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Design, Analysis and Fabrication of Driving Wheel to be used in Disc Underground Conveyor System

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Abstract: ***Driving wheel design considerations generally taken for drive unit made for disc conveyor in multiple applications. To run the conveyor this driving sprocket type concept is taken and which forms standardized wheel with proper selection to overcome on the rotary driving application .This will be only for specific use in disc conveyor only not compatible with other types of conveyors. Driving wheel arrangement is designed and validate with applying its all boundary conditions. Comparison is to be done with all possible geometric structure while designing the wheel which can be effective in costing and manufacturability also. Driving wheel validation will be carried out with working stress and deflection occurs while rotating and pulling the conveyor.***

Keywords: Tubular disc conveyor, Rotary wheel, Weldment structure.

I. INTRODUCTION

Generally conveyors seen in chain type, moving trolleys, slat type, belt type, typically these conveyors takes space challenge while installation in industries. Also these conveyors are bulky and give ugly working surrounding views inside the plant. Here we have found solution to overcome these issues and aesthetic concept is developed that is “Tubular disc conveyor”. It consist of few simple parameters just a flexible rope pulling no of discs by rotational pulling force applied by specific designed rotary wheel. Project gives brief design of rotary wheel behave as a sprocket to pull disc to disc conveyor , scope to hold and pull the disc attached to rope fixed uniformly distanced As shown figure below.

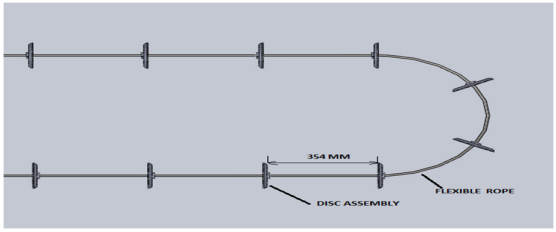


Fig: 1 Conveyor medium which need to be move by flat disc type transmission

Project defines the clear conclusion over the use of rotary wheel the best solution can be suggest to get perfect output as per application needed. As the conventional type sprockets are available in market which are well suited for the chain conveying purpose , here the application is same but the rope and disc assembly is to be moved instead of chain .Wheel get produce with the simple machining and weldments process instead of using any typical casting or forging process as the application is well suited in weldment wheel design.

II. ROTARY WHEEL WORKING

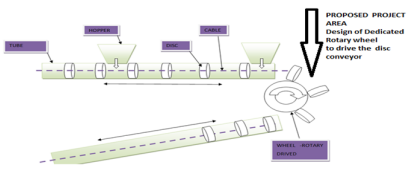


Fig: 2 Process layouts



Fig: 3 Material used for conveying in food industry in this application.

III. KEY FEATURES TO BE CONSIDERED WHILE DESIGNING ROTARY WHEEL

Wheel mounting horizontal and vertical axis of rotation
Torque required pull/drive the conveyor
Weldament structure to be considered for wheel component
Material must be used grades like AISI304, AISI310
Manufacturability to be examine while designing the wheel.

