Available online: www.ijsrmes.com

International Journal for Scientific Research in Modern Engineering and Science

International Journal for Scientific Research in Modern Engineering and Science, 3(3): 17-26 (2022)

DESIGN AND FEM ANALYSIS OF CONVEYOR IMPACT ROLLER ASSEMBLER

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Abstract

In this research work authors', "Design and FEM analysis of conveyor impact roller assembler" has a lot of potential in the future since it simplifies the assembly process. This concept is first conceived and developed right here. One key benefit is that it reduces on operating time and makes it simple to perform. It is a very strong substitute for the present assembly method using manpower, which requires at least two to three people with exhausting effort and takes more time. To address these difficulties, we designed this conveyor impact roller assembler, which helps to carry out the assembly operation conveniently. Our project is primarily concerned with maximizing the efficiency of human effort and reducing the amount of time spent in assembling or transporting the rollers.

Keywords: FEM; Conveyor; Roller Assembler.

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1. INTRODUCTION

Mechanical devices or assemblies that transfer items with minimal effort are known as conveyor systems. Conveyor systems come in a variety of shapes and sizes, but they all have a frame that supports rollers, wheels, or a belt that transports things from one location to another. They can be driven by a motor, gravity, or by hand. These material handling systems are available in a wide range of configurations to accommodate the various products or commodities that must be transported.

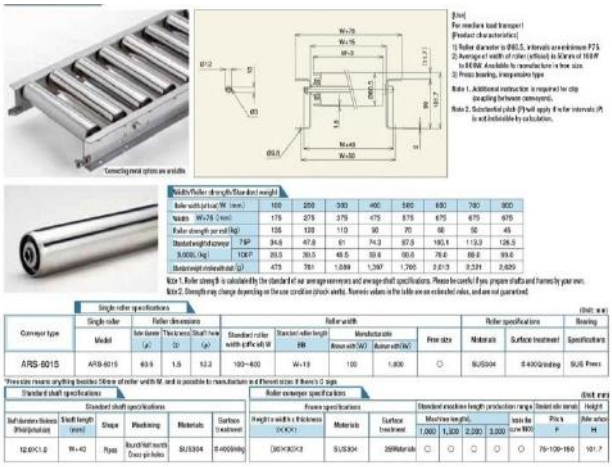
Conveyor impact roller - Conveyor impact rollers are used to cushion the stress of loaded material exiting the chute at the loading and transfer point, preventing belt damage or deterioration.

Functions –

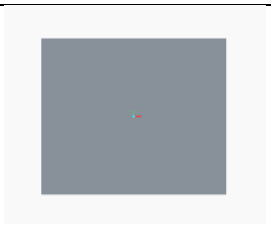
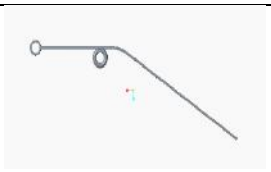
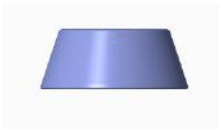
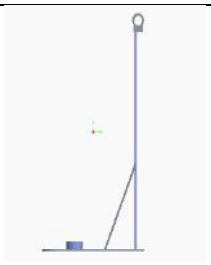
Impact rollers are employed and positioned in accordance with the load points, where bumps and the weight of material dropping onto the belt may cause damage. To reduce the material's impact on the rollers, they are coated with a succession of rubber rings of sufficient thickness and resistance. Impact rollers are stressed not only by the material's load, but also by the dynamic forces that occur as the load descends onto the belt. The impact on the belt caused by material falling freely is naturally greater than the impact caused by material being deflected onto the belt by an inclined plate. Check the properties of the base roller for proper dimensioning and impact roller selection in proportion to the load.

2. DESIGN DETAILS

Selection and specification of Conveyor Roller



PTC Creo Parametric 3.0 M010 was used to create the following components. The details of the components and their dimensions are listed in the table below. This assembler is built for a roller with a diameter of 64 mm, i.e. according to ARS-6015. The remaining of the dimensions are in relation to the roller diameter.

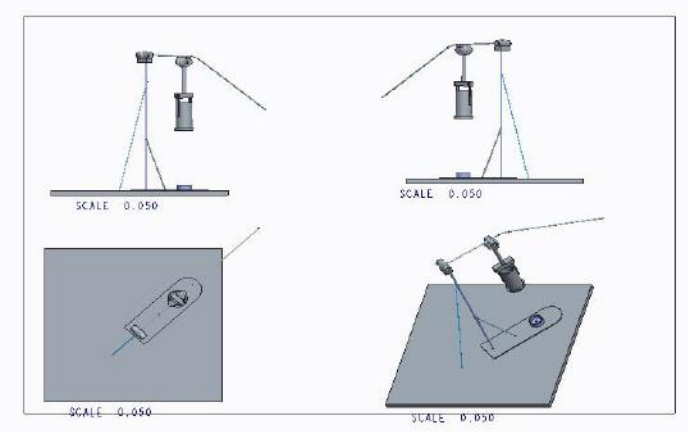
S.No.	Component	Designed Parts
1.	Rim (Inner radius=64mm, outer radius=94mm)	
2.	Base plate (1620mm x 1620mm, Thickness = 20mm)	
3.	Handle (L=1662mm)	
4.	Die (Inner radius=64mm, H=800mm)	
5.	Cover (Outer radius=64mm, Inner radius=95mm, H=50mm)	
6.	Roller (Radius=64mm, L=555mm)	
7.	Stand (H=1430mm Base length=815mm)	

