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Enhancing the Availability of C206 Conveyor Belt

Dr V Janakiraman [1], I Ashok Kumar [2], Ajmal.A [3], Abhijith KU [4], Akhilsajeev [5], Nithin Joseph [6]
[1] Associate Professor, Department of Mechanical and Automation Engineering, PSN College of Engineering and Technology Tamil Nadu, India.
[2] Assistant Professor, Department of Mechanical and Automation Engineering, PSN College of Engineering and Technology Tamil Nadu, India.
[3, 4, 5, 6] Students, Department of Mechanical and Automation Engineering, PSN College of Engineering and Technology Tamil Nadu, India.

Abstract – This research work aims to enhance the availability of belt conveyor. The detailed study has been conducted on the existing c206 belt conveyor. History card of c206 checked and identified the various problems have been faced. After detailed study, redesign on the existing conveyor some remedies suggested for enhancing its availability. The principle of lean manufacturing has been used to reduce the overall downtime and the lean manufacturing principle helps to achieve ever time production. For belt conveyor we proposed some preventive measurements show the downtime due to maintenance can be reduced.

Index Terms – Belt Conveyor, C206.

1. INTRODUCTION

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—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 pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

2. EXISTING CONVEYOR BELT

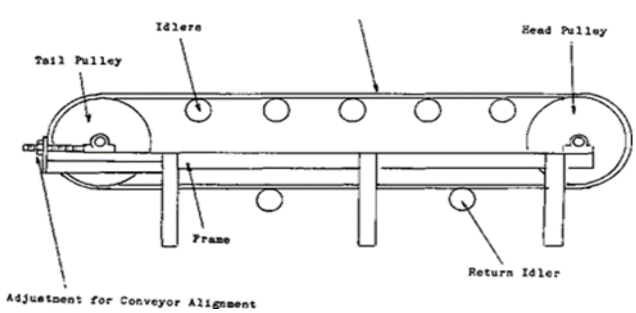

FIG.1 (EXISTING CONVEYOR BELT)

2.1 SPECIFICATION

LENGTH = 40037mm

BELT WIDTH = 500mm

CAPACITY = 15TPH

BELT SPEED = 1m/S

TYPE OF TAKE UP = SCREW

T.U TRAVEL =850 mm

MATERIAL = Leachet elmenit

BULK DENSITY = 1.2T/m^3

LUMP SIZE =1mm

MAX WORKING TENSION(T1) =4418N

SLACK SIDE TENSION(T2) =1864N

MAX WORKING TENSION(T1) = 4118N

MAX ALLOWABLE WORKING TENSION = 2554N

TYPE = EP

GRADG = m24

RATING = 315/3

TOP COVER = 6mm

BOTTOM COVER

Longitudinal vibration, the natural vibration frequency in the transverse direction and the response to =3mm

SPLILING = VULCANISING

ANGLE OF RESPONSE =33^0

LOAD CARRYING = 5T/hr

2.2 COMPONENTS

BELT

The belt consisting 3ply,28,0z NYLON and OVEK,4mm TLP, 400mm belt width capacity 15 TPH, Length of the belt 38 m,Belt width 500mm,material of belt 20m/min,Power of material 7.5 HP,Operating temperature Ambient

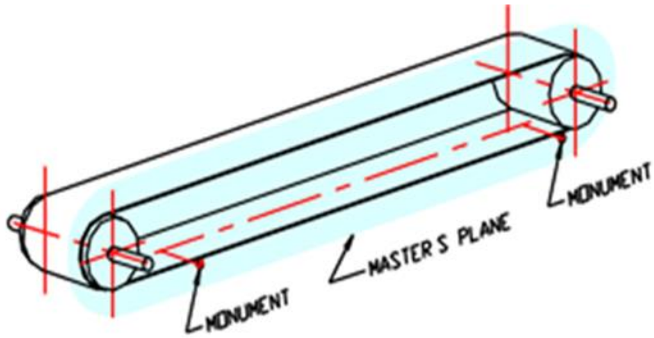

FIG.2 (BELT)

