Rs.3, 60,00 /-
Total Demurrage for 16 rakes	Rs. (3, 60,000*12)
	= Rs 43,20,000

Thus, Rs. 43, 20,000/- were saved only due to demurrage. The loss of generation avoided due to bunkering of less wet coal from stack yard during this wagon unloading through wiper should also be the saving which may goes in crores of rupees again.

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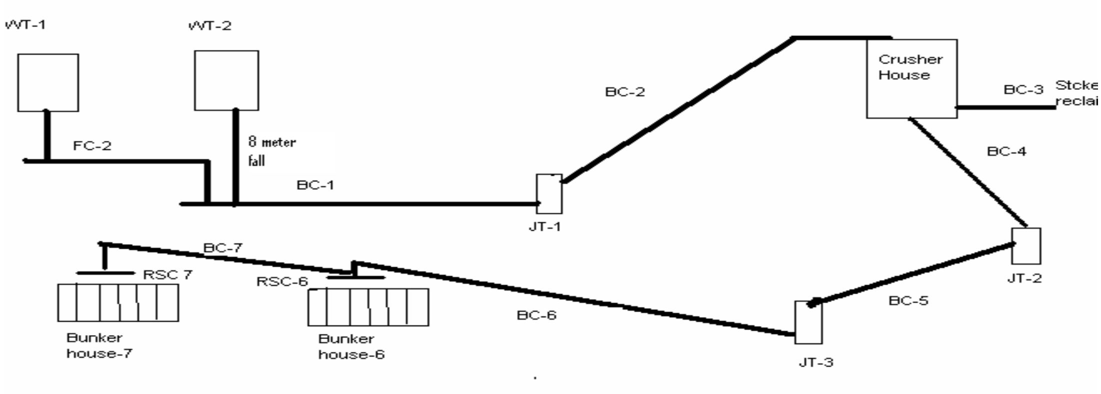

Figure 5: Single stream conveyor system at new NP TPS

Figure 6: Free fall of coal on ground after installation of wiper

3.6 Conclusion

This case study is concerned with the cost effects of improper handling of coal and solutions available that can be practiced to minimize the costing. It was observed that there will be losses due to inefficient handling of coal. The losses can be reduced by using methods like v–type wiper installation. This case study shows that a lump sum amount can be saved by using v-type wipers. Many such methods can be implemented to reduce demurrage costs. The commercial application of such methods is still under trial phase. The dedicated efforts towards this sector are sure to yield benefits.

4. Case study C

4.1 Introduction

New Parli Thermal Power Station (NPTPS) of MSPGCL comprises of two coal base electricity generating units of capacity 250MW (Unit-6 and Unit-7). Total generating capacity of New Parli Thermal Power Station (NPTPS) is 500 MW (2x250 MW). Unit-6 was commissioned in 2007 and Unit-7 was commissioned in 2010. Both units are fed with common coal handling plant. Daily coal requirement of each unit is @ 4500 MT. Hence total coal required for NPTPS station is @ 9000 MT/ day.

Coal Handling Plant of NPTPS had threatened for generation loss on account of various repetitive problems in CHP in initial years. Generation loss of main plant results in heavy financial losses to MSPGCL.

CHP (Coal Handling Plant): Coal handling plant of NPTPS was commissioned in Jan. 2006. First wagon was unloaded in CHP on 11.01.2007. CHP is designed for feeding coal to both units (ie Unit-6 and Unit-7). CHP plant comprises 5 rail lines in railway yard for wagon movements and connected to old plant rail lines along with one separate line up to Parli railway station. CHP at NPTPS comprises following main auxiliaries.