8.	Complete assembly without roller	
9.	Complete assembly with roller	

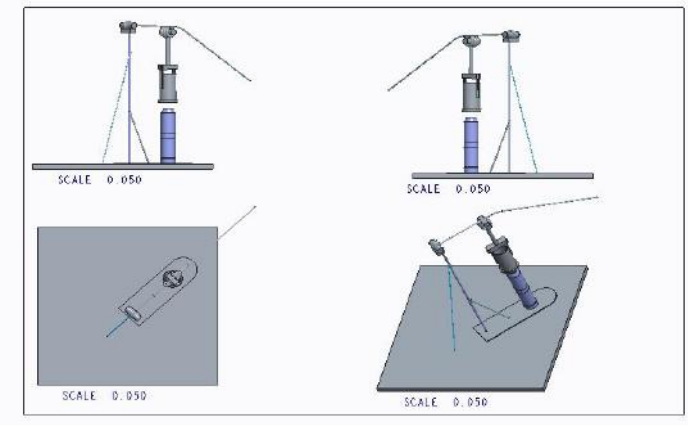
Frame pipe diameter = 21mm

Thickness of sheet = 10mm

Proposed design of Assembler

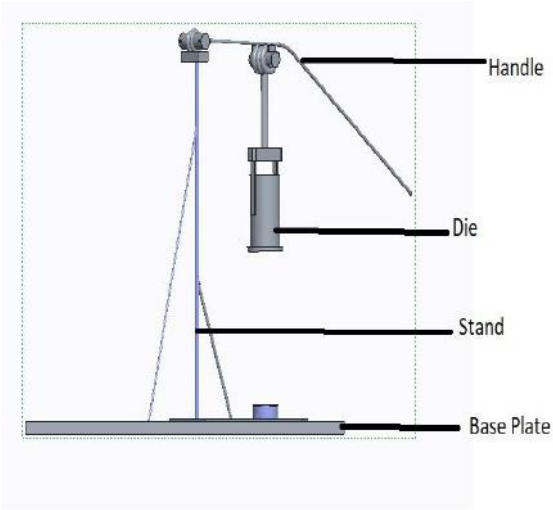


Assembler without roller and roller cover (Die)



Assembler with roller and roller cover (Die)

Specification of assembler



3. PRINCIPLE AND WORKING

Punching operation - Punching is a shaping technique that involves forcing a tool called a punch through a workpiece to create a hole through shearing. During the procedure, a scrap slug from the hole is placed into the die. This slug may be recycled and reused or dumped, depending on the substance pierced., Each time a punch enters the punching die, a scrap slug is removed from the metal workpiece. The metal workpiece is left with a hole as a result of this technique. The following equation can be used to calculate the punch force required to punch a piece of sheet metal

$$F = 0.7tL\ (UTS)$$

Where t is the sheet metal thickness, L is the total length sheared (the shape's perimeter), and UTS is the material's ultimate tensile strength.

Hammering operation - Using well-aimed hammer blows on sheet metal and sections, hammering is a technique for shaping or straightening workpieces, as well as enhancing their strength and hardness. It's only utilised in one-off production, specialised industries and trades, and repair operations.

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Hitting force :-

$$\text{Force (N)} = \text{mass (kg)} \times \text{acceleration (m/s}^2\text{)}.$$

$$F=ma$$

Torque principle - The force that can cause an object to revolve around an axis is known as torque. Torque is also responsible for angular acceleration. As a result, torque can be defined as the linear force's rotational equivalent. The axis of rotation is the point at which the item rotates.

Torque is the rotating equivalent of linear force in physics and mechanics. Depending on the subject of study, it is also known as the moment, moment of force, rotating force, or turning effect. Archimedes' study of the use of levers gave birth to the concept. A torque is a twist of an item around a given axis, similar

to how a linear force is a push or a pull. The product of the magnitude of the force and the perpendicular distance of the line of action of a force from the axis of rotation is another definition of torque. Torque is usually represented as τ , the lowercase Greek letter tau. When the term "moment of force" is used, it is usually abbreviated as M.

The torque is a pseudovector in three dimensions, and it is given by the cross product of the position vector (distance vector) and the force vector for point particles. The force applied, the lever arm vector connecting the point around which the torque is being measured to the point of force application, and the angle between the force and lever arm vectors determine the magnitude of torque in a rigid body. In terms of symbols

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$$

$$\tau = \|\mathbf{r}\| \, \|\mathbf{F}\| \sin\theta$$

Where, τ is the magnitude of the torque, and is the torque vector.

r is the vector of position (a vector from the point about which the torque is being measured to the point where the force is applied).F is the force vector.

X According to the right-hand rule, the cross product gives a vector that is perpendicular to both r and F. θ the angle formed by the force vector and the vector of the lever arm.