Dynamic characteristics of a belt conveyor are determined to a large extent by the properties of the belt. This paper describes experiments designed to establish the dynamic properties of belting material. The dynamic elastic modulus, vice of the belt were measured. Several properties were studied as a function of the tensile loading on the belt. These included an impulse excitation. Vibration response was observe under several different excitation frequencies. Most of these properties have not been tested previously under conditions appropriate for the ISO/DP9856 standard. Two types of belt were tested, a steel reinforced belt and a fabric reinforced belt. The test equipment was built to provide data appropriate for designing belt conveyors. It was observed that the stress wave propagation speed increased with tensile oad and that tensile load was the main factor influencing longitudinal vibrations.

2.3 CARRING IDELERS

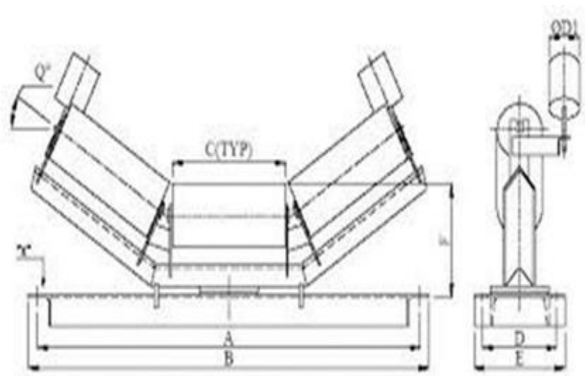

FIG.3(CARRING IDELERS IN BELT CONVEYOR)

Carrying rollers are used to support the conveyor belt and are installed on the groove shape frame, Groove shape forward inclined idler frame and transition idler frames. Rollers include high quality bearing, multi-labyrinth sealing, greased and sealed for life and critical specifications essential for high performance.

FEATURES :

Rollers are designed for smooth rotation, low noise, and long service life.

Diameter range: 75mm to 219 mm, other diameters available on your request.

Pipe length: 180mm to 3500 mm.

Water proof and dust proof.

Each roller come out through strict inspection and test to ensure high level quality.

Roller Surface Colour : Any colour as per customer request

2.4 IMPACT IDELERS

Instead of normal steel at a loading point. On steel roller Impact rollers are used as carrying rollers there are rubber rings assembled, side by side, to absorb the weight and impact of material falling onto the belt. At the same time impact rollers reduce the shock and vibration through the steel structure.

FIG.5 (IMPACT IDELER)

FEATURES:

- Shocks.
- High loading capacity.
    - Absorbs weight and Roller diameter: 75-219 mm
    - Shaft diameter: 20mm,25mm,30mm,35mm,40 mm
    - Roller length: 150 - 2800 mm
- Shocks.
- High loading capacity.

SPECIFICATIONS:

- Absorbs weight and Roller diameter: 75-219 mm

- Shaft diameter: 20mm,25mm,30mm,35mm,40 mm
- Roller length: 150 - 2800 mm

2.5 RETURN ROLLER

The straight tracking of the belt may be compromised by the type of conveyed material, especially when this material is sticky and thereby adheres easily to the belt surface.

In this case, material is also deposited on the return rollers that support the belt, adding an irregular addition of scale to the roller itself.

FEATURES :

As a consequence, not only wear and tear of the belt occurs, but forces are brought into play to move the belt away from its correct track.

Return rollers with spaced rubber rings contribute largely to eliminating the buildup of scale that forms in certain conditions on the belt surface. The rings are pointed, assembled at intervals, in the central part of the roller, where they have the scope to break up the scale which normally is present at the belt center; meanwhile flat rings mounted in groups at the extremities of the belt, support and protect the belt edges, also in cases of limited belt wandering.

Return rollers with rings should not be used as belt tensioning devices.

