

DESIGN, DEVELOPMENT AND ANALYSIS OF ROLLER BELT CONVEYOR SYSTEM: A REVIEW

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ABSTRACT

The roller belt conveyor system is the process used in different industries to carry heavy loads from one place to another place with ease. Now-a-days, most of the companies are using heavy conveyor systems which tend to consume more power. Heavy assembly system also causes problems due to maintenance of critical components and results in increased man power and time consumption, which is not helping industries in attaining profitable growth. Material processing is an integral part of the industry and contributes a significant proportion of the total power supply. Material processing includes different types such as lifts, conveyors, etc. out of which conveyors are most useful and less time-consuming systems for the continuous movement of materials in industries. Belt conveyor is widely used for the continuous transportation of different equipments with better efficiency and strength. It is important to reduce the energy and energy costs of material handling. Therefore, this process is based on improving the efficiency of energy of belt conveyors, because these are the main reasons of this system that consume energy. This detailed study focuses on the optimization of critical parts like belt, rollers, roller shafts, frame, c- channels, brackets and by using different materials such as belt, roller and analyze it to minimize the assembly's weight without changing its structural strength with the help of proper finite element model using software like CATIA. This paper also provides brief information on redesigning of critical parts of roller belt conveyors used in the industries for reducing the weight and power consumption. This paper also provides information about Roller belt conveyor system and different materials used in the system.

KEYWORDS: Ansys, CATIA, Material Handling, Weight Reduction

Article History

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INTRODUCTION

A conveyor system is a system that is a part of a mechanical device which can easily move heavy material from one location to next. Most of the industries are using roller belt conveyor to move heavy products from one place to another place which results in lesser time consumption and faster work execution. Conveyor systems are widely used in different fields, including automotive, agriculture, food industries where, food is moved to different locations such as medical field, chemical, bottling, packaging, etc. Roller belt conveyors are useful in reducing manual work and it can help better industrial growth. But material used to make the conveyors is heavy in weight and hence it results in more power consumption and lesser profit. The main objective of this study is to discuss roller belt conveyor system. This includes a detailed study of the conveyor system to optimize critical parts such as roller, c- channels, brackets etc., and thus

minimising the assembly’s overall weight without changing its structural strength. As the growing need of energy is an important factor, it is imperative to understand parts for energy consumption applications, such as conveyor systems. As in many industries, conveyors are used to move goods and materials and the use of conveyor systems is a safest system for minimizing the risk of injury in manual activities and as these are the continuous processes, this will reduce the continuous lifting of materials. To achieve this, the most important factor is to analyze the design of roller belt conveyor system and optimize the critical parts like roller, channels, etc. by using composite material with a purpose to reduce the overall weight of assembly without interfering its structural strength. Using CAD Pro-E Wildfire 5 technology, a proper finite element model is created and then the results of an analysis of existing design and optimized design are compared. Analysis is important in which the roller conveyor’s geometry is suitable for use with 3D modeling. The design of the roller conveyor would require knowledge of the product design fundamentals coupled with intuition gained from design engineer’s experience.

Results for the Stainless Steel Material

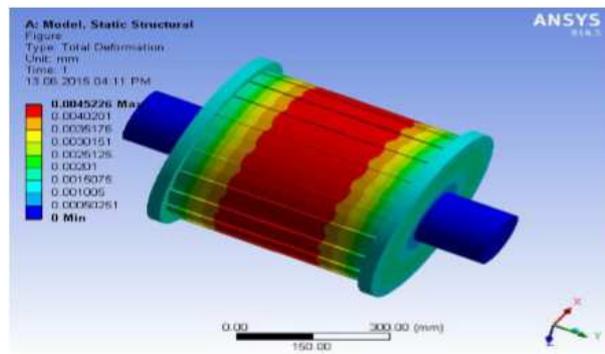


Figure 1: Total Deformation.

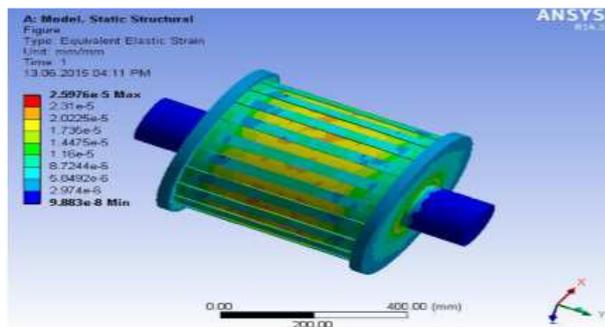


Figure 2: Equivalent Elastic Strain.

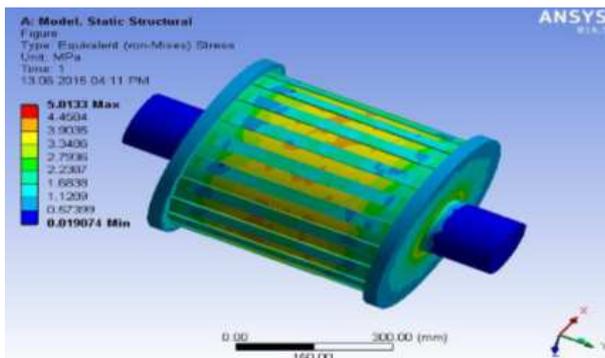


Figure 3: Equivalent Stress.