The newton-metre (Nm) is the SI unit for torque.

Impact and Energy: The ability to work is defined as energy. The energy of an object is turned into work during an impact. Kinetic energy is equal to one half of an object's mass times the square of its velocity and is the energy of a moving item.

$$K\,E = 1/2mv^2$$

Where,

K= kinetic energy , M= mass of body , V= velocity of body

Working

1. Placing

The roller is placed in the slot provided in the base of stand. The roller cover will be placed above the roller. Rim is attached on the roller cover. Die attached with the handle is now placed above the rim placed on roller cover.

2. Punching process

The rim placed on the roller cover is punched till it reaches the upper end of the roller

3. Hammering process

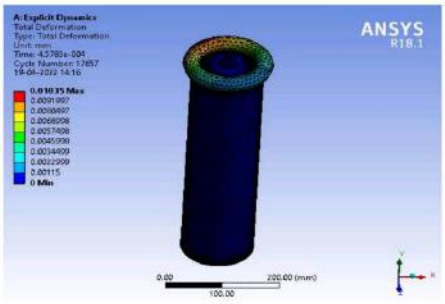
When rim reaches the upper end of the roller , more force is applied on the handle of the roller to hammer the rim to reach the desired position (at the centre). This process is continuous till the rim are placed in half of the length of roller(from centre to upper end).

Now the roller is inserted and the process is repeated till all the rim are attached on the roller.

4. FEM ANALYSIS OF CONVEYOR IMPACT ROLLER ASSEMBLER

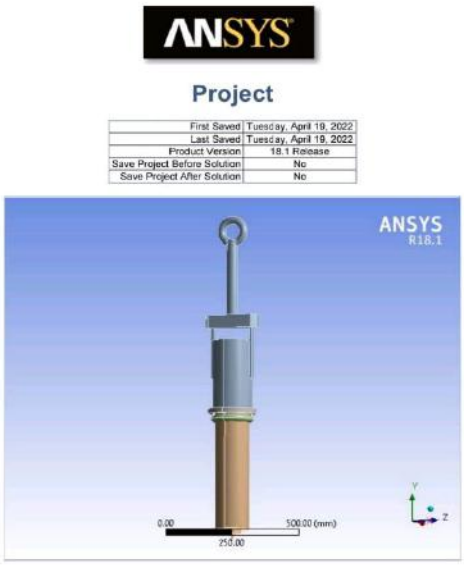
The finite element analysis has done for axial load (Dynamic) i.e., Explicit analysis performed in Ansys (Workbench 18.1) for assembly of roller and rim for both cases manually and with using the assembler The result obtained by the Analysis is as follow

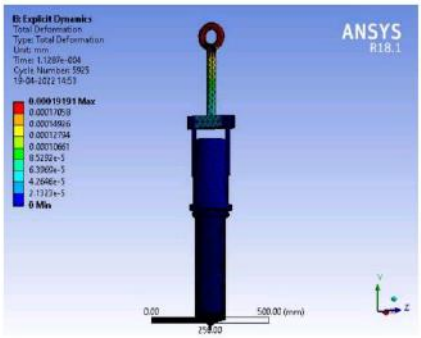
Manual assembly



Manual analysis of roller and rim shows the deflection of 0.01035 which can be considered approximately equal to 0.01.

Assembly using assembler





Assembly of roller and rim through assembler shows the deflection of 0.00019191 which can be considered approximately equal to 0.0002

Assembly method	Deflection
Manual assembly	0.01
Through assembler	0.0002

5. RESULT AND CONCLUSION

Result

The deflection obtained by analysing the data in workbench, we found that the deflection for manual assembly method to be 0.01 and by using the assembler to be 0.0002

This data shows that by using the assembler or using a die for pressing a rim the force can be reduced by 50% .

The handle used in assembler shows the implementation of torque principle i.e., by using that principle, it can be reduced by 25% .

Therefore “By using the assembler, assembly of ri, and roller can be done by 25% of the force required for manual assembly method”.

Conclusion

1. Using this assembler, putting a rim on a simple conveyor roller to turn it into an impact conveyor roller will be much easier.
2. This assembler will speed up the assembly of the rim and roller.
3. It also minimizes down on the amount of people needed for assembly.
4. This assembler will ensure the workers' safety.

ACKNOWLEDGEMENT

It is a matter of immense pleasure to acknowledge the debt of gratitude to my academic guru and renowned mentor, Mr. Sharad Kumar Chandrakar in Mechanical Engineering. Department for the unrelenting guidance and continuous encouragement in completion of this project work. The opportunity to work under such esteemed academician is a matter of great pride and privilege. The duration of project work has been very enlightening and has provided immense satisfaction to us.

We are thankful to Dr P.B. Deshmukh, Director, SSGI, Bhilai and Prof. Alok Sharma, H.O.D., Mechanical Engineering Department who have not only provided me with knowledge on different subjects in this B. Tech. program but above all, have also ignited my mind towards pursuance of engineering and technology.

We express my indebtedness to my Parents, and Brother for their love and moral support which has kept me intact and spirited throughout this work.

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