

## Review Article

# Design And Analysis Of Idler Of Belt Conveyor For Weight Optimization & Material Saving

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### I. PROBLEM DEFINITION

The raw material has to be transported from one station to another at a long distance (1 Kilo meters or more). The method of manual transport by fork-lift or by trucks etc. is time consuming. A mechanism for continuous and uninterrupted transport is desired. Mechanical conveyor has advantages in terms of the ability to affect accurate control in the monitoring of material from one process to another.

### II. INTRODUCTION

Conveyor is used in many industries to transport goods and materials between stages of a process. Using conveyor systems is a good way to reduce the risks of musculoskeletal injury in tasks or processes that involve manual handling, as they reduce the need for repetitive lifting and carrying. Conveyors are a powerful material handling tool. They offer the opportunity to boost productivity, reduce product handling and damage, and minimize labor content in a manufacturing or distribution facility. Conveyors are generally classified as either Unit Load Conveyors that are designed to handle specific uniform units such as cartons or pallets, and Process Conveyors that are designed to handle loose product such as sand, gravel, coffee, cookies, etc. which are fed to machinery for further operations or mixing. It is quite common for manufacturing plants to combine both Process and Unit Load conveyors in its operations. Roller conveyor is not subjected to complex state of loading still we found that it is designed with higher factor of safety. If we redesigned critical parts eg. Roller (Idler), Bearing & Frame etc then it is possible to minimize the overall weight of the assembly. Powered belt conveyors are considerable long as compared to roller conveyor. So we can achieve considerable amount of material saving if we apply above study related to roller conveyor to this belt conveyor 'Finite Element Method' is a mathematical technique used to carry out the stress analysis. In this method the solid model of the component is subdivided into smaller elements. Constraints and loads are applied to the model at specified locations. Various properties are assigned to the model like material, thickness, etc. The model is then analyzed in FE solver. The results are plotted in the post processor. The scalar plot shows us the stresses and deformations over entire span.

### III. NEED FOR ANALYSIS

The geometry of the roller conveyor is agreeable to the handling of 3D modeling. The design of the roller conveyor would require knowledge of the fundamentals for Product Design coupled with suspicion gained by experience of the Design Engineer. The information like 'weight' of the belt conveyor and 'location of the Centre of Gravity' can be readily offered by the three dimensional CAD edge. Although it is iterative process the physical design of each

iteration for testing is not possible for conformance to the conditions specified (test conditions) could be done through the utilization of a suitable tool – Software for Analysis in the domain of Mechanism Design. With the past experience of the Service provider in this field, modeling in Creo-5 and analysis in ANSYS -12 appears as a competent tool to pursue Analysis for this Project Work.

### IV. OBJECTIVES OF THE WORK

The following are the objectives of the study:

- Study existing Belt conveyor system.
- Geometry modeling existing belt conveyor.
- Analysis of existing belt conveyor.
- Modification of critical conveyor parts for Weight optimization.
- Analysis of Modified design for same loading condition.
- Recommendation of new solution for weight optimization.

### V. LITERATURE REVIEW

We could not find much of the literature directly related to the weight optimization of roller conveyor. Few of the literatures are cited below.

#### A. Design and analysis of Bearing Seal and its Mold

Amit S. Ghade\*, Sushil R. Lanjewar\*\*

Purpose:

Industry sources have reported that over 90 percent of all rolling element bearings will not reach their projected design life. Millions will fail prematurely each year from such causes as dirt and moisture contamination.

Bearings are among the most important components in the vast majority of machines and exacting demands are made upon their carrying capacity and reliability. Therefore it is quite natural that rolling bearings should have come to play such a prominent part and that over the years they have been the subject of extensive research. Indeed rolling bearing technology has developed into a particular branch of science. Bearings are one of the most critical components in many machines and various mechanical ups. Most bearing systems fail to meet their predicted life due to issues other than fatigue failure. Says one expert on bearing failure: "Only 1% [of bearings] actually fail due to pure fatigue. The majority of bearing failures are from a lubrication-related issue." This means that approximately "95% of bearing failures can be either prevented or have their service life extended. The primary system to protect and extend the life of bearings is the sealing system. When compared to the costs of repairing or replacing the bearing system, the sealing system is much more economical

\* Typical Sealing methods-

1. Radial Lip Seals,
2. Labyrinth Seals,
3. Magnetic And Spring-Loaded Face Seals

\* Material Selection for seal

Nylon - 66

PTFE—Teflon

Hydrogenated nit rle rubber

\* Development of parts of seal

\*Mould design calculation

1) *Conclusion*

This type of seal provides a much simpler and cost effective solution to seal the bearings which are installed in many numbers.

Improving equipment life is a continuous process.

Its cost and simple design provides a distinct advantage

B. An investigation into design and manufacturing of mechanical Conveyors Systems for food processing. S.H. Masood, B. Abbas, E. Shayan, A. Kara

This paper presents a application of concept of concurrent engineering and the principles of design for manufacturing and design for assembly [4, 5], several critical conveyor parts were investigated for their functionality, material suitability, strength criterion, cost and ease of assembly in the overall conveyor system. The critical parts were modified and redesigned with new shape and geometry, and some with new materials. The improved design methods and the functionality of new conveyor parts were verified and tested on a new test conveyor system designed, manufactured and assembled using the new improved parts. The improved methodology for design and production of conveyor components is based on the minimization of materials, parts and costs, using the rules of design for manufacture and design for assembly. Results obtained on a test conveyor system verify the benefits of using the improved techniques. The overall material cost was reduced by 19% and the overall assembly cost was reduced by 20%

compared to conventional methods.