•No. of conveyor streams – 01. Conveyor path for coal flow from wagon tippler to bunkers/ stack yard is single. This is first time practiced in MSPGCL in view of increased conveying capacity with advance technology. Rated capacity of conveyor system is 1200 TPH (Tones per hour) and designed capacity is 1600 TPH. Speed of conveyor belt is 3 m/s which is quite high as compared to any other CHP,s in MSPGCL. Steel cord conveyor belts of construction 7x7, strength- ST 640, top rubber-8mm, bottom rubber-4 mm, width 1400 mm and 95 steel cords are used first time in CHP to cope up requirement of strength for higher rate of coal conveying. Belt gradients are used at higher side to reduce total length of belt while conveying coal from wagon tippler to either stack yard or coal bunkers. 6.6 KV drive motors are used for conveyor drives with fluid coupling arrangement. Gear boxes with reduction ratio of 16:1 are used to give rated output speed to drive pulleys of conveyor. Each unidirectional conveyor is consisting of 1 drive pulley, 1 tail end non drive pulley, 2 bend pulleys, 1 take up pulley and 1 snub pulley. Carrying idlers are provided so that conveyor toughing angle is 35 degree. Total No. of conveyors in CHP NPTPS are 13 nos. All conveyors and system is operated from CHP control room through PLC system. Interlocks provided for safe operation. Also safety devices like pull chords, belt sway switches, motor overload protection etc. are used in view of safety of human and equipment.

•No. of Wagon Tipplers – 02 Nos. Elecon make side discharge type wagon tipplers are used in

CHP NPTPS. Maximum tipping angle is @135 degree. Maximum no. of tips per hour are 20 (rated). 04 no. of wagon holding clamps are used in each tippler. Wagon tippler is designed to unload coal wagon with max. gross weight of 110 MT. Tipping cycle of tippler is of 90 secs. Wagon tippler is operated through hydraulic system and controlled through PLC system. This is first time practiced in MSPGCL to use hydraulic system in dusty and polluted atmosphere. Hydraulic system consists of hydraulic pump (main) to supply high pressure hydraulic oil (HLP 68) to hydraulic motors. Each tippler is coupled with two no. of hydraulic motors through pinion gears and planetary gear box at two sides of wagon tippler.

•Coal crusher – 02 nos. Instead of primary and secondary crushing system single crusher is used to crush coal from received size to 25 mm and below size. One crusher is working at a time and other remains standby. Crusher is driven through flat belt by 1200 KW capacity motor. Crusher is impact type and having capacity as that of conveying capacity of CHP system. Ie 1200 TPH rated and 1600 TPH designed. Each crusher is equipped with 96 no. of beater arms provided with beater head (hammer) at free end. Crushers are reversible in direction. Alloy metal grinding jibs and liners are fabricated internal to crusher to support hammering action. Output size of coal after crusher is (-) 25 mm. Arrangement is available to control the coal output size by increase or decrease clearance of hammer and grinding wall of crusher.

•Wobbler feeders: 02 nos. Wobbler feeders are positive drive for coal feeding used in place of vibrating feeders to overcome coal choke up problems in vibrating feeder. Wobbler feeders are used to screen coal below 25 mm size and above 25 mm size. Coal of size below 25 mm is bypassed from crusher and fed to system after crusher while coal of size above 25 mm size is pushed to respective impact crushers for crushing to required size. Each wobbler feeder is using 18 no. of wobbler bars of elliptical cross section and driven externally with chain and sprocket arrangement. Arrangement is made so that successive wobbler bars will made 90 degree angle with each other and form a gap of 25 mm so that coal while pushed by one wobbler bar to next bar coal of size below 25 mm will drop down through gap and higher size coal will be pushed towards crusher through wobbler bar arrangement. Angle of wobbler arrangement is @ 9 degree declining towards crusher.

•No. of stacker /Reclaimer - 01. Elecon make single stacker is used for stacking of coal and reclaiming of coal as and when required. Capacity of stacker is in line with plant capacity ie 1200 TPH (rated). Stack yard provided for coal stacking accommodate @ 2 lakh MT of coal. Stacker is equipped with bucket wheel, boom conveyor and intermediate conveyor.

