Failure Analysis of Bolt Fitted In Sprocket of Double Wall Corrugated Pipe Manufacturing Machine

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Abstract- *In double wall corrugated pipe manufacturing system there is drive system of double chain and sprocket. The two sprockets are hold together by bolts but bolts which are holding driver sprocket breaks frequently so the production halts. In this project i have studied the working of driving system forces acting on sprocket FBD diagrams of sprocket . I have studied various types of bolts their shearing strengths and bearing strengths. In this project i tried four cases with bolts to increase its overall strength to withstand sudden impact of load i have created cad models of existing and new developed bolts and compared their shearing strength by analytically and i also did analysis of all the four cases on the ansys software and compared with analytical calculations and results are satisfying.*

I. INTRODUCTION

orrugated Pipes are manufactured from HDPE resins. The design philosophy of Corrugated pipes is to provide products with suitable properties and the required margin of safety, that will enable the pipe to perform satisfactory after an extended period of operation (more of 50 years) under typical service conditions.

Corrugated pipes are resistant to nearly all chemicals .Double corrugated pipes are manufactured in diameters ranging from 20 mm to 3000 mm. Nominal diameter coincides with the internal diameter. Larger diameters can be manufactured at side by means of special equipment Plastic pipes are produced on extrusion lines in many companies.

A double valve corrugated manufacturing machine is used for extrusion in BAJAJ pipe factory in wardha

This machine is drive by chain drive to give rolling motion to moulds and forward motion to pipe

When load increases the bolts which are holding sprocket brokedown as effect of loadThe high density ioPE pipe with inside diameters of 150 mm to 800 mm can be produced on the offered two production lines. The production line consists of an extruder, dies, corrugators, cutting saw, and stacker. A comprehensive array of product sizes is possible through the simple replacement of molds and dies.

Fig 1: bolt fitted in sprocket

II. LITERATURE REVIEW

1) M. Ravi Teja Reddy* , C. Sai Virinchy, T.S.A. Suryakuma"Design and analysis of chain drive for different materials and load conditions" Published in Journal of Chemical and Pharmaceutical SciencesISSN: 0974-2115

Study gives the values and safe dimensions for chain drive It is evident that chain drive is one of the key aspects that must be taken under consideration for designing a vehicle. A chain drive is a component used for transmitting power from motor to wheels hence it is very important to have a perfect design for a chain drive.

study helps us in determining the dimensions of a chain drive in case of a specific applied load. In the study a clear and detailed analysis of the chain link has been done using ANSYS software. Pitch selection tables are used for selection of proper pitch, which is also used for synchronous belts

2) **Abhishek Barua and Sasmita Kar "Review on Design Optimization of Sprocket Wheel Using Different Techniques". in International Journal of Advanced Mechanical Engineering**

Study gives the information on sprocket . A sprocket or sprocket-wheel is a profiled wheel with teeth that meshes with a chain or track. They are generally used in bicycles, motorcycles, cars, tracked vehicles, and other machinery to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc.

The most common form of sprocket is found in the bicycle where the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel. Early automobiles were also largely driven by sprocket and chain mechanism

3) **Yan Chen, Qiang Gao, and Zhenqun Guan "Self-Loosening Failure Analysis of Bolt Joints under Vibration considering the Tightening Process" Article published in Hindawi Shock and Vibration**

In this paper the bolt joint always requires a sufficiently large preload to guarantee a reliable force transmission between the clamped components. However, due to the complex working environment, bolt joints often experience self-loosening (gradual loss of preload) with increasing service time, which can cause a decrease in the structure stiffness and in some cases may even lead to fatal consequences if it remains undetected. Implement the hexahedral mesh generation of the thread structure by modifying the node coordinates. Besides, an ABAQUS plug-in is made for parametric modeling and further study. Using this model, we study the differences between different fastening means and their effects on bolt self-loosening. Additionally, the mechanism of bolt self-loosening is analyzed using the relative motion of nodes and a creep slip phenomenon

III. PROBLEM IDENTIFICATION AND NEED OF PROJECT

In extrusion process polymer granules after heating form liquid plastic which is heated up to 400 degree Celsius.

This liquid is cooled to form pipe but when pipe comes in shape in mould it exert the load on chain drive for pushing forward. As a result the bolts which are mounted to hold sprocket breaks which leads to production halt. Extrusion of pipe is continuous process in the process consistency is important to maintain production When bolts of double valve corrugated machine breaks whole production line stops.To recover it takes 2 to 3 hours or may be more and this happens frequently .Material which is trapped in moulds due to failure of bolts must be removed to continue This requires lot of physical strength

:Picture shows the sprocket chain assembly

IV. AIMS AND OBJECTIVES

Failure analysis of bolt fitted in sprocket of double wall corrugated pipe manufacturing machine

1. Study of working and design of sprocket of pipe manufacturing machine .
2. To study the designing of sprocket and bolt of pipe manufacturing machine .
3. Designing and Modelling of sprocket and bolt assembly.
4. Analysis sprocket and bolt using Ansys software .