C. *Latest Developments in Belt Conveyor Technology*

M. A. Alspaugh, Overland Conveyor Co., Inc.

This paper presents latest development in belt conveyor technology & the application of traditional components in non-traditional applications requiring horizontal curves and intermediate drives have changed and expanded belt conveyor possibilities. Examples of complex conveying applications along Padwal, et al, International Journal of Advanced Engineering Research and Studies E-ISSN2249-8974 Int. J. Adv. Engg. Res. Studies / II/IV/July-Sept.,2013/138-140

with the numerical tools required to insure reliability and availability will be reviewed. This paper referenced Henderson PC2 which is one of the longest single flight conventional conveyors in the world at 16.26 km. But a 19.1 km conveyor is under construction in the USA now, and a 23.5 km flight is being designed in Australia. Other conveyors 30-40 km long are being discussed in other parts of the world.

D. *Availability modeling of powered roller conveyers*

John R. English, University of Arkansas, John Usher, University of Louisville

This paper provides an analysis of the reliability and availability of two common designs of the line-shaft roller conveyor. The first is a standard design in which each roller is belted directly to a spinning line shaft under the conveyor. The second is a new design in which only one top roller is belted to the line shaft, and all other rollers are belted to the one powered roller in a series arrangement. The main reason for this design is that the upper belts are faster to replace than belts connected to the line shaft, thus increasing system availability. However, the latter design is less reliable in that the failure of a single belt may lead to multiple roller failures.

E. *Modeling power & free roller conveyor system*

Dev P. Sathyadev, Sanjay Upendram, Eric Grajo, Ali Gunal, Onur Ulgen Production Modeling Corporation.

This paper establishes the groundwork to model power and free conveyor systems using AutoMOD II simulation software. A methodology to identify and model system parameters, control and routing logic, and sequencing product mixes is developed. A description of pitfalls, work-arounds, and other issues of concern in using AutoMOD to model power and free systems is presented. Recommendations for future enhancements and a comparison of power and free systems with state-of-the-art movement systems conclude the paper.

F. *Development of concept design CAD system*

C. Sekimoto Energy and Mechanical Research Laboratories, Research and Development Center Toshiba Corporation.

In order to shorten the product development time and improve the product quality, 3 dimensions at CAD/CAE system is essential. It is necessary to develop a system which utilizes the concept design data at the early stage for the whole process of the product development. The purpose of this project is to improve the product quality by the sufficient design study iteration at the early stage of design. A CAD system which can be used for the concept design and an appropriate CAD environment should be developed. And another purpose is to shorten the product development time at the late stage of design.

G. *Optimize belt conveyor manufacturing*

Savonia University of applied science, business and engineering, Varkaus (Thesis)

Purpose: The project focuses on choosing the right conveyor belt and suitable components to ensure manufacturing of high-quality belt conveyors. The existing problems of the idlers and belt conveyor are pointed out and proper solutions are given to make them have a longer service life. A plan of designing a belt conveyor for extreme cold weather conditions was carried out, but further research still is needed to make it come true.

To increase the capacity of belt. To place the Idler at right place. Idler is the supporting device for belt and cargo of a belt conveyor. Idlers move as the belt moves so as to reduce the running resistance of the conveyor. Idlers' qualities depend on the usage of the belt conveyor,

particularly the life span of the belt. However, the maintenance costs of idlers have become the major part of the conveyor's operating costs. Hence, idlers need to have reasonable structure, durability in use, small ratio of steering resistance, reliability, and dust or coal dust cannot get in bearing, due to which the conveyor has a small running resistance, saves energy and prolongs the service life.

Conclusion: In the condition of the same belt's width, when the groove angle is increased from 20o to 30o, the section area of belt conveying bulk material could increase by 20%, the conveying capacity can boost by 13%, and material spatter can be reduced. The belt sagging of adjacent idlers is no more than 2.5% of the idler spacing.

#### VI. SCOPE OF THE STUDY

The mechanical elements of the Roller Conveyed need to be designed individually and tested in the assembly environment. The structure need to be tested for external forces acting on the entire assembly.

#### VII. SOFTWARE FOR DESIGN AND ANALYSES

Pro-e, Creo 5 is the design software which provides basic platforms for designing any machine parts that can be used for the advanced design engineering companies that require product, process, and resource modeling and for the high-end design, where high quality surfacing or Class-A surfacing is used for designing. A good feature is that any change made to the external data is notified to user and the model can be updated quickly.

#### VIII. ANSYS 12.0/14.0 (WORKBENCH)

The general purpose FEA software Workbench is used to develop the model for a wide range of engineering problem-solving requirements (e.g., static, dynamic, nonlinear behavior, thermal analysis, or optimization). It is a compressive general purpose finite element analysis program for structures.

#### IX. PROPOSED FLOW OF WORK AND METHODOLOGY

- To generate a surface model suitable for linear static analysis.
- To generate a finite element model of the same.
- To carry out all the necessary checks on the model.
- To carry out the linear analysis to study the behavior.
- To validate the model for the limiting load (permissible load)

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