A. Tools Using

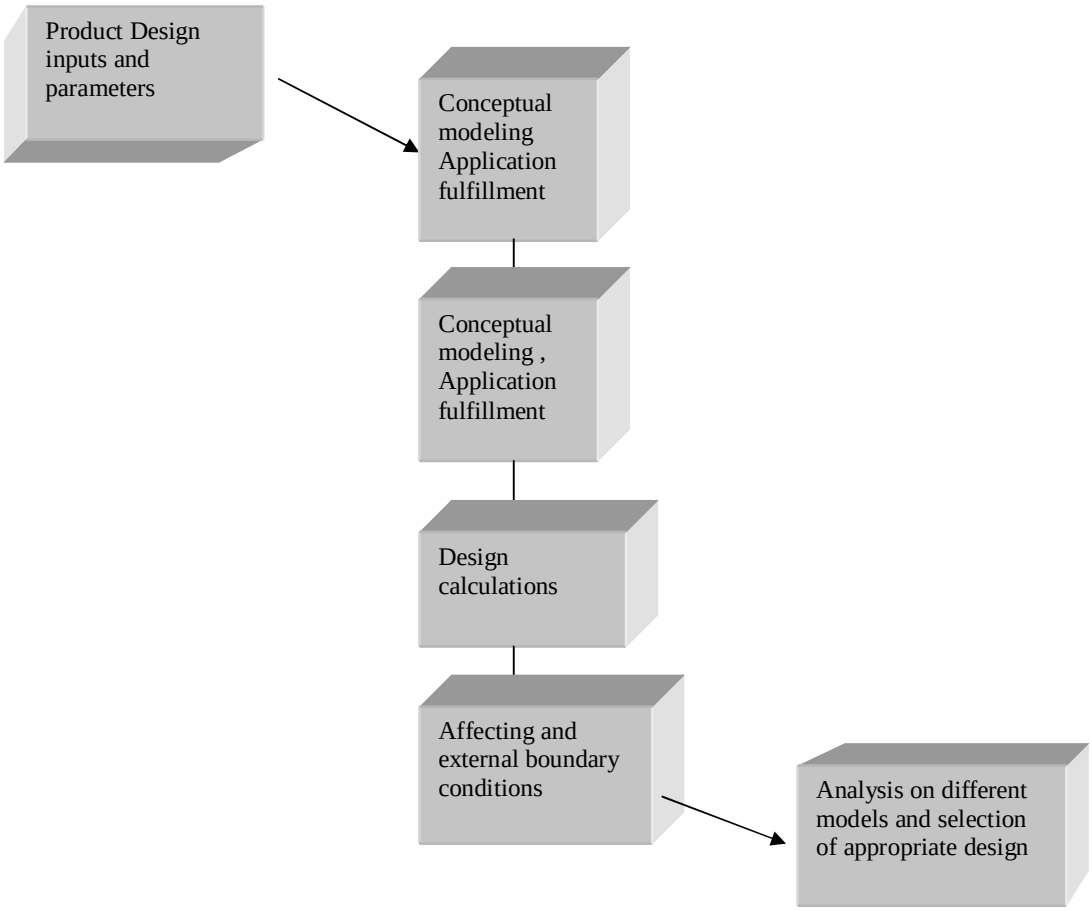
Solid works for CAD 3D modeling. As in market nowadays top CAD tools are available like Proe, Creo, Solid works, Solid edge, Catia. By classifying them application wise solid works comes into weldments, automation, SPM, Structure design. Also in solid works piping work can be handled very effectively within single feature.

Analysis: Ansys
Stresses on driving wheel.
Structural bending analysis. etc

IV. FORMULATION

Proposed work formulation is decided as per the requirement of this product which is to me considered as a rolling application for transmission.

GENERAL FORMULATION INVOLVES IN THIS CRITERIA



V. PROBLEM IDENFINITION

In FMCG industry /food processing industry conveying material from one station to another carried by inline conveyors like chain, roller, slat, and rope conveyors .traditional type of conveyors are very bulky space consuming and expensive, Dedicated covered conveying system need to be designed. For solving environmental affect on food particles while handling through conveyor.

VI. PRODUCT SOLUTION

Solution on these us has developed a concept of tubular type moving disc.
Conveyor and dedicated rotary wheel to drive the whole conveyor
Driving rotary wheel will play important role here.

VII. OBJECTIVE

To provide proper transmission solution for moving disc conveying system.
Overhead rotary wheel to be designed to make disc by disc rotation in uniform speed
Optimized design to be provide with weldment structure instead of any casting process
Rotary torque calculation, to pull the material and selection of geared motor
To perform bending and stress structural analysis to validate the results

VIII. SCOPE OF THE WORK

3D modeling
Weldment / casting design for rotary wheel.
Wheel drive assembly design
Structural stress, deflection and behavior analysis
Selection of wheel design as considering the strength with all affecting loading conditions

IX. DRIVE SYSTEM ARRANGEMENT

Drive unit mounting is fixed on the structure .tube conveying concept is ready to start only drive unit plays important role to move it with feasibility, Material transfer is very smooth and slowly carrying by the dedicated wheel driving mechanism provided, wheel is mounted horizontally.

