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Minimisation of Sleeve Defect in Stripping Machine by Changing the Gripper Arrangement

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ABSTRACT:**J.K FENNER INDIA LTD**., is a leading power transmission belt manufacturer in the world. They manufactures V-belts, Timing belts, Poly V-belts and REC (Row Edge Cogged) belts.J.K FENNER engineers design and maintain the tooling utilized in the manufacturing lines.

In this organization, raw materials are milled and calendared in the calendaring machine. After that, they are coated over the mould with dipped cord in building section. Then the mould is cured in vulcanizer and cooled in cooling tank. After cooling, the belt sleeves are stripped from the mould by **Stripping machine**. The stripped sleeves are finished with the required shape and required dimensions.

They have some problems in production line with large amount of scrap. The main cause of the scrap is due to sleeve damage in **stripping machine**. In this machine, 8 gripping hands are used to grip the sleeve. Each hand having a **single grip belt**. These single belts causes improper gripping. To reduce this sleeve damage, we are suggested a design of **double grip belt** in each gripping hands. It increases the contact area of gripping to make a proper gripping of sleeve, which in turn increases the productivity and reduces the scrap and mould damage.

KEYWORDS: Stripping Machine, Single belt grip, Double belt Grip, Scrap, Sleeve Damage.

I. INTRODUCTION

The rubber industry is one of the key sectors of the Indian economy. India is the fourth largest producer of natural rubber and third largest consumer of the polymer. As far as consumption of natural and synthetic rubber together is concerned, the country occupies the fourth position. Although rubber product manufacture started in India in the year 1920, the industry has been mostly inward, oriented catering to the needs of the vast domestic market. But in the recent past the country has been transforming itself into a major rubber product exporter as well, thanks to the economic policies being pursued by the government and the market integration brought about by the WTO/Regional trade agreements.

Indian rubber industry has been growing in along with the strength and importance, as a part of India's burgeoning role in the global economy. India is the world's largest producer and the third largest consumer of natural rubber and is also one of the fastest growing economies globally. With a stable annual growth rate of 8-9%,rising foreign exchange reserves, rapid expansion in the capital markets and FDI inflow, India proudly takes its claim as the second fastest growing major economy in the world. Such factors combined with high concentration of automobile production and the presence of large and medium industries in south India, Chennai has become the perfect place for the event India rubber Expo-2011

Production of rubber in the world was considered to be very unstable during the last few years comparatively; with the worlds India's production of rubber is consistent at the rate of6% per annum. The Indian rubber industry has been growing tremendously over the years. 90% of India's total production of natural rubber is contributed by Kerala. Kerala and Tamil Nadu together occupy 86% of the growing area of natural rubber.

II. PROCESS FLOW

J.K. Fenner (MDU 2) is the mass producer of belts. In this industry the raw materials are arrived from MDU 1 branch. After the arrival of raw materials they are processed in the production line to convert the raw material into finished belts. The current process flow is shown in fig

The finished belts are sent to the Quality control and then to the Packaging section. After packing the belts are shipped to the various parts of the world.