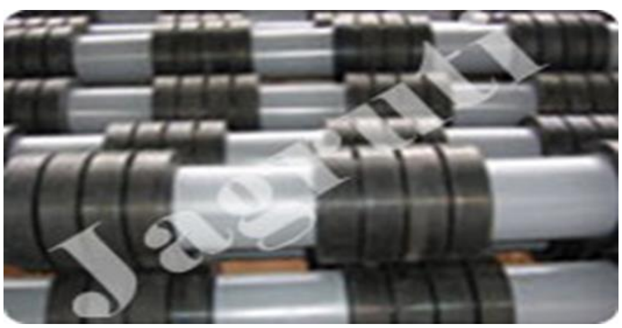

FIG.6 (RETURN ROLLER)

2.6 JOINING METHOD BELT CONVEYOR

COLD BONDING METHOD

FIG.7 COLD BONDING METHOD

Cold bonding can be described as the joining of two parts or materials without the use of heat. Traditional bonding techniques such as welding use high temperatures generated by an electric arc or the burning of gasses to melt the materials so that they fuse into one. Cold bonding is achieved with the use of an adhesive that forms a bond between the two materials. Belzona cold curing composites allow for this bond to be created without the use of heat.

ADVANTAGE OF COLD BONDING METHOD

One of the advantages of cold bonding is the process is cheaper when compared to hot bonding. Being less involved and easier to perform not only assists in keeping the cost down but the lead-time is also shorter.

DISADVANTAGES OF COLD BONDING METHOD

- One of the downsides of using cold vulcanised bonding is there are more potential modes of failure.
- One of the common modes of failure is caused by gaps between the rubber strips. The glue and filler which is used to join the rubber strips can be worn away leaving gaps in the lagging. This can allow water to penetrate the lagging and may lead to pulley shell corrosion.
- Corrosion of the pulley shell can cause the rubber lagging to lift off the pulley shell. When the pulley is refurbished the pulley shell may need to be machined to remove the corrosion and may lead to a reduction in the shell thickness.
- Due to the increased modes of failure, the average service life of cold bonding lagging is generally shorter than hot bonding – Cold bonding
- One of the downsides of using cold bonding is there are more potential modes of failure.
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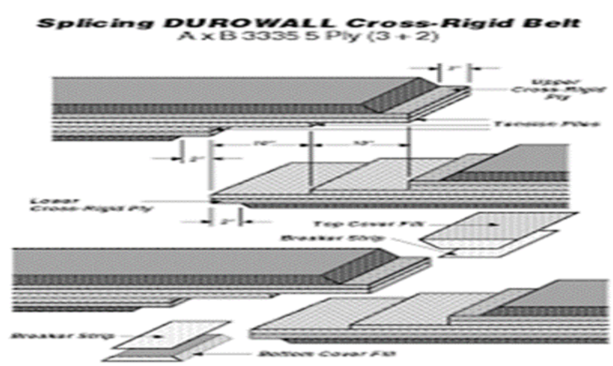


FIG.8 COLD BONDING METHOD

3. LEAN MANUFACTURING PRINCIPLES

One of the most critical principles of lean manufacturing is the elimination of waste. Many of the other principles revolve around this concept. There are 7 basic types of waste in manufacturing

FIG.9 LEAN MANUFACTURING

- Over Production
- Waste of Unnecessary Motion
- Waste of Inventory
- Production of Defects
- Waste of Waiting
- Waste of Transportation
- Waste of Over processing

Although the above mentioned types of waste were originally geared toward manufacturing, they can be applied to many different types of business. The idea of waste elimination is to review all areas in your organization, determine where the non-value added work is and reduce or eliminate it.

