Analysis of roller of roller gravity conveyor and validation

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Abstract- **A conveyor system is used for material handing in all process industry. We work from many years on weight optimization of material handling system. In which the roller conveyor is one of most use material handling system. When we go for weight optimization we will be concentration on the roller of that conveyor. We work for weight optimization by changing the material of the roller.**

Index Terms- **Roller Conveyor, Glass fiber, Weight optimization.**

I. INTRODUCTION

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. [2]

The problem is taken up for study and execution for evolving alternatives to design while targeting weight optimization for the critical components like roller in the assembly. Structural analysis of the rollers in conveyor should offer insights into the problem at hand. The FEA methodology would be adapted to solve the problem while

Finding out the structural strength of the rollers and addressing the reduction in weight without compromising on the strength of raw material handling member parts in the assembly.[4]

II. METHODOLOGY

1. Create model of roller in catia
2. Import model in ansys for analysis
3. Analyze the roller by using roller material as mild steel and composite glass fibre material .
4. Validation of ansys result by hand calculation
5. Compare the result .

III. OBJECTIVE OF THE STUDY

The following are the objectives of the study:
1. Study existing roller conveyor.
2. Geometric modeling (3D modeling) of existing roller conveyor by using CATIA V5R20.
3. To generate FEA model and Analysis of roller by using ANSYS Workbench 14.5.
4. To carry out static structural analysis of existing roller conveyor.
5. Modification of roller material for weight optimization.
6. To carry out Analysis of Modified design for same loading condition.
7. Recommendation of new solution for weight optimization.

Problem Statement
Aim of this project is to study of original gravity roller conveyor system of all parts and redesign it for weight optimization by using composite glass fiber material.

IV. DESIGN OF ROLLER

DESIGN OF ORIGINAL ROLLER:

Material – MS
E = $2.10*10^5$ Mpa, ρ= 7860 Kg/m^3,
Considering uniformly distributed load & FOS = 2

Maximum Stress Calculation for given condition
W= 36kg
D_1= Outer diameter of roller = 40 mm
D_2 = Inner diameter of roller = 33 mm
w = Width of roller = 300 mm
y = Distance from neutral axis = 0.04/2 = 0.02
Considering uniformly distributed load**,**
Maximum Moment (Mmax) = $W*L^2/8$
= $(36*9.81*.3^2)/8$
Mmax = 3.973 Nm
Moment of Inertia (I) = $\Pi (D1^4 - D2^4)/64$
= $\Pi (0.04^4 – 0.033^4)/64$
I = $6.74*10^{-8}$ m4
Maximum bending stress σ_b = Mmax * y/ I
= $3.973 * 0.02/ 6.74*10^{-8}$
σ_b = 1.177 Mpa

DESIGN OF GF ROLLER:

Material – GF
E = 34000 Mpa, ρ= 2600Kg/m^3,
Considering uniformly distributed load & FOS = 2

Maximum Stress Calculation for given condition
W= 36kg
D_1= Outer diameter of roller = 54 mm
D_2 = Inner diameter of roller = 33 mm
w = Width of roller = 300 mm
y = Distance from neutral axis = 0.054/2 = 0.027
Considering uniformly distributed load**,**
Maximum Moment (Mmax) = $W*L^2/8$
= $(36*9.81*.3^2)/8$
Mmax = 3.973 Nm
Moment of Inertia (I) = $\Pi (D_1^4 - D_2^4)/64$
= $\Pi (0.054^4 – 0.033^4)/64$
I = $3.5917*10^{-7}$ m4
Maximum bending stress σ_b = Mmax * y/ I
= $3.973 * 0.027/ 3.5917*10^{-7}$
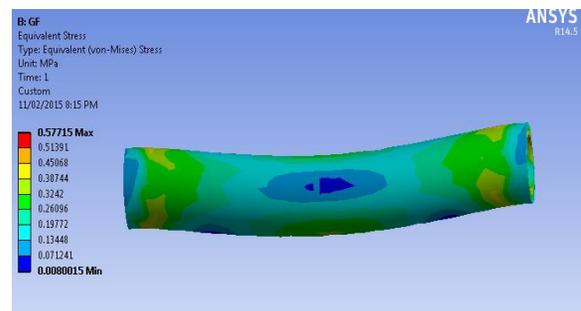σb = 0.30 Mpa

V. ANSYS RESULT

Static structural for MS roller
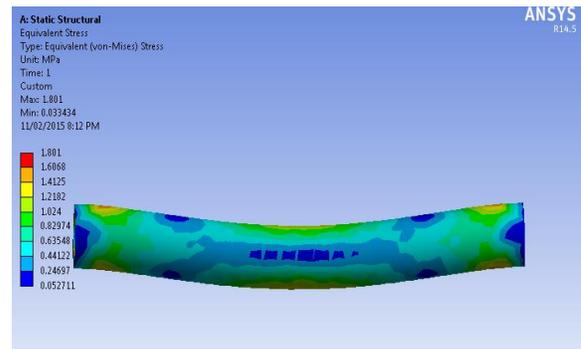
Static Structural for GF roller

Result table for stress

Sr. No	Material	Manual (MPa)	ANSYS (MPa)	Wt. (Kg.)
1	M.S.	1.177	1.8	1.82
2	G.F.	0.30	0.57	1.02

VI. CONCLUSION

As reducing weight and increasing strength of products are high research demands in the world, composite materials are getting to be up to the mark of satisfying these demands. In this paper reducing weight of conveyor part and increasing the strength of their spare parts is considered.
From the static analysis results it is found that there is a maximum stress of 1.8 MPa, in the steel roller and the corresponding stress in E-glass / epoxy, is 0.51MPa.

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