Result for Existing Material Stainless Steel

Table 1: Measurement of Parameters

	MINIMUM	MAXIMUM
Total deformation (mm)	0	4.522e-3
Equivalent elastic strain (mm/mm)	9.883e-8	2.597e-5
Equivalent stress MPa	1.907e-2	5.013

The above design models and Table 1 implies that the stainless steel was analyzed. Results are shown for deformation, equivalent elastic stress and equivalent stress. The Table 1 provides the details of the analysis that was carried out. They intent were to carry out the same analysis for the composite materials used in the rollers and then, results will be compared to the existing design and optimized design. [1-6]. In all above studies, optimization of roller and c-channel alone is performed. However, in this study, roller, roller shafts, c-channels, brackets and belts are going to be optimized which results in reduction of power consumption. Material handling is the most useful and important factor which consumes large proportion of the overall electricity used in industry. For example, in South Africa, material handling contributes 10% of the overall production. Due to their high transport capacity, belt conveyors are most useful in material handling and so reduction in energy usage or energy costs in material handling process is important [6-9]. Now-a-days, it is important to minimize other cost so as to increase the industry growth. This study will help industries to reduce power consumption, minimize intensive human work and also, it will speed up overall conveying processes easily without the use of excessive power. From the study, we can conclude that, the system is not fully optimized with belt and roller. Thus, the total optimization of system can be achieved, so to get optimized system by considering the load bearing components like supporting c-channels, brackets, belt and frame.

Roller Belt Conveyor Systems

Now-a-days, in many factories, heavy loads need to be moved quickly and safely so as to do work in minimal time. This work of moving heavy loads cannot be done using human resources and it can be very dangerous and time consuming. This is where roller belt conveyor systems come into the work. There are many bars provided on the conveyor to distribute the overall weight with safety. It means that they can easily move large objects according to their length. Motorized mechanism helps to spin these bars enough in such a way that objects can carry to long distances in seconds, even with the heavy loads. Roller belt conveyor systems enables to have smoother and quicker production work. Roller Belt conveyor system includes various components such as Belt, Roller, Roller shafts, Frame, C-channels, brackets and Bearings, etc.

Belt

Belt conveyors are used for large-scale material transport applications such as manufacturing, food packaging and its processing and heavy industrial equipments. Belts are very important elements used in conveyors which are made of different layers such as an under layer to provide better strength and shape, which is also called as carcass. Another layer is over layer, which is used as cover for the belts.

Roller

There are mainly two categories of roller, namely Live roller (powered roller) and Gravity roller (non-powered). And, it is further divided into different types, as given below:

- **Gravity Roller (Light to Medium Duty):** These rollers are suitable for loads up to 160 kg per roller.
- **Gravity Roller (Heavy Duty):** These rollers are suitable for loads up to 400 kg per roller.
- **Plastic Roller:** These rollers are suitable for light duty gravity applications.
- **Stainless Steel Roller:** These rollers are ideal for wash down applications or for usage in the area of high humidity.
- **Grooved Roller:** These rollers are useful in either line shafts or 24V DC motorized roller conveyors.
- **Tapered Roller:** These rollers are useful for conveyor bends.
- **Sprocket Roller:** These rollers useful for pallet or heavy duty conveyors.
- **Drum Roller:** Such large diameter walled drum rollers are designed as either drive or idlers drums for use on belt conveyors.

Material used in Roller Belt Conveyor System

In belts, an under layer is made of different materials such as Polyester, Nylon and Cotton and over layer is made of rubber or plastic material. There are different materials used in the rollers such as stainless steel, plastic, polypropylene and rubber, etc. Stainless steel rollers are easy to clean, corrosion free, strong and durable. Plastics rollers are less in price, but can carry small materials. On the other hand, polypropylene rollers are used for the food packaging while rubber rollers are useful to provide more grips. In addition, this system has also different components that such as roller shafts, frame, c-channels, brackets and bearings which are having different materials like roller shafts and brackets are made of ms material and material used for the bearings is standard material, while on the other hand frame is made of c-10 material and most of the industries using this type of components.

Summary

The roller belt conveyor system is very useful in industries to carry heavy load material from one location to another with ease, which is not only useful in reducing time as well as human efforts but also boosts overall work and increases profit. The current process used in factory with increased weight belt conveyor causes various issues for workers like back and muscles strain at the time of maintenance due to heavy weight of system and technical issues like difficulty in maintenance of machine components. The detail study of current belt conveyor system with its design and specifications and finding suitable method for optimization of current design, and later wards results of redesign compile as modeling will be done using CATIA software and analysis of components will be done using ANSYS software. Optimization results in an appropriate optimum design for carrying the same load while saving the material of system, weight reduction and power conservation of the system. The brief information is also given on the type of rollers used in the conveyor systems with their applications. This paper also provides information of different types of belts with their applications.

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