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Design and Analysis of Flip Type Scrapper for Belt Conveyor System

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Abstract: ***Conveyors are one of the most commonly used mechanical handling equipments which transports or moves bulk materials from one point to another point. Conveyors are useful in many applications which involve the transportation of bulky materials. Conveyors allow efficient and quick transportation of a several varieties of materials, making conveyors very popular in material handling industries as well as packaging industries. Though these conveyors have above advantages they will require huge amount of power to drive the belts. As a result of increase in fuel prices all over global markets and scarce of fossil fuels the electricity charges are increasing tremendously. By reducing belt drive power consumption huge amounts of money can be saved and we can reduce the emissions of green house gases. Fixed solid scrappers are used to remove coal or powdered raw material which sticks to belt due to surface moisture during rainy season. Though fixed solid scrappers are one of the resistances which contribute to additional power consumption of the belt conveyors, it is essential as If powder deposits are not removed will erode return idlers. As a part of my project dissertation I have opted to study a coal conveyor system design, selection of various components, calculation of tension / loads on conveyor system and reduction of conveyor power consumption by modifying conventional fixed solid scrapper to flip type scrapper. The arrangement will expose the belt to solid scrapper only when belt is wet and remaining time to brush.***

Keywords: Flip type scrapper, belt conveyor, Solid belt scrapper

I. INTRODUCTION

Different kinds of conveying systems are in use worldwide and they are used as per requirements of different industries like Power, Mining, Shipping systems, Handling of grain etc., Belt Conveyors are having numerous uses in various industries due to the benefits provided by them. Belt Conveyors can transport materials safely from one position to another with cost effectiveness and greater ease Belt Conveyors can be installed anywhere and they are much more reliable than any other conveying systems for movement of bulk material handling systems.

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Belt Conveyors can easily move materials of different shapes, weights and sizes. Several options are available for driving belt conveyor systems, which includes mechanical, hydraulic, electrical and automated systems based on individual requirements. Though these conveyors have above advantages they will require huge amount of power to drive the belts. As a result of increase in fuel prices all over global markets and scarce of fossil fuels the electricity charges are increasing tremendously. By reducing belt drive power consumption huge amounts of money can be saved and we can reduce the emissions of green house gases. Fixed solid scrappers are used to remove coal or powdered raw material which sticks to belt due to surface moisture during rainy season. Though fixed solid scrappers are one of the resistances which contribute to additional power consumption of the belt conveyors, it is essential as If powder deposits are not removed will erode return idlers.

1. Conveyor Frame Structure

The conveyor structure shall consist of independent prefabricated tables. The length shall be 5 to 6 m about for the standard table for supporting idlers but when required special tables shall be provided. All standard tables shall be supported generally as shown in the enclosed drawings. Typically conveyor idlers shall not be directly mounted on the galleries. Stringers shall be channels and the channel size for stringers shall be minimum 200mm.Self cleaning V type deck plates shall be provided under the loading points; extending 1.0 m before and after the end of the loading skirts and above the V-plows protecting the return pulleys. For the stockyard conveyors the deck plate shall be provided for the entire travel length of the stacker-reclaimer. In no case shall minimum clearance between the floor and the lower most point of the return belt shall be less than 500 mm. In case of ground conveyor the conveyor vertical supports will be fixed on a minimum 300 mm high concrete pedestal. The belt conveyors will be covered with a hood wherever applicable. Hood shall be open able throughout. One hinged inspection door shall be provided at each hood segment. The hood shall be of pre-coated corrugated steel/ CGI sheet which could be pushed / collapsed / tiltable /hinged type segment wise. It shall be of proven design and easy to operate.

2. Idler Assembly

Carrying idlers for all belts shall be three roll garland type with articulated joints having freedom of movement in both vertical and horizontal directions for all conveyors.