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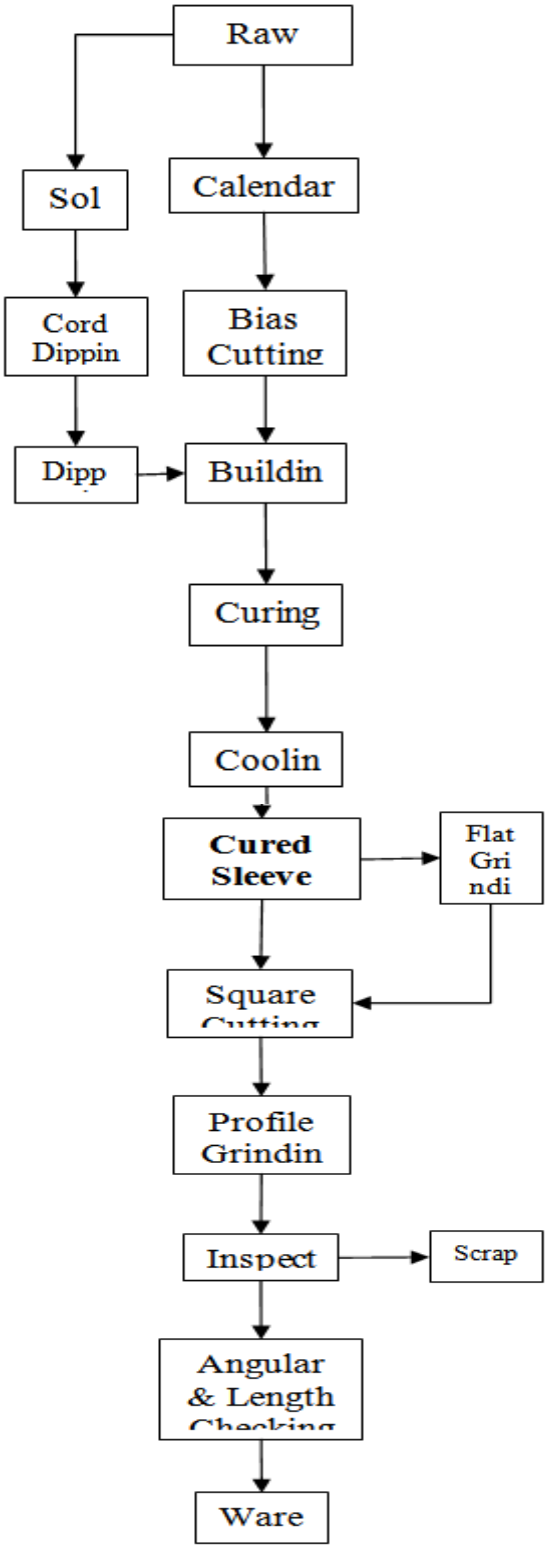

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III.LITERATURE REVIEW

Pravinkumar M Shah et al (2016) reviewed bending and contact stress of helical gear. He founded that, and helix angle increases the contact stress decreases and helix angle is inversely proportional to contact stress. Then the helix angle increases the contact area

Gagandeep Singh et al (2015) studied simple tyre rubber and v-belt rubber materialsterms of their composition and its mechanical properties.From his study, he stated that Hardness is more in case of v-belt rubber as compare to tyre rubber

Edward Igelegbai et al(2015) investigated mechanical properties and microstructure of brass alloys. He stated that, increases of zinc in brass leads to improve hardness, yield strength, tensile strength and ductility of brass alloy.

Prabhakar Purushothaman et al(2014)discussed hertz contact theory validation. He concluded that, the stress value changes with contact area. If higher the contact area the stress generated will bereduced.

Na Jin Seo et al(2008)investigated relationships among grip forces, normal forces, and contact area. Also, the grip force increased proportional to contact area

IV. STRIPPING MACHINE

The sleeve extraction machine (Stripping machine) is used for extract the Cured rubber sleeve from the cylinder mould. This machine has eight movable jaws. Each jaw has two linear motion bearings which are moved on the rail or guide way. These movable jaws are operated by hydraulic pressure. In this machine first moving four jaws are called as pressure jaws and other four jaws are called as holding jaws.

Mechanical Data:
Drum Circumference - 160 to 796 mm
Belt Length - 500 to 2500 mm
Drum length - 1000 to 1200 mm
Electrical Data:
Installed Power - 15 KW
Hydraulic group motor - 11 KW
Control Voltage - 24 V DC
Power Supply - 3 x 230 VAC +- 10% - 60Hz
Max. Consumption - 13 KWh
Utilities:
Air supply - ¾" – 6 bar (60KPa) min.
Max Consumption - 0.5m^3 / hour
General Data:
Machine Weight - 20.000 N
Hydraulic group Weight - 5.000 N
Electrical cabin Weight - 1.200 N

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V. MOULD

A mold or mould is a hollowed-out block that is filled with a liquid or pliable material such as plastic, glass, metal, or ceramic raw material. The liquid hardens or sets inside the mold, adopting its shape. A mold is the counterpart to a cast. The very common bi-valve molding process uses two molds, one for each half of the object.