4. DOWN TIME DUE TO CONVEYOR PROBLEM

Delays are unique and one of the largest issues mining/manufacturing companies is facing today. Delays in mining/manufacturing projects have become a major concern across all parts of the world. Substantial value is destroyed and companies face significant corporate risk if these delays occur during project execution. However, despite the concern regarding the project delays, there has been very limited research conducted in this area. Delay in the completion of a project can be a major problem for contractor companies leading to costly disputes and adverse relationships amongst project participants. Projects can be delayed for a large number of reasons. The reasons are related to the various types of uncertainty associated with activities during the mining/manufacturing processes. The most common factor of delay are natural disaster like flood, earthquake etc. and some others like financial and payment problems, improper planning, poor site management, insufficient experience, shortage of materials and equipment etc. Delays will also result in several negative effects like lawsuits between house owners and contractors, exaggerated prices, loss of productivity and revenue, and contract termination. So, comprehensive study on these delays is important.

SL NO	DISCRIPTION	YEAR	DELAY TIME
1	SWAYING PROBLEM	2017-2018	120 HR
2	JOINING DAMAGES	2017-2018	120 HR
3	CONVEYOR BELT REPLACEMENT	2017-2018	3-4 DAYS
4	C-206 CONVEYOR RUBBER PATCH U P	2017-2018	140 HR

Table 1

5. PROPOSAL

5.1 INTRODUCING REVATING METHOD

FIG.10 REVATING METHOD

Riveting is a permanent mechanical fastener Riveting is a forging process that may be used to join parts together by way of a metal part called a rivet. The rivet acts to join the parts through adjacent surfaces. A straight metal piece is connected through the parts. Then both ends are formed over the connection, joining the parts securely. A rivet. Before being installed, a rivet consists of a smooth cylindrical shaft with a head on one end. The end opposite to the head is called the tail. On installation, the rivet is placed in a punched or drilled hole, and the tail is upset, or bucked (i.e., deformed), so that it expands to about 1.5 times the original shaft diameter, holding the rivet in place. In other words, pounding creates a new "head" on the other end by smashing the "tail" material flatter, resulting in a rivet that is roughly a dumbbell shape. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

5.2 FIXING SELF ALIGNMENT CARRYING IDLERS/ GUIDE ROLLER

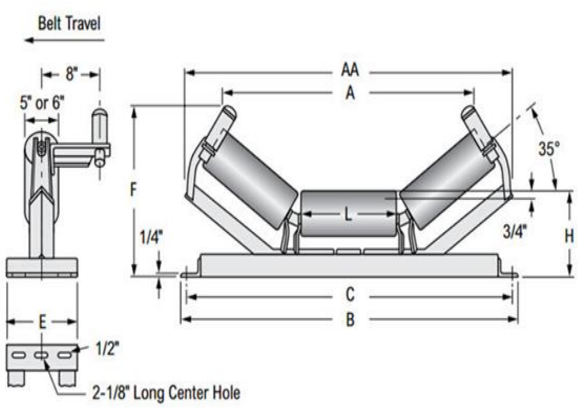


FIG.11 SELF ALIGNMENT CARRYING IDLER

Self-Aligning Idlers are intended to aid in maintaining alignment when conditions such as temporary off-center loading, unusual side winds or misalignment of a transient nature, due to lump concentration, disturbs the alignment of a properly installed conveyor belt.

FIG.11 SELF ALIGNMENT CARRYING IDLER

Rotate each roller to verify that it turns freely. Thoroughly inspect for any blocking or shipping wires that have not been removed.

Visually inspect for any shipping or installation damage to the idler frame or rolls.

- Head and tail shafts need to be parallel to each other
- All bolts should be properly tightened.
- Troughing idlers

6. REDESIGNING OF C206 BELT CONVEYOR

Basic Introduction to Troughed Belt Conveyor Design

Troughed belt conveyors offer an efficient means of transporting materials in large quantities (bulk), over distances ranging from a few meters to several kilometers, continuously. As will be seen below, troughed belt conveyors are only one of the types of belt conveyors available in the market today however, the troughed belt conveyor takes numerous forms and is used in many different applications with tremendous success.

