A Review on Materials For Belt Conveyor Roller Shaft

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Abstract- *This review paper presents the study of existing problem of the systemi.e. shaft breakage and wear problem. Due to this problem shaft will breakage after 2 months. To overcome this problem done the Material selection study and process to design analysis and manufacture efficient shaft for the conveyor system. For the design of the shaftCREO-2015used and FEA analysis is done in ANSYS R-18.1 software .While doing analysis compared the MS bright material shaft with EN 24 material shaft. EN24 having efficient mechanical properties than mild steel and other material properties like, hardness, tensile strength and availability. For the same load EN24 shaft will be durable for long life as compared MS bright shaft. The experimental setup of project and taking the readings for EN24 material shaft. By comparing the experimental results and analysis results. With this result shaft life gets doubled i.e.4 months by using the EN24 material.*

Keywords- ANSYS R-18.1, CREO-2015, EN 24 material, Experimental results, FEA analysis, MS bright material.

I. INTRODUCTION

In today's scenario fast growing, extremely high competitive industrial world, a company must be flexible, cost effective and efficient to endure.Material handling equipment plays asignificant role in many industries, constructional sites and storage units[2].For example, material handling pays about 10% of the total maximum demand in India[3]. As a kind of continuous moving tackle, belt conveyor is widely used in today's modern port, especially in the transportation of coal and mineral powder because of its high effectiveness and environmental safety [4]. Belt Conveyor systems are also used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging[3]. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed [3]. Many factors are important in the accurate selection of a conveyor system [1].

Belt-conveyors are more suitable than other means of moving bulk materials; they neither pollute the air nor deafen the ears [4]. Belt conveyor is one of the main transport equipment in coal mine, driving drum and belt is its key part.Proper attention should be paid while designing the roller conveyor system for particular application. Friction principle is used to initiate mechanical drive for belt conveyor. So friction is the driving force[4]. In demand to increase transportation efficiency of belt conveyor, driving force of drum must be increased. Energy saving & efficiency, friction, fire & safety, maintenance and inspection are the other key factors of belt conveyor design [4]. Most of the researchers focused on design modification to reduce the pulley (drum) and belt failures, maintenance cost, breakdowns, energy consumption and overall cost of the system for continuous transportation of material [4].

1.1 INTRODUCTION TO THE PROPOSED SYSTEM

The proposed system is the concept of automatic faulty job rejection system. The system used in steel company, and to eliminate the manual errors of quality issue the automatic rejection system utilized in a company. The system use conveyor system to transfer the job from one point to another and for the transfer of the material the conveyor system utilizes the drive side shaft drives by the gear box and the gear box rotated by the DC motor.

1.2 PROBLEM STATEMENT

The conveyor drives by the high torque gearbox to avoid the load on input side motor which drives the shaft, due to the load of gear box and tension from the belt side there are two types of load developed on the drive shaft.

1. Angular load
2. Axial load

So, there is a problem of crack in shaft and wear as the operating time increased of the machine day by day. So, need such a design of shaft which needs to avoid the life problem of the shaft and improve its efficiency.

1.3 OBJECTIVE OF THE PROJECT

The objective of the project is as under;

1. To study the existing problem of the machine (shaft breakage and wear problem)
2. Material study and process to design and manufacture efficient shaft for the conveyor system.
3. To design the shaft in CREO-2015
4. To do the FEA analysis in ANSYS R-18.1 software
5. To do the experimental setup of project and take the readings from trials.
6. Compare the experimental results and analysis results and plot the readings in charts form.

II. LITERATURE REVIEW

1. **Pradnyaratna A Meshram, Dr. A R Sahu**, Design, Modeling and Analysis of conveyor system used for transportation of Cartons, the aim of this paper is to develop a 3D model of a conveyor system with the help of PRO-E and Analysis it.In this paper they had suggested a conveyor system for the company who are in a process of automization of a plant and they are in a need of a dedicated conveyor system for the continuous filling of liquid in the cartons having chamber of two types 1 X 16 (4 X 4) and 1 X 25 (5 X 5). With the proposed conveyor system the labour cost will be reduced also the transportation and material handling cost will be reduced. The overall material cost was reduced by 19% and the overall assembly cost was reduced by 20% compared to conventional methods. With this conveyor system the 420 cartons can be filled with the help of programmable filling machine each chamber can be filled in3 seconds.

2. **Ashveer Singh, Mr.Ronak R Patel, Prof. Shashank P Joshi,**A review on design of Live Roller conveyor system, this review paper presents the comparative study of results and outcomes of designing the powered roller conveyor and components for typical requirement of different application which makes the system unique from general purpose roller conveyors. The design of roller conveyor mainly depends upon the loading conditions in particular application. The design as well as the component selection will change as the loading condition changes. Various types of rollers in different industrial applications were studied by these researchers mentioned in this review paper. This paper is an idea about estimated approach toward the design of live roller conveyors for heavy industries.