VI. SLEEVE

A Sleeve is the circular component which is prepared by winding a thin rubber sheets over the circular mould to the required dimensions of belt. In this the dipped cord also winded at the middle of the rubber sheets. This sleeve is grinded and cut down into belts**.**

VII. STEP BY STEP PROCEDURE OF SLEEVE REMOVAL PROCESS IN STRIPPING MACHINE

Step 1: Cured mould from the cooling tank is placed at the centre of the stripping machine with the help of hoist/crane.

Step 2: After the mould with sleeve is placed at the center of the stripping machine, 4 holding jaws are move towards the mould by hydraulic action. Then, the remaining 4 pressure jaws are move towards the mould and make a gripping of sleeve effectively.

Step3: The mould is removed from the sleeve by using the hoist/crane. Thus the sleeve is extracted from the mould

Step 4: Finally, the sleeve is sent to the flat grinding section and then they cut down into the belts for the required width.

Figure 3.6 a- Eight Jaws moving towards the mould and sleeve
Figure 3.6 b-Jaws are holding the mould and sleeve
Figure 3.6 c-Mould is removed from the sleeve
Figure 3.6 d-Jaws release the sleeve and sleeve is extracted

VIII. PROBLEM IDENTIFICATION

I started my research in PRODUCTION LINEand we noticed that the grip belt was not working properly during sleeve removal. Due to this ineffectiveness of grip belt, quality of the sleeve is reduced. The contact area of grip belt is small; hence the gripping failure may occur. Improper gripping leads to the sleeve damage and as well as the mould damage. It reduces the quality of the belt and increases the replacement cost of mould. It also increases the scrap.

IX. OBJECTIVE OF THE RESEARCH

The objective of our researcht is

i. To reduces the scrap.
ii. To eliminate the defective sleeve in the mass production line.
iii. To find the root cause for the defective sleeve.
iv. To design & development of a double belt gripper in stripping machine.
v. Cost estimation and effective implementation of double belt gripper in stripping machine**.**

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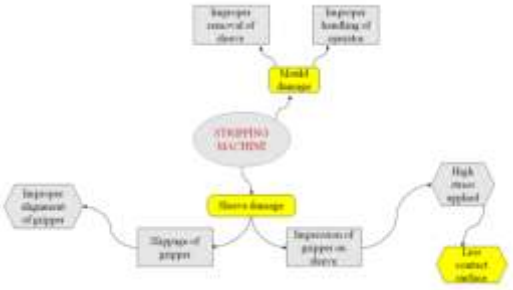
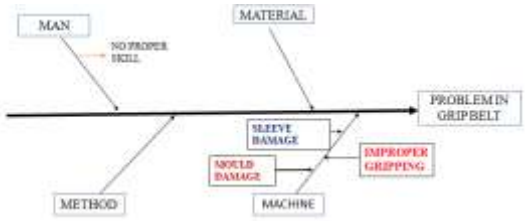
X. ANALYSIS



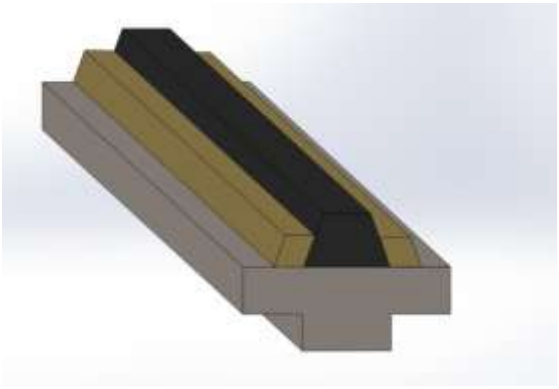
Brainstoming



Root Cause Analysis

XI. DESIGN AND DEVELOPMENT

Single belt Gripper



3D View of Single belt Gripper

S.NO	APPEARANCE	QUANTITIES	MATERIAL
1	BLACK	1	RUBBER
2	GOLDEN	2	BRASS
3	GREY	1	STEEL

The stripper machine has totally 8 jaws. In this, 4 jaws are holding jaws and 4 jaws are pressure jaws. Each jaw have single gripper belt.

Width of gripper belt = **16 mm**
Length of gripper belt = **1140 mm**

Contact area of gripper belt in a jaw = Width x Length x No.of.belt
= 0.016 x 1.14 x 1
= 0.018 m ^{2}.