Fig No.1.0 3 Roller Idler Assembly

Return idlers shall be 'V' type two rolls, minimum 15 deg incline to the horizontal with articulated joints with freedom of movement in both the vertical and horizontal directions.

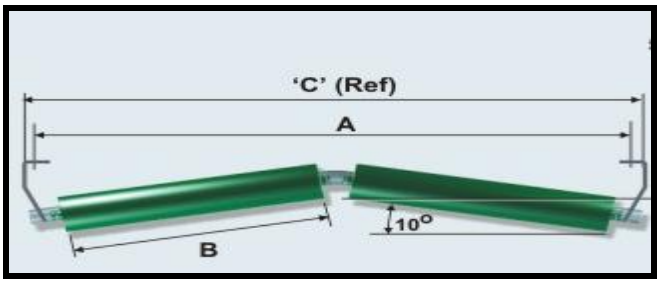

Fig No.2.0Return Idler Assembly

However, in case of inclined portion of conveyors, return idlers shall be 'V' type mounted on fixed supports. For both types the rolls shall be identical. Minimum clearance between the bottom of return belt and the floor shall generally be 500 mm.

3. Belt Scrapper

The Scrapper shall be located beneath the discharge pulley drum. The scraper shall be provided for removing the heavy residue of materials adhering to the belt surface on the return side of belt. The blades of primary scraper shall be made of abrasion resistant polyurethane material, inclined against the direction of belt travel, ensuring maximum cleaning with minimum wear and tear of belt surface. The scraper shall be easy to install and minimum maintenance.