It is important to draw a distinction between bulk handling of materials and unit handling. The former refers to the transportation of particulate product(s) on a continuous basis for example, the conveying of lumpy ore from a mine to a processing plant or for transporting coal from a stockyard to a bunker above a crusher.

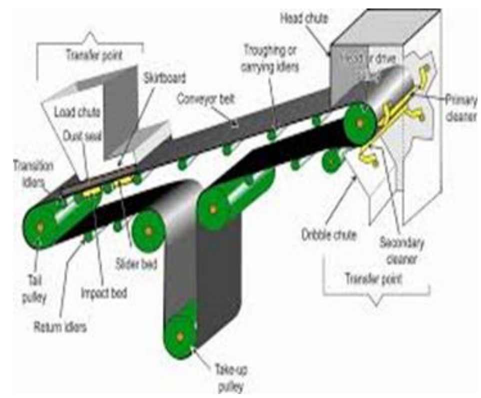


FIG.12 RE DISIGN OF C206 BELT CONVEYOR

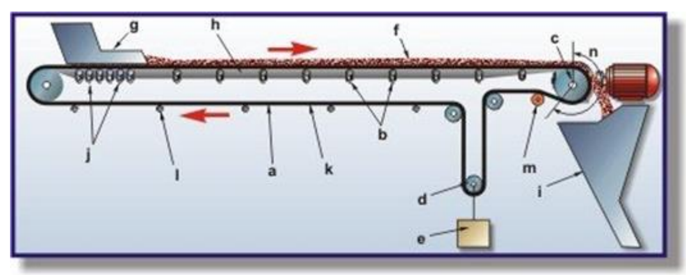


FIG.13 REDISIGN OF C206 BELT CONVEYOR (SCHEMATIC DIA.)

'Unit handling' on the other hand is generally described as discontinuous as this involves the transportation of for example, packed boxes, filled bags of cement and so forth.

Troughed belt conveyors as described in this Handbook refers to conveyors which are used to convey product in bulk.

A brief introduction to troughed belt conveyors and factors which affect the selection and design of conveyors is provided below.

Functional Description (refer to figure below)

A troughed belt conveyor comprises an endless, rubberized flat belt (a) suspended between pulleys at either end and supported along its length by a number of rotating idler rollers (b). The belt is driven via one of the pulleys (usually the head pulley (c)) and the tension in the belt is maintained by using a sliding pulley (d) which is tied to a gravity take-up unit (e).

The material (f) is loaded onto the conveyor at the tail-end via a chute (g) and is transported along the carrying-side (h) to the head-end where it discharges into a discharge chute (i) which guides the product onto the downstream equipment.

Impact idlers (j) are located at the loading point to support the belt where the load impacts onto the belt as it is dropped down the loading chute.

Once the material has been discharged from the carrying belt, the return belt (k) is guided back to the tail pulley on return idlers (l).

The impact, carrying and return idlers are spaced at different intervals. On the carrying-side, the mass of the belt plus the load conveyed is greater than the mass to be supported on the return-side and thus, for the tension in the conveyor belt (by the take-up and induced by the drive unit), the idler spacing is selected accordingly. This 'sag' in the belt between the carrying and return idler sets must therefore be designed on the basis of the heaviest load that the conveyor is to transport.

Snub pulleys (m) are sometimes incorporated into the design of a conveyor in order to increase the angle of wrap (n) of the belt on the drive pulley. The greater wrap angle on the pulley allows more power to be introduced into the belt as is passes around the drive pulley without slip occurring. In this way, fewer drives are needed on longer conveyors or conveyors with high conveying loads.

