THOMSON REUTERS
ENDNOTE

[Shenkar, 5(7): July 2018]
DOI: 10.5281/zenodo.1313535

ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

METHODOLOGY CONCEPTS FLOW FOR DESIGN, MODELING AND ANALYSIS OF ROLLER CHAIN CONVEYOR SYSTEM

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ABSTRACT

The basic aim of this Paper has been conducted on the most of the time conveyor chain is under tension which causes failure of chain assembly which is the major problem for industrial sector. Causes of this failure are improper design. It is important to study the influence of these parameters. All these parameters can be considered simultaneously and chain link design optimally. Optimization is the process of obtaining the best result under given circumstances in design of system. In optimization process we can find the conditions that give the maximum and minimum value of function. In this study a shape optimization process is used for the design of roller chain link for minimization of failure modes. This process various design variables, such as wall thickness of link, breaking area of link and shape of the link. While deciding the shape optimization of roller chain link raw material plays important role, so it is necessary to decide new material and Design the new chain with Suitable Design Process.

Keywords: *conveyor chain, composite material.*

I. 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 required in a manufacturing or distribution facility. All lifting and conveying machines can be divided by their operating principles into two large groups: (i)Intermittent motion, (ii) Continuous motion Intermittent motion includes all types of cranes, lifts; surface transport means (trucks, loaders, prime movers), aerial tramways and cable ways, scrappers and the like. Continuous motion includes conveyors, pneumatic and hydraulic transport means etc. which may generally called continuous transport machines or conveying machines. Continuous machines are characterized by non-stop motion of bulk or unit loads along a given path, without halts for loading and unloading. At the same time they can distribute loads among a number of destination points, deliver them to stores, and transfer products from one technological operation to another and ensure the desired pace of a production process.

Review of Literature

The literature review has been conducted on failure analysis of conveyor chain link and is still continued. This chapter reviews the relevant literature of failure analysis of chain conveyor and link can be divided into three categories. The failure analysis process relies on collecting failed components for subsequent examination of the cause or causes of failure using a wide array of methods. Mean while describes that "FEA based study of effect of radial variation of outer link in atypical roller chain link assembly Chain Link assembly" is extensively used in the industry; the scope of his paper was to review the applications in the industry and explore the design considerations that go into the design of the assembly. Their paper deals with various application aspects and manufacturing aspects to formulate an idea of the system. Finally Finite Element Analysis (FEA) has been used to conduct shape optimization. According to him lot of work has already been done in other components, in their paper the focus has been narrowed down to specific component of outer link.

Research Gap

After a detail literature review it has been noticed that no one have tried to minimize the weight of the outer link of roller conveyor chain by using a composite material. Use of composite material can reduce the weight and increase the load carrying capacity as well as fatigue life by replacing the Mild steel outer link by composite material.

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II. METHODOLOGY

Project will start from the study of failure cases of chain. Focuses on improving life of the chain and minimization of its failure.

1. FAE Based Study of Effect of Variation of Outer Link in A Typical Roller Chain Link Assembly
Chain Link assembly is extensively used in the industry, the scope of this paper is to review the applications in the industry and explore the design considerations that go into the design of the assembly. The paper delves into various application aspects and manufacturing aspects to formulate an idea of the system. Finally Finite Element Analysis (FEA) has been used to conduct shape optimization. Since lot of work has already been done in other components, in this paper the focus has been narrowed down to specific component of outer link.

2. Failure analysis of the chain link.
The aim of this paper is to find out the cause of the chain link breakdown occurrence. Its superstructure leans on three crawlers of the same length, width and the height. During the stackers travels from the erection site to the open pit mine, three crawler chain link fractured. Working stresses in the chain link are defined by applying FEM. Experimental investigations define the chemical composition, the tensile properties, the impact toughness, the macro and micro hardness.

3. Design and analysis of chain outer link by using composite material.
using FEA software package ANSYS and by hand calculations comparing the weight optimization of chain outer link. The goal of this paper is to optimize the weight of chain. According to the ANSYS result and hand calculation there is little difference in result. These are the theoretical results, not actual test model. For the original chain link compare to the glass fiber, weight is more, nodes and elements required more. And the stress is decreases as the thickness of chain link increase in composite material.

4. Study of roller conveyor chain under tensile loading
For the testing purpose, Glass fiber material model is used. This paper shows that the sample model tested for tensile strength on universal testing machine. The fatigue initially nucleated at external crack of the chain link and later propagated to the inside of the link until sudden fracture occurred. Comparing the analytical, experimental and numerical result there is +/- 10% difference in result. It shows that, strip is safe under the maximum working load condition. A roller chain drive may be subjected to all of the tensile loads, thus the roller chain must have several tensile load properties to withstand the wide range of tensile load that may be imposed on it.

5. Static stress analysis of link plate of roller chain using finite element method and some design proposals for the weight saving.
Stress on the commercially available standard chains are analyzed .When the form of the link plate changed, the analyzed stress was compared with that of the standard chain. To simplify the analysis of link plate stress, the roller was not regarded because the roller did not support the generated force when the chain was pulled independently. To determine the standard stress for weight saving design, FEM analysis was applied for the static tensile load of 500 N. The result shows that stress concentrate around the pin or bush. Moreover, the stress at the constricted part of the link plate is large. In Some design proposals,

6 .link plate with centrally located hole; the different holes sizes are considered for the weight reduction and for stress analysis. It is possible that a 10% maximum weight saving is realized without a change a change in maximum stress at centre hole.