4. Scrapper rubber with drills

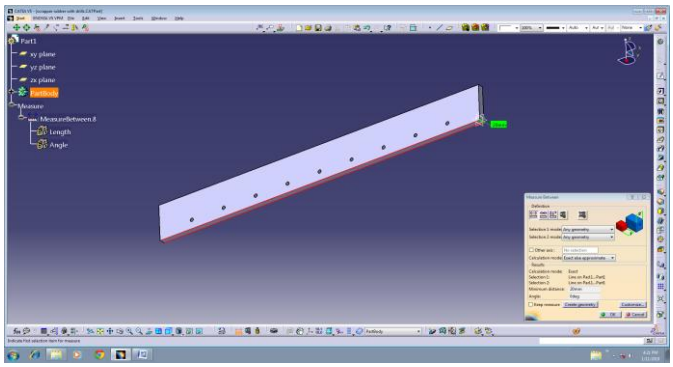

Fig No.3.0General Arrangement Drawings of Scrapper Rubber

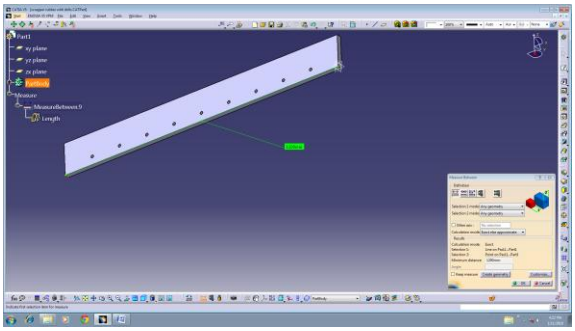

Fig No.4.0General Arrangement Drawings of Scrapper Rubber

5. Support plate for Scrapper Rubber

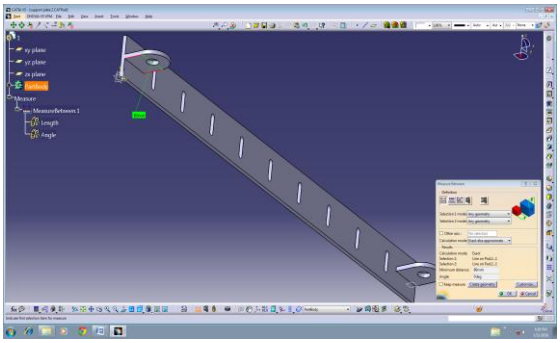

Fig No.5.0General Arrangement Drawing of Support plate for Scrapper Rubber

6. Fixing plate for Scrapper Rubber

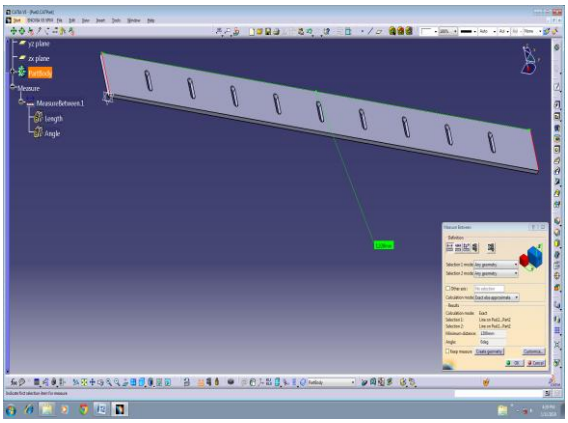

Fig No.6.0General Arrangement Drawing of Fixing Plate for Scrapper Rubber

7. Brush

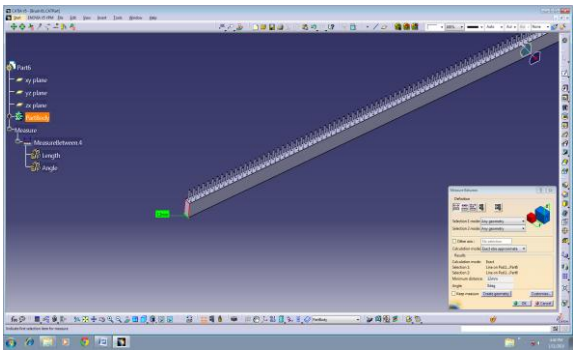

Fig No.7 .0 General Arrangement Drawing of Brush for Belt Cleaning

8. Lever for Flip Scrapper

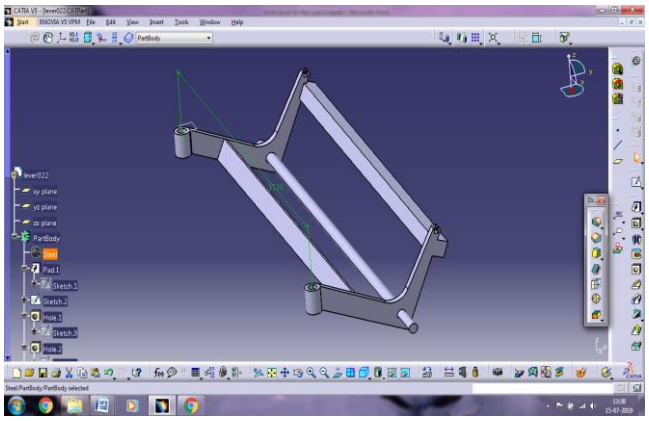

Fig No.8.0General Arrangement Drawing of Lever for Flip Scrapper

9. Analyses

Mild steel material properties are added to the component

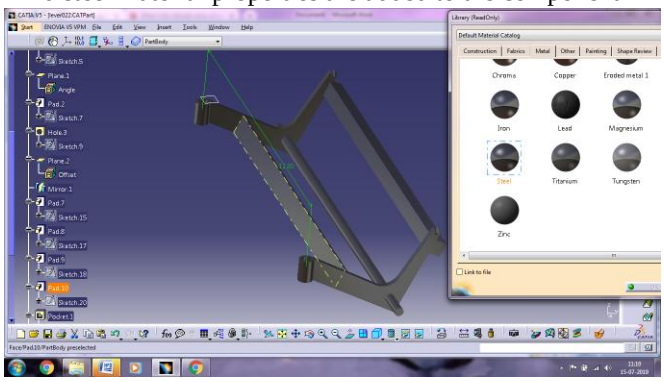

Fig No.9.0

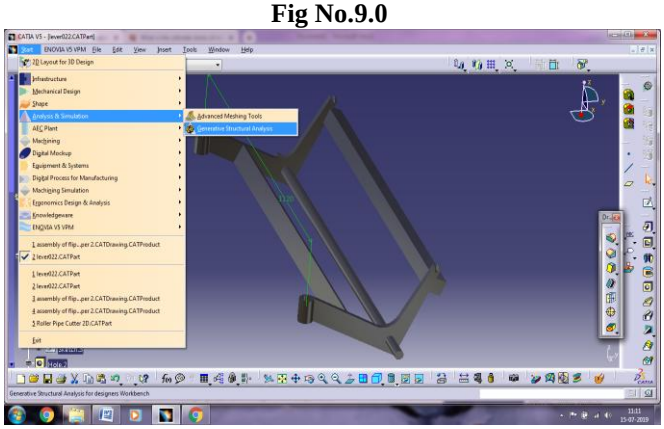

Fig No.10.0 Selection of Analysis

10. Calculations

II. CONVEYOR DATA

Profile length- I (L1) 60.418 m
Total Conv. Profile Length (L) L= L1 60.418 m
Lift in Length- I (H1) 4.500 m
Total Conv. Lift (H) H= H1 4.500 m
Lift between Tail Pulley & Drive Pulley(C/C) (Hc) 4.500 m
Conv.Inclination in Section-1 (δ1) 4.275 deg
Maximum Slope (δ) 4.275 deg

III. MATERIAL CHARECTERISTICS

Rated Capacity 3000 TPH
Design Capacity (C) 3600 TPH
Bulk Density (ρ) 800Kg/m^3
Max. Lump Size 300 mm
Filling Factor (Kf) : 0.90 (0.90 for B.W.> 600mm, =0.75 for B.W.<=600mm;)
Slope Factor (K) = 0.98 Ref: IS 11592, Table-9
Surcharge Angle 20 deg Ref: IS 11592, Table-9
Repose Angle (Φ) 37 deg

IV. DESIGN PARAMETER

Trough Angle (α) 45 deg
Belt Width (BW) 1800 mm
No.of Roll in Carrying Idler (Flat-1 , Trough-3) 3