V. ANALYTICAL CALCULATIONS

To find out the failure of bolt we calculated the shear failure of bolt with considerations of two cases with existing one

CASE 1) Existing bolt

Table 1 : case 1 properties

1	Material of bolt	SAE 1030 MEDIUM CARBON STEEL
2	Diameter of bolt	8 mm
3	Length of bolt	60 mm
4	Ultimate tensile strength	525 mpa
5	Yield strength	440 mpa
6	Density	7.85 gm/cm3
7	Youngs modulus	190-210 Gpa
8	Poissions ratio	0.27-0.30
9	Compressive tensile strength	500-850

Shear strength of existing bolt is not sufficient to withstand the load so we introduced another to cases to study the shear strength

CASE 2)

case 2 properties

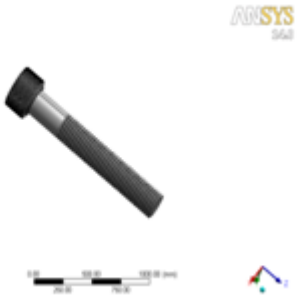
1	Material of bolt	AISI 1035MEDIUM CARBON STEEL
2	Diameter of bolt	8 mm
3	Length of bolt	60 mm
4	Ultimate tensile strength	585 mpa
5	Yield strength	370 mpa
6	Density	7.85 gm/cm3
7	Youngs modulus	190-210 Gpa
8	Poissions ratio	0.27-0.30

in case two we change the material required for the bolt to increase the shear capacity of bolt bolt diameter and ultimate tensile strength of bolt plays an important role
Shear strength of bolt

$$V_{nsb} = f_u / 3^{1/2} (n_n * A_{nb})$$

f_u= Ultimate strength of bolt
n_n= single shear plane
A_{nb} = Net area of bolt
d = diameter of bolt

VI. CAD MODEL AND ANSYS WORK

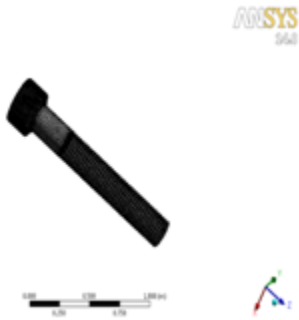


For analysis we used the FEA ansys software in this way we can save the csot and time

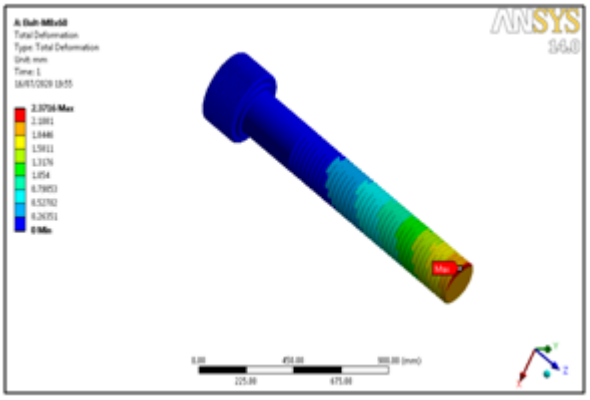
For ansys work we required the geometry, meshing, boundary condtions and fixed supports

Meshing

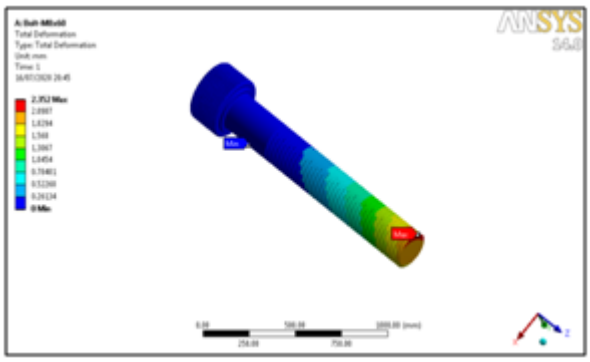
Meshing Type = Tetrahedral
Nodes = 59412
Elements = 30387



1) Medium Carbon Steel-SAE 1030 (Existing Material)
Total Deformation



2) Medium Carbon Steel-AISI 1035 (Case 1)
Total Deformation



VII. RESULT

By calculating analytically and going through ansys software we found out that in the existing bolt the shear capacity of bolt is low as the ultimate tensile strength of bolt is low as we increase the ultimate strength of bolt shear capacity of bolt increases so by considering the two different cases of bolt properties we calculated and found out that our bolt capacity increases and by going through software we recorded total deformation , max shear stress , von-mises shear stress and found that total deformation is gradually decreases by going through the cases respectively and max shear stress point is also decreases so for this project if we change the material of the bolt to the ASI 1035 medium carbon steel its gives the max shear capacity for the bolt and low value for max shear and von- mises shear stress and low deformation value.

VIII. CONCLUSION

To increase the production and reduced the waste and also increase the man- machine efficiency we have to keep with each other corrugated pipe manufacturing machine is the efficient machine to produce pipes due to the frequent failure of bolt cause the loss time and money with the existing bolt which has high max shear stress value , high deformation value and high von mises stress value and low shear strength value the bolt is bound to fail with the study of the bolt and using ansys software we found out the values and keeping with 4 cases we found out the best bolt for the assembly the shear failure will be overcomed.

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