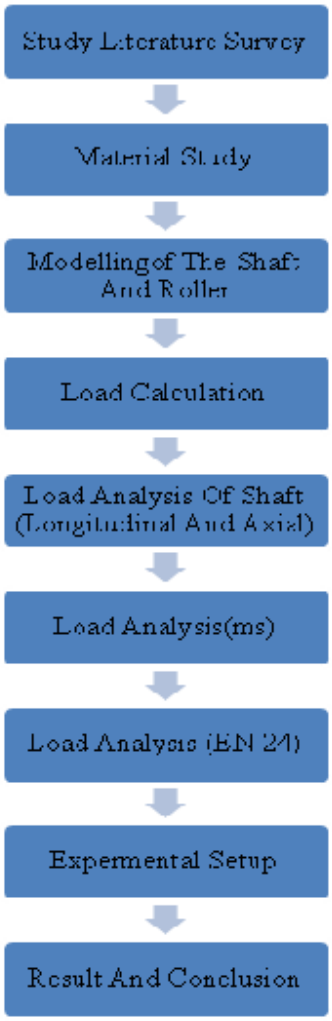
3. **Miss Pawar Jyotsna, Prof.D.D.Date, Prof.A.B.Galke**, Design, Analysis and Weight Optimization of Belt Conveyor for Sugarcane Industries, The aim of this thesis is to study existing conveyor system and optimize the critical parts like Roller, Support Bracket, Roller Shaft, Base frame to minimize the overall weight of assembly and material saving. Thesis also involves geometrical and finite element modelling of existing design and optimized design. Geometrical modelling was done by using CATIA V5 R20 and finite modelling was done by usingANSYS14.5.Results of linear static analysis of existing design and optimized design are compared to prove design is safe. Optimization gives optimum design for same loading condition with huge amount of weight reduction. Using this procedure and using practical available structure 39.25%weight reduction is achieved.

4. **Harshavardhan A. Kadam1, Nilesh S. Hyalij**, Design and Analysis of Belt Conveyor Roller Shaft, for the continuous transportation of material a belt conveyor are used in the transport of Coal and mineral powder it gives high efficiency and environmental protection. The objective of this paper is to study the existing Belt Conveyor System and Analyses of the Roller shaft at higher specification of motor to overcome the failure of belt conveyor Roller Shaft at higher inclination of belt conveyor system. Paper also involves Geometrical Model and Finite Element Modelling of Roller Shaft at lower and higher inclination. The geometrical modelling can be done by CREO Parametric and Finite Element Modelling done using ANSYS 14.1. Result of Linear static model and Transient Analysis of existing design and Analysed design at higher inclination with Design Failure Mode and Effective Analysis (DFMEA) are compared to prove which design is safe. In this Paper they work on Design of Roller Shaft and improve the life of Roller Shaft.

III. METHODOLOGY

3. 1 Principle of the project:

To design and fabricate the efficient shaft for conveyor system which can sustain at variable load and variable speed to minimize the breakage and wear of the shaft. The methodology of the project is as under;



3. 2 Construction of the project:

The below block diagram shows the conveyor system of the project, in which conveyor belt rotates between the two shafts, one is drive shaft and another is slave shaft which will rotate ideally via conveyor belt. So, the load develops on the conveyor drive shaft is shown as under.

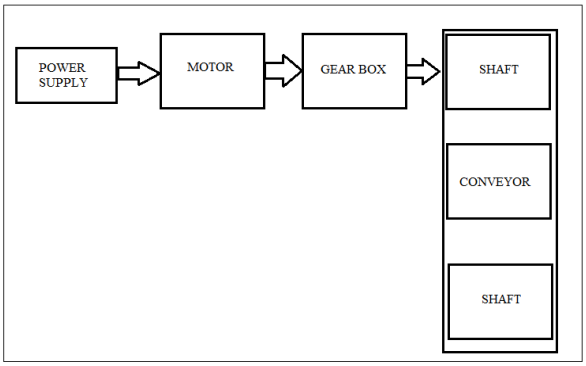


Fig: Block diagram of construction of project

3. 3 Load develops on the conveyor drive shaft

Fig. damaged piece of a shaft (side view)

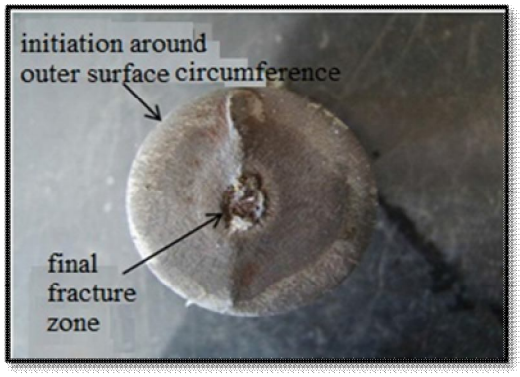


Fig. damaged piece of a shaft (front view)

The load applied on the shaft is 3 types of load;