•Line diagram of CHP: Coal wagons unloaded at wagon tippler. Both tipplers work simultaneously. Coal from tippler drop in respective hoppers. Chain conveyor mounted below hopper known as apron feeder then feed coal to tail end chute of conveyor no.1. C1 belt receives coal at its tail end and convey to Junction Tower No.1 discharge chute on tail end of C2 belt. C2 belt then convey coal and discharge it at chute in crusher house. Discharge chute of C2 belt discharges coal at central zone of RBF-1 belt (Reversible belt feeder No.1). RBF-1 belt is reversible to facilitate selection of pair of wobbler feeder and crusher. A forward rotation of RBF-1 belt discharge coal to wobbler feeder No.1 and crusher No.1 while reverse direction discharges coal to wobbler feeder No.2 and crusher No.2. Coal screened in wobbler feeder and passed to RBF-2 conveyor bypassing crusher. Coal of higher size is discharged by wobbler feeder to respective impact crusher. Coal crushed after crusher is also discharged on RBF-2 (Reversible belt feeder-2) belt conveyor. Forward direction of RBF-2 belt discharges coal on C3 belt for stacking in stack yard while reverse direction of RBF-2 discharges coal on tail end of C4 belt for bunkering. Coal from C4 belt passed to C5 then on C6 belt. Head end of C6 belt is on top of bunker floor in main plant. Coal discharged from C6 belt in inverted 'Y' chute. One leg of chute discharges coal on RSC (Reversible shuttle conveyor) of Unit-6 and other leg discharges coal on conveyor No.C7. C7 belt convey coal to Unit No.7 and discharges it on RSC of Unit-7. Each Unit is provided with six no. of bunkers each of capacity of 1000 MT. RSC of respective Unit discharges coal in required bunker by movement of trolley.

4.2 CHP Problems

- Hydraulic systems used for Wagon Tippler and Side Arm Charger fails frequently.
- Wagon tippler clamps were not suitable to unload heighted wagons.
- •Premature failure of Wagon Tippler foundation
- Frequent failure of shortest FC-2 conveyor belt due to handling of wet coal.
- High impact height of discharge chute from Apron feeder 2 to C1 belt tail end @ 8.3 m.
- Grilling of Wagon Tippler hopper took huge time thereby delay unloading due to wet and sticky coal.
- Heavy choke up in rainy season at take up point of RBF-2 belt.
- RBF-2 – A reversible conveyor (fig 7) in crusher house receiving coal from 2 wobbler feeders and 2 crushers fails frequently due wet coal handling. Replacement took time @ 20-24 hrs. Minimum.
- Wobbler feeders always have problems of setting disturbance due to lumpy coal and wet coal
- RBF-2 belt had very less ground clearance at take up. This frequently chokes up gap and damages to belt on account of wet coal receipt. Frequent failure of RBF_2 belt adds maintenance cost and generation loss on account of unavailability of coal stream.
- CHP equipped with steel cord belting which took more time for belt replacement. Single stream of conveying system - Every problem on stream adds hours of plant outage which result in generation loss.

4.3 Identified Problem: Detail description

Reversible Belt Feeder No.2.

Problem –

1. Heavy choke up in rainy season at RBF-1 take up point of belt.

RBF-2 – A reversible conveyor in crusher house receiving coal from 2 wobbler feeders and 2 crushers fails frequently due wet coal handling. Replacement took time @ 20-24 hrs minimum.

RBF-2 belt is located in crusher house. It receives crushed coal from Wobbler feeder1, Crusher1, Wobbler feeder2 and crusher2. RBF-2 belt when operated in forward direction it discharges coal on conveyor no.4 for direct bunkering. RBF-2 belt when operated in reverse direction it discharges coal on conveyor 3 for stacking. RBF-2 is equipped with two drive pulleys, two bend pulleys and two take up pulleys. Screw take up arrangement is made for belt tensioning. The gap between conveyor belt and floor is just @90 mm. Total belt length of this belt is 56 meters. Complete conveyor is housed in deck to avoid coal dust spillages on account of coal fall from height.

Since from commissioning it is experienced that conveyor belt life at this conveyor is less. It needs replacement twice in a year to 5 times in a year. While going through its behavior of failure it comes to our knowledge that belt rubbing takes place at take up. This is due to the fact that gap between belt and floor level is just 90 mm. This gap immediately fills up with coal dust when belt is operated. Another reason is belt tension. With screw take up arrangement when new belt is commissioned it elongates more than the margin available in take up arrangement. This loosens belt thereby reduces slack side tension of belt. This result in belt slippage on drive pulley while in operation and reduces belt speed. This in turn overloads belt. In rainy season damages to belt joints and ply opening problems are more serious. A single failure of RBF-2 belt leads to complete outage of coal handling plant for @ 24 hours. It adds heavy penal demurrage charges and generation loss.