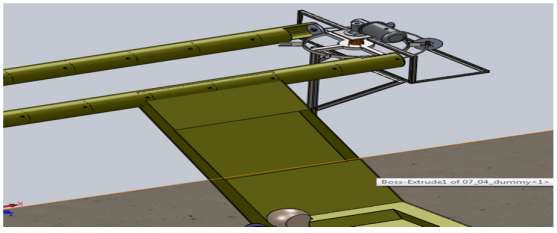


Fig 4**:** Drive system arrangement

X. WORK SETUP FOR CABLE DISC CONVEYING SYSTEM

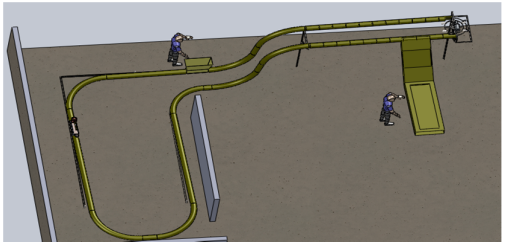


Fig no 5: Cable disc conveying system

XI. WHEEL ASSEMBLY

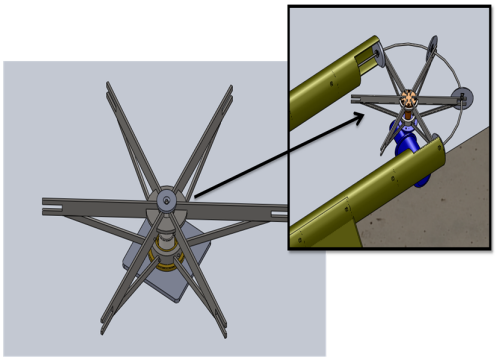


Fig no. 6: Wheel assembly to be design.

XII. CALCULATION FOR TORQUE REQUIRED TO PULL CONVEYOR BY THIS WHEEL DRIVE

A. Volume Of Single Bucket

As we are going to use tubular packed structure to move rope and disc inside it

Cylindrical Volume: Dia. 150 mm, and length 354

$V = \pi r^2 h$

$V \approx 6.26 \times 10^{6\ mm3}$

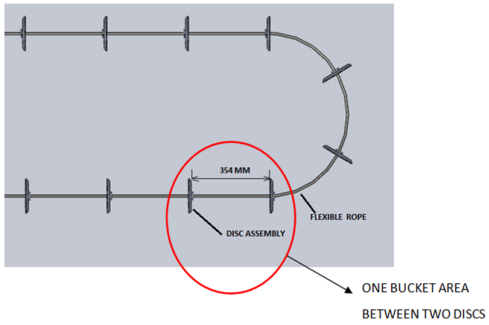


Fig 8 : Area covered between Disc.

B. Rope / Wire

Rope having length L is considered diameter of 10 mm (assumed) will depend on its strength .

C. Rope Can Be Used

Metallic wired, Nylon flexible wire, Break wire type metallic wire, Cotton + fibre wire etc.

assume weight or cable/rope 400 gms per meter

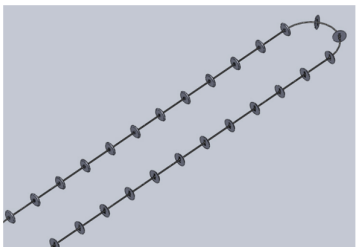


Fig 9 : Rope / wire

D. Total Weight Inside The Per Meter Tube (kg) Without Material / Object

4 discs and 3 buckets are can be seen in 1 meter tube length

Total wt = 4x (disc assembly weight) + 1meter cable weight hardware

(Disc assembly includes 3 parts and)

= 4 (0.470) + 0.300
= 2.18 kg
Total volume in 1 meter tube = 3 x 6.26×10^6 mm3 = 18.78 x 10^6 mm3

E. Handling Material Consideration

If we considered almond pieces
Weight can be accommodate in each bucket is 1.5 kg
Then in 1 m length 1.5 x 3 = 4.5 kg almonds

F. Design of Rotary Wheel

20 mm thick plate is flame cut shaped forms a wheel in circular shape as shown, design make it light weighted and stable with application as it is to be rotated in vertical shaft holding arrangement as shown in assembly.
Sheet metal plates 5mm thick are welded

G. Torque and Drive Calculations Required To Drive The System Or To Pull The Discs Inline

Total length of tube 35 meter so conveyor weight =35x8 =76.3 kg
Total Conveyor weight = (sprocket wt) + wt of cable and disc = 30.8+ 76.3 = 107.1 ~ 107 kg
Per bucket weight =1.5 kg
Maximum number of components at a time = 35 x 3 = 105
For rolling applications, generally preferred value the coefficient of friction is 0.2.
Total pulling Weight = Total conveyor weight +
(Per bucket material weight × Maximum No. of buckets)
Hence,
Total pulling weight = 107 + (1.5×105)
= 264.5 kg.
Maximum Pull = Total Pulling weight × Coefficient of Friction
= 128 × 0.3
= 79.35 kg
= 793.5 N

H. Calculated Results Are Tabulated In Excell Sheet To Make Flexible Variants By Making Vaues Variations

STATION - TUBULAR DISC

TOTAL CONVEYOR WEIGHT	107	KG
PER COMPONENT WEIGHT	1.5	KG
MAX. NO. OF buckets AT TIME	105	NOS.
COEFF. OF FRICTION	0.3	
TOTAL PULLING WEIGHT	264.5	KG
DEFUALT FREQUENCY	50	Hz
RUNNING FREQUENCY	50	Hz
MAX PULL	79.35 793.5	KG N
REQUIRED TORQUE	277.6237	NM
REQUIRED RPM	2.5	
SERVICE FACTOR	1.7	

FINAL OUTPUT TORQUE	471.9602	NM
FINAL OUTPUT RPM	2.5	
FINAL OUTPUT HP	0.164812	HP

CONVEYOR Disc PITCH	350	MM
DRIVE SPROCKET NO. OF TEETH	6	NOS.
PITCH BETWEEN buckets	350	MM
TIME TO TRAVEL PITCH	4	SEC.
P.C.D. OF SPROCKET	699.7446 0.699745	MM MTR.