7. Changing thickness of link plate, if the thickness were changed, the other dimensions would remain constant. Therefore, effective weight saving would be realized. Thus he stress was analyzed with the change in the thickness of inner and outer link plate for the standard roller chain. Different sizes of thickness of link plate analyzed, the tensile stress increases when thickness of the plate decrease. Particularly, if the thickness becomes less than 1.25 mm, the stress increases. However, in the thickness range larger than 1.50 mm, weight saving ratio is similar to rate

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Impact Factor- 4.022

of increase in tensile stress. Consequently, weight saving with decrease in the thickness of link plate can be realized using higher strength material.

8 Chamfering edges of link plate circumferences, stress does not get cantered at the circumference of link plate. Three types of models tested, model 1 with chamfer at one side of plate does not markedly affected the stress, model 2 with chamfer at both side of plate- weight is reduced by 14% but tensile stress also increased and model 3 with centre hole with one side chamfer- the state of stress is similar to model1 and weight is reduced by 3%.

Static structural comparison for glass fiber and mild steel.

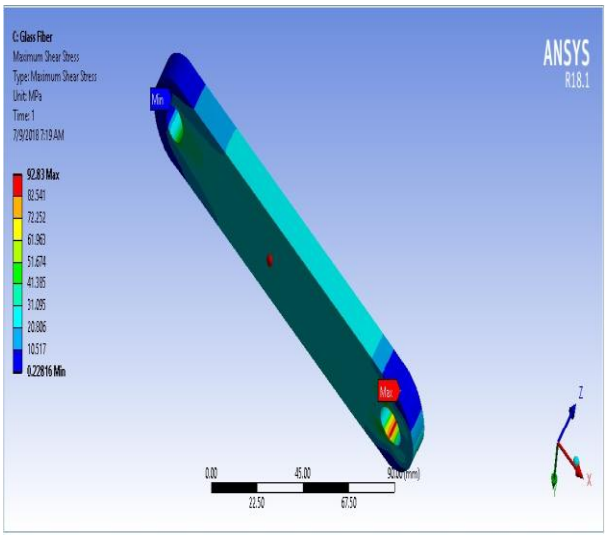

Figure 1: Static structural for glss fiber
Maximum shear stress- 92.83 MPa

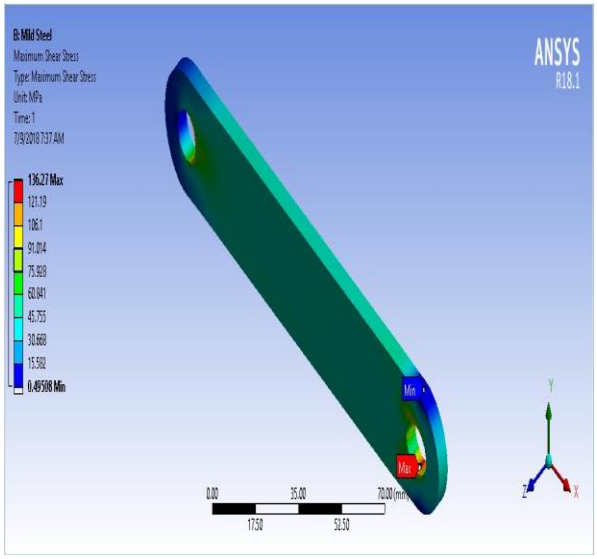

Figure 2: Static structural mild steel.
Maximum shear stress- 136.2 MPa

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III. EXPERIMENTAL SETUP

Tension test is carried out on universal test machine The most common type of test used to measure the mechanical properties of a material is the Tension Test. As the glass fiber link is having two holes for pin connection to connect with other link. Attachment is fabricated shown in Figure which is used to fix the glass fiber specimen in universal testing machine.

Figure 3: Experimental setup

Table 1: Experimental setup result on UTL

Maximum Load, Kg	19.2
Maximum Displacement ,mm	3.8

IV. RESULT AND DISSCUSSION

Table 2 : Comparison between mild steel and glass fiber

Property	Mild Steel	Glass Fiber
Directional Deformation	6.5 mm	18.6 mm
Eq. Sress	136 MPa	92.86 MPa
Directional Deformation on UTM		3.8

Result Discussion:-

1. Glass Fibre are resistant to a broad range of chemicals. Painting required only when exposed to direct sunlight as compare steel Subject to oxidation and corrosion. Requires painting or galvanizing for many applications.
2. Glass Fibre is Light weight - weighs 75% less than steel. 1/2" thick plate = 4.7 lbs/ft2 compare to steel 1/2" thick plate = 20.7 lbs/ft2.
3. Glass Fibre has Modulus of Elasticity LW = 2.9 x 106 psi CW = 1.2 x 106 psi compare to steel having Modulus of Elasticity 29 x 106 psi.
4. Glass Fibre have a high strength-to-weight ratio, and pound-for-pound are stronger than steel in the lengthwise direction. Ultimate flexural srength (Fu) LW = 30 ksi CW = 10 ksi Compare to steel Yield strength (Fy) 36 ksi.

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Impact Factor- 4.022

V. CONCLUSION

The Paper presents that design optimization of link, wear mechanism, stress analysis is widely done by FEA & FEM and failure of link plate. Chain link consider different design parameters and behavior of failure. FEA apply in mechanical element and link, we find in which the parameters are affect to its failure. FEA based simulated model gives approximation of simulated parameters and generate the mesh FEA mode gives the result respect number of nodes and elements. Also the review presents that for weight reduction and effectiveness of chain operation, the focus will be on using alternate polymer material & design parameters.

VI. ACKNOWLEDGEMENTS

The authors take this opportunity with great pleasure to express my deep sense of gratitude towards my esteemed guide Prof. Hredeya Mishra, Prof. Mankar his valuable guidance , incessant encouragement and co-operation to me this work.

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