It is required to find the solution to this problem which will give sufficient belt tension and provide wide gap with floor. Hence the idea of providing gravity takes up arrangement to RBF-2 belt come in existence. Now the big problem with this idea of gravity take up is that 1 floor below of RBF-2 conveyor, conveyor no.3 (stacking/reclaiming conveyor) is fouling. Height margin from top of conveyor no.3 to bottom of RBF-2 belt is found sufficient but in case of belt snap of RBF-2 it may result in accident as take up weight of RBF-2 will drop exactly over running conveyor no.3. Hence it is planned to provide sufficient safety for conveyor no.3 to avoid such incidence.

4.4 Analysis

1. Gap between belt and floor level is just 90 mm. This gap immediately fills up with coal dust when belt is operated. During belt in operation belt rub with choked up coal in the gap. This damages belt joints, open ply of belt at joints. Being reversible in nature joint in any direction faces this problem.

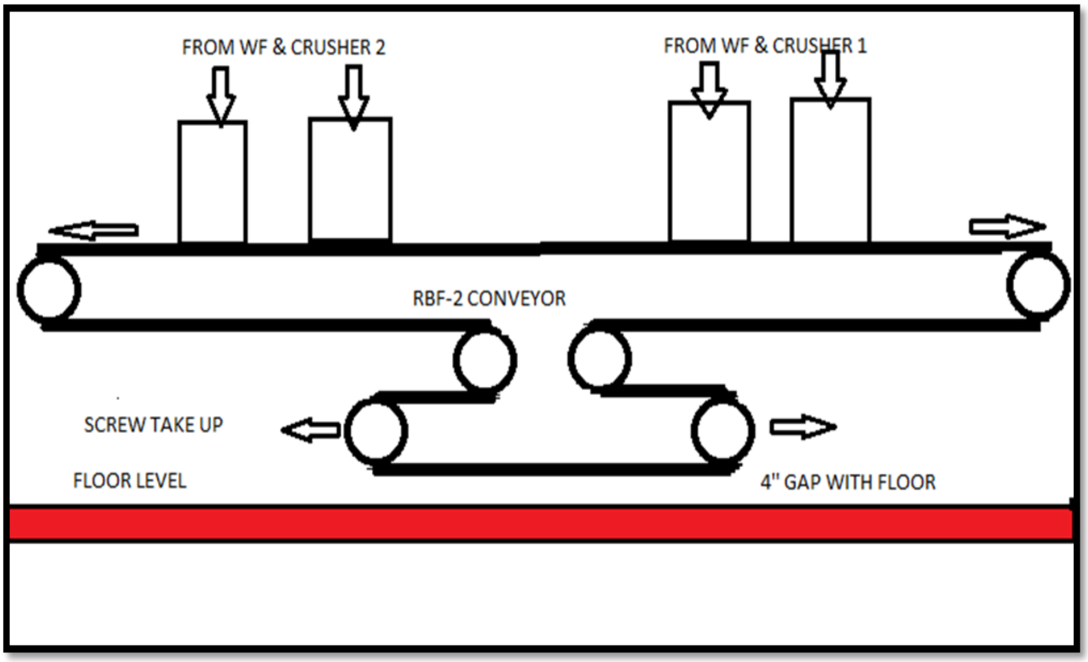

Figure 7. RBF conveyor

2. Another reason is belt tension. With screw take up arrangement when new belt is commissioned it elongates more than the margin available in take up arrangement. This loosens belt thereby reduces slack side tension of belt. This result in belt slippage on drive pulley while in operation and reduces belt speed. This in turn overloads belt. In rainy season damages to belt joints and ply opening problems are more serious.

3. Another reason of RBF-2 belt failure is its shortest length. Length of RBF-1 belt is 56 meter only and center to center distance between two pulleys is 28 meter. If we compare RBF-2 belt with longest conveyor in CHP i.e. C3 belt which is 1100 meter in length then simple conclusion can be drawn that during one revolution of C3 conveyor, RBF-2 conveyor makes @ 20 revolutions. Hence cyclic loading frequency on RBF-2 belt is quite higher than any other belt in CHP. This also results in early end of belt life.
4. Another reason for belt failure is that it is reversible. Every conveyor belt in CHP is provided with scrappers to remove wet coal stickup with belt surface. Scrappers are provided on discharge side near pulleys so that material removed from belt surface in scrapping will fall down in discharge chute. In case of receipt of wet coal scrapping is required to avoid choke up problems, belt running out problems. Scrappers almost kept tight on belt surface when wet coal is to be handled. In reversible belt scrapping is provided at both ends. Fabric belts on conveyors are joined with cold or hot vulcanization joints. Belts also have

various patches at several locations. Due to reversible direction of RBF-1 belt joints gets damaged on account of scrappers. Joints can be provided with ease of operation in one direction only. Following fig. shows when belt moves in direction 'A' scrapper will have tendency to remove rubber layer cover at joint. (Fig 8)