XIII. CONCLUSION

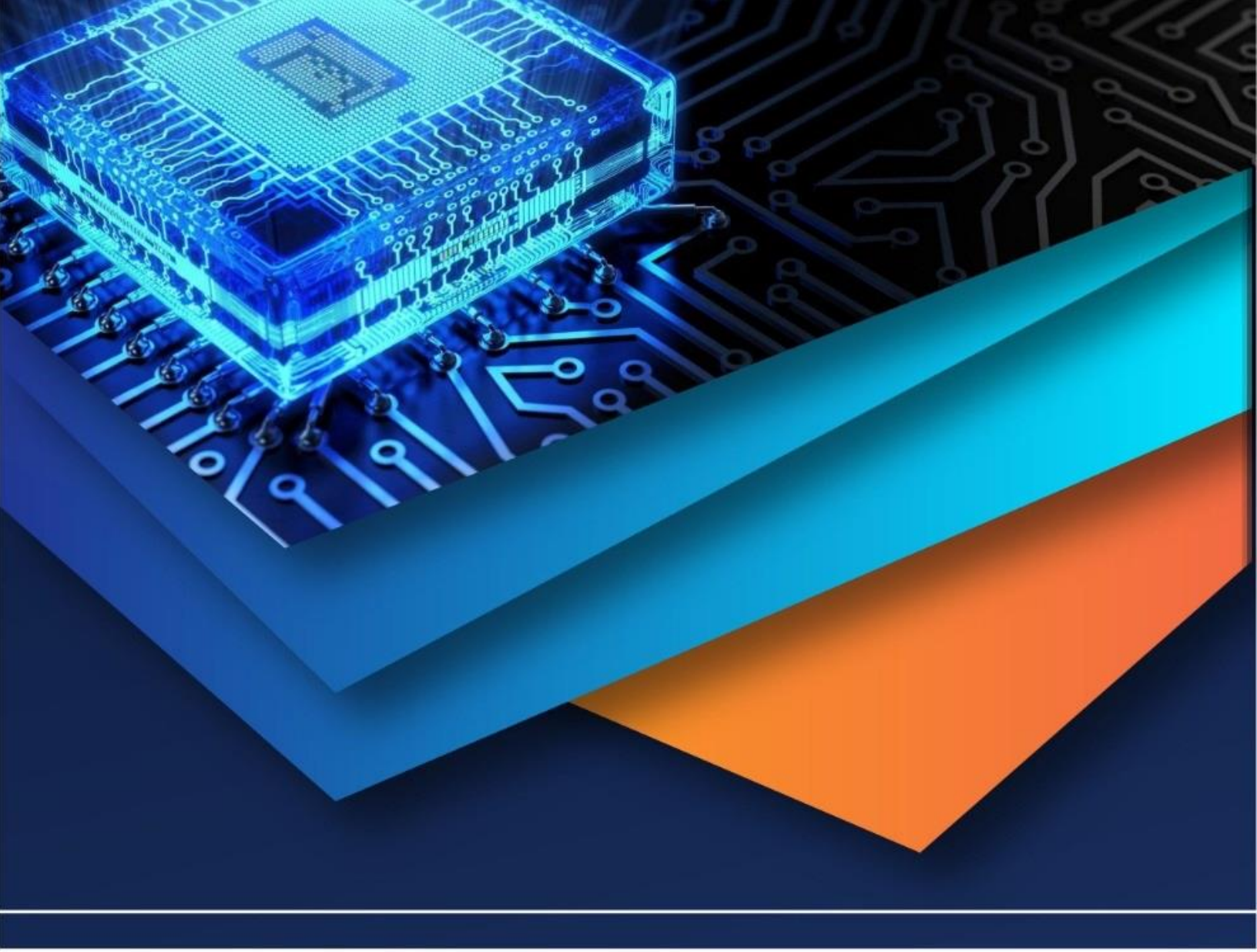
It has been concluded that drive wheel can be work to drive new disc conveyor for material handling and can be made standardized with its application along with as Assembly validation gives full proof exercise to used this wheel drive into cable

-disc moving conveying system

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