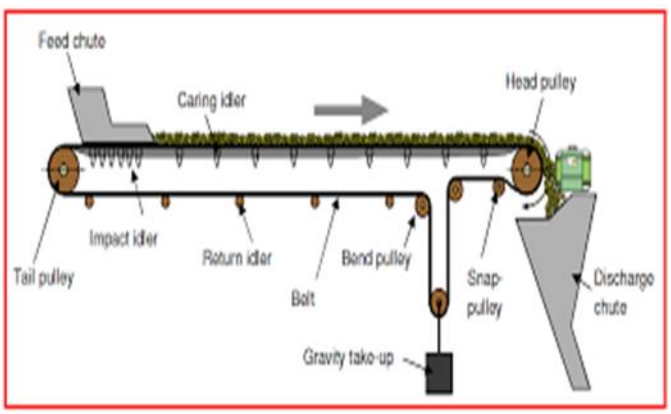


FIG.14 PROCESS DIAGRAM

6.1 COMPONENTS OF MODIFIED CONVEYOR

- TAIL PULLEY
- CONVEYOR BELT
- TAKE UP PULLEY
- HEAD PULLEY
- TRANSITION IDLERS
- DUST SEAL
- RETURN IDLERS
- IMPACT BED
- SLIDER BED
- CARRYING IDLERS
- TRIBLE CHUTE
- SECONDARY CLEANING
- PRIMARY CLEANING
- HEAD CHUTE

CONVEYOR PULLEY BASIC

Conveyor pulleys are designed for use on belt conveyor systems as a means to drive, redirect, provide tension to, or help track the conveyor belt. Conveyor pulleys are not designed for the same application intent as conveyor rollers. Conveyor rollers are designed to be used in the bed of a conveyor as a support for the conveyed product and often under the conveyor bed in the return section to support the return side of the conveyor belt.

Drive/Head Pulley – A conveyor pulley used for the purpose of driving a conveyor belt. Typically mounted in external bearings and driven by an external drive source.

Idler Pulley – Any pulley used in a non-drive position that is intended to rotate freely and be driven by the belt.

Return/Tail Pulley – A conveyor pulley used for the purpose of redirecting a conveyor belt back to the drive pulley. Tail pulleys can utilize internal bearings or can be mounted in external bearings and are typically located at the end of the conveyor bed. Tail pulleys commonly serve the purpose of a Take-Up pulley on conveyors of shorter lengths.

Snub Pulley – A conveyor pulley used to increase belt wrap around a drive pulley, typically for the purpose of improving traction.

Take-Up Pulley – A conveyor pulley used to remove slack and provide tension to a conveyor belt. Take-Up pulleys are more common to conveyors of longer lengths. Bend Pulley – A conveyor pulley used to redirect the belt and provide belt tension where bends occur in the conveyor system. Conveyor Roller – A product used either in the bed of a conveyor as a support for the conveyed product or in the return section under the conveyor bed as a support for the conveyor belt

CONVEYOR PULLEY THERMINOLOGY

Pulley/Core Diameter – The outside diameter of the cylindrical body of conveyor pulley, without coating.

Finish Diameter – The outside diameter of a coated pulley (core diameter + 2 times the coating/wrap thickness).

Face Width – The length of a pulley's cylindrical body. This area is intended to act as the contact surface for the conveyor belt.

Wall/Rim Thickness– The initial thickness of the tube, pipe, or formed plate that makes up the cylindrical body of the pulley.

End Disks – The plates welded on the ends of a pulley which act as the medium between the hub and rim.Crown/Profile– A change in the shape of the pulley face designed for the purpose of enhancing belt tracking.

Shaft/Axle – The mounting mechanism for the pulley assembly.

Hub – The point of connection between the shaft and end disk or pulley wall.

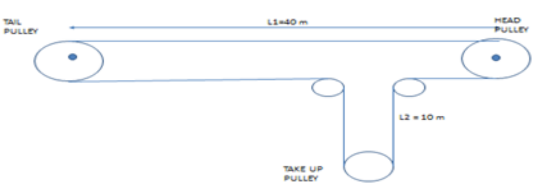
Bore Diameter – The inner diameter of a pulley at the point where the shaft is inserted

Bearing Centers – The distance between the center lines of each bearing race in which a pulley is mounted.