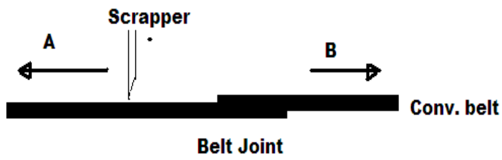

Figure 8. Belt joint

4.5 *Solution and work carried out*

Solution: To get free from all problems related to RBF-2 it is proposed to provide gravity take up arrangement with self-locking system to safeguard Conveyor 3 below RBF-2 belt.
This will benefit as,

- Reduce belt failures of RBF-2.
- Improve belt life.
- Provide sufficient belt tensions and avoid belt slip.
- Remove plant outages on account of RBF-2 problems.
- Improve plant availability.
- Reduce demurrage charges due to delay in unloading.
- Reduce generation loss.
- Reduce maintenance cost.

Site data is collected for provision of gravity take up. Available height above conveyor no.3 and below RBF-2 is found sufficient in view of belt length and probable elongation of belt. Structural arrangement is decided and drawings are prepared with provision to safeguard conveyor no.3 in case of RBF-2 belt snap. Available bend pulleys and take up pulleys are decided to use as it is in available dimension.
Following works are carried out,

1. Breaking of concrete floor below take up zone.
2. Removal of bend pulleys and take up pulleys and strengthening foundations of bend pulleys.

3. Fabricating structure with strong foundations at conveyor 3 floor.
4. Fabricating platform near take up pulley level for the ease of maintenances.
5. Fabricating weight box and providing arrangement over it for fixing take up pulley bearing blocks.
6. Provision of slack chain arrangement to hang the take up mass in case of belt snaps.
7. Provision of guide channels to guide takes up weight movement in vertical direction.
8. Providing additional strengthening to take up structure with available concrete structure facilities.
9. Provision of stoppers on guide channels to restrict the movement of take up weight below certain level to avoid stuck up with running conveyor no.3.
10. Shortening the distance between two bend pulleys which should be equal to diameter of take up pulley. Accordingly modifying base foundations of bend pulleys.
11. Commissioning of take up pulley.

Following arrangement (fig 9) shows two no. of bend pulleys below which concrete floor is removed to house gravity take up arrangement.

Figure 9. Bend pulleys

Following arrangement (fig10) shows provision of structural support for gravity take up arrangement below RBF-2 belt and above conveyor no.3.

Figure 10. Support for Gravity take-up Arrangement

4.6 Results Obtained

- In 4-5 years after commissioning of gravity take up arrangement, not a single incident of coal choke up is noted at that location.
- Belt life is improved and one new belt can work for more than 2 years till failure.
- Plant outages on account of RBF-2 conveyor are reduced drastically.
- CHP plant availability is improved drastically.
- Generation loss on account of CHP problems is decreased drastically. It reduces from 348 MU in 2010-11 year to only 0.8 MUs in 2014-15.
- Most worst CHP of MSPGCL in year 2007-2010 becomes best CHP in MSPGCL and wins a prestigious award “Black Diamond Award" in year 2014-15.
- Coal stock built up is possible due to improved rate of wagon unloading.
- Penal demurrages are reduced on account of reduction in delay period of wagon unloading.

5. Conclusion

This paper highlights the cost effects of improper handling of coal and solutions available that can be implemented to reduce the costing. It is observed that there will be losses due to inefficient handling of coal and cannot be eliminated completely. However, the losses can be reduced by using methods like v–type wiper installation, gravity take up arrangement, etc. The case studies presented that a lump sum amount can be saved by using v-type wipers & gravity take up arrangements. Also the plant losses were reduced. Many such methods can be implemented to improve the plant performances and in reduction of demurrage costs. The commercial application of such methods is still under trial phase. The dedicated efforts towards this sector are sure to yield benefits.

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