Design Analysis for Improvement of Manufacturing Process for Minimizing the Failures Modes of Chain Assembly

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Preamble:

The project titled, "Design Analysis for Improvement of Manufacturing Process for Minimizing the Failures Modes of Chain Assembly" was financially supported by Rajiv Gandhi Science and Technology Commission (RGSTC), Govt. of Maharashtra to aid technology development was successfully executed at demonstration level by Prof. B. D. Gaikwad and Dr. P. M. Pawar. (Department of Mechanical Engineering, SVERI's College of Engineering, Pandharpur). Economy of Maharashtra state is dominated by agricultural as well as industrial sector. Sugar factories play an important role in economy of Maharashtra state. About 60 percent processes in these factories are based on roller chain conveyors. Apart from that, other industries also use these chains frequently for process atomization. However, failure of these chains is perennial problem in these industries which causes huge losses to these industries along with its dependents and in turn economic growth of the state.

As these chains operate under various forces, failure of chain assembly is the major problem. Causes of these failures are improper material selection, uncertainties in manufacturing, faulty manufacturing processes. It is important to study the influence of these parameters on the strength of the chain which governs the failure modes of the chain. This work is focused on parametric study to understand influence of these parameters on chain strength using numerical and experimental methods. The faulty manufacturing processes are another source of failure initiation. The efforts will be made for improving the chain manufacturing process to minimize failure mode initiation.

Technology generated and its salient features

1. Modified Roller Conveyor Chain with Improved Strength.

Salient features: Breaking load of conveyor chains is increased by 10Tonnes without change in raw material quantity.

Procedure: In order to the increase breaking load of conveyor chain with modifications in manufacturing process. The heat treatments, blanking and piercing operations are carried out in controlled manner. In the controlled environment of heat treatment, the optimal heat treatment parameter viz. soaking, hardening, tempering are defined.

2. Chain Strength Measurement Setup.

Salient features: Design and development of conveyor chain assembly test setup.

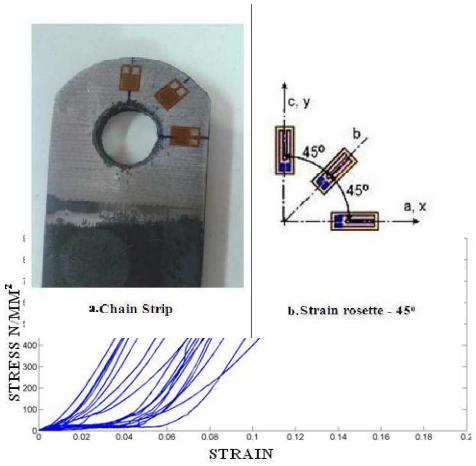
Procedure: In the blanking and piercing process, the walls are maintained to remain perpendicular the whole surface which results in obtaining specified bearing area. Chains are designed for specified breaking loads. Therefore, there is need for breaking load measurement setup. Existing UTM was modified with additional fixture to convert it into chain breaking load measurement setup.

Before testing After testing

3. Detailed Stress Analysis to Study Local Behavior of Roller Conveyor Chain Link.

Salient feature: To get detailed insight and location of critical stress in chain components, strains at critical location needs to be measured.

Procedure: Strains at various critical location of the roller chain assembly are measured to find out stress at critical location. Further, similar experiments are repeated to understand the manufacturing uncertainties and its effect on stress performance.



4. Systematic Conveyor Chain Quality Testing Methodology.

Salient features: Chemical analysis of all parts, mechanical properties testing, design and development of piercing tool for maximum bearing area of chain link hole and heat treatment of all conveyor chain parts.

Procedure: As per design, get the raw material and analyze it chemically and test the same as per the requirement of mechanical property. Manufacturing of piercing press tool for maximum bearing area of the chain link. Heat treatment of chain link as per the material and their hardening temperature and soaking times.

For heat treatment of conveyor pin, make use of case hardening process in order to achieve at least 4% case depth of pin diameter and surface hardness should be in between 50HRC to 55 HRC and core hardness 38HRC to 40 HRC.

5. Preloading and Length Measuring Machine for Conveyor Chain. (PATENT FILED, Application No. 3687/MUM/2014)

Salient features: Every conveyor chain has to be manufactured as per the IS 8466:1990 and it should be free from working stresses. However IS 8466:1990 code suggests based on change in length under certain loading. As per result of this project we have designed a pre-loading and length measurement setup. A patent has been filed on this setup**,** Application No. 3687/MUM/2014**.**

Procedure: Select conveyor chain pitch, design sprocket as per conveyor pitch, select number of pitches, select optimum speed, select preloading load and length measuring load on basis of breaking load. Assembly of the machine is as shown in figure below.

Preloading and Length Measuring Machine setup

EQUIPMENTS REQUIRED TO APPLY ABOVE MENTIONED TECHNOLOGY:

1. Computerized Universal Testing Machine (100 Tons Capacity).
2. Preloading and Length Measuring Machine.
3. Metallurgical microscope.
4. Blanking and Piercing Tool.
5. Ultrasonic Testing Equipment.
6. Case Depth Measuring Equipment.

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