No.of Roll in Return Idler (Flat-1 , V Type-2) 2
Cross section area of load (At) Ref: IS 11592, Page-8, Table-7 0.414 m^2
Required Conveyor Speed V=C/(3.6×At×Kf×K×ρ)= 3.423 m/sec
Actual Conveyor Speed (G.R.=14) (V) V=π×Dh.p × N/(60*GR) = 3.608 m/sec
Mass of material Handled W_m=(0.2778 X C)/V(m/s) = 277.14 kg/m
Mass of material Handled (Wm) 186.23 Lbs/ft

V. RESULTS AND CONCLUSIONS

Scrappers are used to clean wet coal powder stuck with belt which otherwise will be responsible for early wear out of return idlers In our country coal will be wet mostly during rainy seasons only Belt conveyor drive requires lot of energy to overcome friction caused by stationary scrappers .If we can replace stationary scrappers with our flip type scrappers it can save lot of energy by discarding scrapper friction during dry seasons. By using flip type scrapper we can easily detach scrapper from conveyor during dry coal passage.
As we are disengaging scrapper blade during dry coal passage we avoid belt & scrapper belt wear out to some extent
Total savings we can make for above six months = (106.36 – 101.26) x 24 x 180 = 22,465 Kwh
The present design is done in such a way that it is very easy to fabricate and replace rubber / adjust As we have provided counter weight at brush end torque required for motor to engage the scrapper is very less which improves life of scrapper motor While conducting analysis on present design it is found that maximum stress is 2.45MPa where as yield stress of Mild Steel is 276MPa. Hence the thickness chosen is more than sufficient to take 500N load Maximum transitional displacement found is 0.0172mm at 500 N forces which is very negligible

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