1. Transverse load
2. Torsional load
3. Axial load

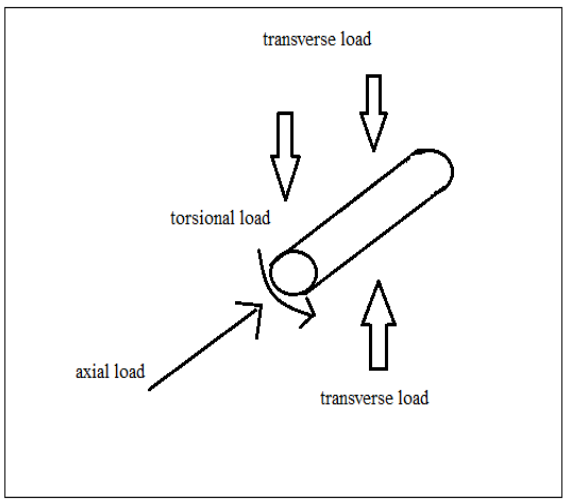


Fig.: Load applied on the shaft

3. 4 Material selection

The material selection of a shaft depends on following factors;

1. Load on a shaft
2. Machining process on a shaft
3. Operating time of a conveyor

As we have seen in above, shaft is under 3 types of loading conditions, axial, transverse and torsional loading condition. Under 3 loading condition continuously the wear stage of shaft depends on the tension of a belt or the variable load applied.

We are considering two materials in our project are as follows;

1. M. S. bright
2. EN 24

The M S bright material is a normal grade of mild steel having easy for the machining and can sustain at a higher load. Having following features;

- Finding high suitability for forging industries, grill fencing and engineering component
- Available in both Metric and Imperial options
- Available in cut to size finish
- Bars produced using cold finishing process support with no/very little heat applied during entire operations

1) M. S. BRIGHT

The M S bright material is a normal grade of mild steel having easy for the machining and can sustain at a higher load.

- **Material properties**

Mechanical Properties	**Metric**	**Imperial**
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)	15.0 %	15.0 %
Reduction of Area	40.0 %	40.0 %
Modulus of Elasticity (Typical for steel)	205 GPa	29700 ksi

- **Chemical composition**

Material Composition	In percentage (%)
C	0.05 TO 0.25
Mn	0.15 to 0.4
S	0.025 to 0.5
P	0.25 0.5

2) EN 24 MATERIALS

Material selection takes following points under consideration

- Hardness
- Tensile strength
- Cost
- Availability
- Machinability

Material selection depends on the mechanical properties and chemical composition of the material. We have selected two materials for the design and analysis i. e. mild steel and EN 24

Because, the mild steel is a common grade of material used in machining and fabrication purpose having good mechanical properties and chemical composition and generally used by most of the manufacturers.

Another material taking in to the consideration is EN 24 because, its having efficient mechanical properties than mild steel and another material like, hardness, tensile strength and availability in the industrial sector. Economical consideration is also another important factor while selection of material.

- **Mechanical Properties**

Tensile strength	850 to 1000 N- mm^2
Yield strength	680 to 700 N- mm^2
Hardness	250 – 300 HB

- **Chemical Composition**

Material Composition	In percentage (%)
C	0.36 to 0.44
Mn	0.35 to 1.90
Si	0.45 to 0.70
S	0.025 to 0.040
P	0.025 to 0.035
Cr	1.00 to 1.40
Mo	0.20 to 0.35
Ni	1.30 to 1.70

IV. DESIGN AND ANALYSIS OF PROJECT

4.1 DESIGN

We have design shaft on the basis of applications, our aim to carry objects over the conveyor so, the conveyor shaft must be design by taking consideration of following points,

1. Belt width
2. Load on shaft
3. Bearing arrangement
4. Gear box fitting arrangement
5. Encoder assembly arrangement

Modeling and static analysis of 3-D Models of the rivet joints were carried out using CREO-2015

4.2 ANALYSIS

ANSYS R-18.1 is a general purpose finite element analysis tool with a group of engineering simulation programs capable of modeling structures under different loading conditions. It can solve problems of relatively simple structural analysis to the most complicated linear to nonlinear analyses.The required inputs for the ANSYS finite element analysis consists of model geometry, material properties and loading.

Steps used in finite element analysis are as follows:

1. Geometry generation
2. Connections examination
3. Mesh generation
4. Application of support
5. Application of forces
6. Solution for results-
   - Total deformation
   - Equivalent Von-Mises stress

V. CONCLUSIONS

The following conclusions can be made from the obtained data;

1. When MS Bright material is used the stresses are more as compare to EN24 material.
2. When EN24 material used less wear and reduced shaft breakage
3. By using EN24 material achieve more strength and life of same size shaft.

VI. FUTURE WORK

We focus to reduce the shaft failure by using EN24 material. The design of conveyor shaft can be done with the help of CREO 2015 and the shaft can be tested by fabricating it in a real life situation. An Analysis of stresses and impact load on roller shaft with the help of ANSYS R-18.1at same load by using different materials.

VII. ACKNOWLEDGMENT

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