Hub Centers – The distance between the center line of each hub contact surface.

6.2 DESIGN OF C206 BELT CONVEYOR

It consist of tail pulley, head pulley, and take up pulley. The length between tail pulley and head pulley 40m. In modified design of conveyor belt take pulley is added in 10m on down ward direction. A constant weight is added in at the take up pulley



TAKE UP PULLEY

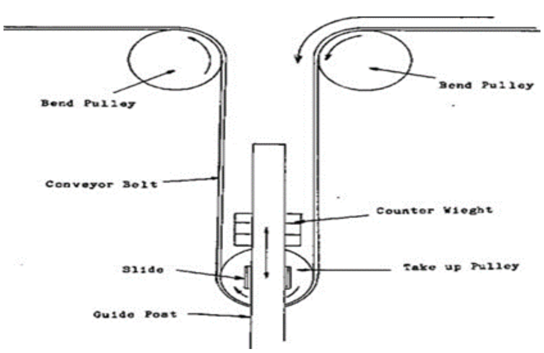


FIG.15 TAKE UP PULLEY

6.3 CALCULATION

DRIVEN PULLEY DIAMETER

From psg design data book page 7.54 and 7.58 recommended pulley diameter = 80 mm

Speed ratio $D/d = N1/N2$

$D/80=1.5/1.25$

$D=96mm$

The recommended driven pulley diameter= 100mm

By psg data book page number 7.54

$D=100mm$

Design KW= Rated KW* Load correction factor KS/Arc of contact8small pulley factor

Rated KW=0.75KW

KS=1.2 (belt conveyor)

Arc of contact = 180 degree – (D-d/c)60

=180-(100-80/4000)60

=179.7 degree

From data book page number 7.54 180 degree K=1.00

Kd=0.6mm(page number 7.62)

Design KW=0.75 1.2/1.00 0.6

=1.5Kw

LENGTH OF BELT

$L=L1+L2$

$L1=2*c+\pi/2(D+d)+(D-d)2/4c$

$=2*4000+ /(100+80)+(100-80)2/4*4000$

$=8282.76mm$

$L2+2*1000+ /2(90+63)+(90-63)2/4*1000$

$L2=2242.5mm$

$L=L1+L2$

$=8282.768+2240.51$

$L = 10523.2821mm$

T1& T2= Tension on the right & slack sides of the belt representatively

We know that p=(T1-T20v

$0.75*10^3=(T1-T2)0.004948$

$T1-T2=3712.50N$

TENSION RATIO OF THE BELT

T1/T2 =e ^μα

Coefficient of friction μ = 0.25[from PSG databook pg.no 7.57]

α=Arc of content = 179.7deree

α = 179.78*π /180

=3.1363

T1/T2=e^(0.25*3.1363)

T1/T2=2.190

T1=2.190*T2

Solve the 2 values we get

T1=6827.39N

T2=3114.79N

LOAD RATING

V=π*d*N1/60

=π*.1*1.25/60

=0.00628m/s

Load rating vm/s=Loard rating at 10m/s=v/10

Load rating at 0.00628m/s=Load rating at 10m/s*(0.00628/10)

For duck belting (heavy duty)=0.0289kw/mm

=0.0289*(0.006289/10)

L=1.8149*10^-5kw/mmply

7. RESULT ANALYSIS

(Table 2)

Sl.no	year	Description	Delay Time(reduce)
1	2018	Swaying problem	70h
2	2018	Joining damage	64h
3	2018	Conveyor belt replacement	2-3 days
4	2018	C206 conveyor rubber patch up	40h

8. CONCLUSION

For reducing the downtime of the existing belt conveyor at first we have studied about the existing conveyor and then we had introduced a new design so that we have been able to reduce the downtime due to the mechanical errors happening in the belt conveyor. 72 % of overall downtime of the belt conveyor has been reduced by the newly proposed modifications.

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