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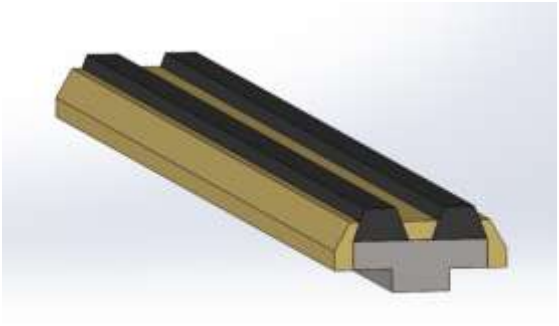
Stress induced on the sleeve by a jaw = Force / Contact area
= 1000 / 0.018
= 55555.56 N/m ^{2}.

Double belt Gripper



3D View of Double belt Gripper

S.NO	APPEARANCE	QUANTITIES	MATERIAL
1	BLACK	2	RUBBER
2	GOLDEN	2	BRASS
3	GREY	1	STEEL

The new suggested gripper has double belt in each jaw. It will increase the contact area of a gripper belt on the sleeve.

Width of gripper belt = **16 mm**

Length of gripper belt = **1140 mm**

Contact area of gripper belt in a jaw = Width x Length x No.of.belt
= 0.016 x 1.14 x 2
= 0.036 m ^{2}.

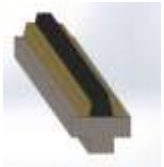
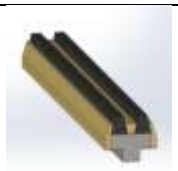
Stress induced on the sleeve by a jaw = Force / Contact area
= 1000 / 0.036
= 27777.78 N/m ^{2}.

XII. COMPARISION

Stress induced on the sleeve by single belt gripper is**55555.56 N/m ^{2}.**

The compressive strength of the sleeve is **50000 N/m^2**. The stress induced by the gripper belt is more than the yield strength of the sleeve. Therefore, the impression is created on the sleeve. Hence, we want to reduce
Stress induced on the sleeve by double belt gripper is **27777.78 N/m ^{2}**.

Thus,the stress induced by the gripper belt is less than the yield strength of the sleeve. Therefore, the impression created on the sleeve is reduced.

DESCRIPTION	SINGLE BELT GRIPPER	DOUBLE BELT GRIPPER
3D View		
Contact Area	0.018 m ^{2}	0.036 m ^{2}.
Contact Stress	55555.56 N/m ^{2}.	27777.78 N/m ^{2}.

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XIII. COST ESTIMATION

S.NO	DESCRIPTION		COST(Rs)
1	Material cost	Belt	**1,872**
		Gripper hand	**18,864**
2	Labour cost	Belt	-
		Gripper hand	**2,200**
Total (For single jaw)			**22,936**

XIV. PAYBACK TO THE INDUSTRY

After implementation, the new design will give the money returns to the industry.

Amount will be saved per shift = Rs.10,000

Shifts per day = 3

Total amount will be saved per day = 10,000 x 3

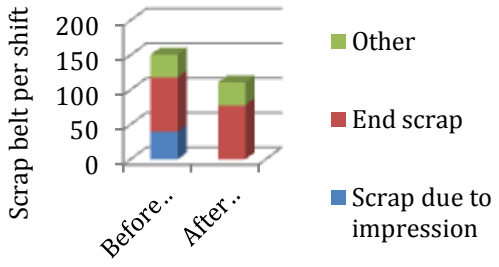
= Rs.30,000

Total amount will be saved per year = Rs.30,000 x 365 days

= Rs.1, 09, 50,000/-

XV. CONCLUSION

- Thus the Design of double belt gripper was developed successfully.
- The modification in the existing design will minimize the scrap around 26.5%
- The problem of getting defective sleeve in the mass production line is eliminated.
- The cost for implementation of Double belt gripper arrangement is minimum when compared to the scrap cost and this project will give good returns to the industry.
- Tools such as Root cause analysis and Brain storming sessions were conducted effectively.
- The tools used for problem identification, methodology and implementation will be useful for us in future.



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