Fracture Reduction in Steel Cord Manufacturing Process

L. Prabhu, M. Natarajan, C. Thiagarajan, M. Natarajan, R. Bharathi, S. Karthick

Abstract: Improve quality and productivity performance of a steel cord manufacturing system. The most important material of steel cord for tyre manufacturing process and that steel cord have good mechanical properties of high breaking strength, and low thermal coefficient of expansion as compared to nylon. Process for producing a Steel cord for pneumatic tires comprising a bunch of wires and core, the core of which consists of 3wire filaments arranged and bunched together in parallel. Then 6 wire (filament) on Core twisted and bunched in together. While processing on steel cord we faced wire fracture frequently like torsional fracture, power fracture, one filament fracture, entanglement fracture bad winding issue due to interrupted power and improper clamping of spool (wire Bobbin) and machine vibration. In this project have modified to Spool shaft on wire drawing machine. In this shaft, locking position and changed that shaft design. That shaft was reduced the spool wobbling while running on machine. In bunching machine, the circuit have power circuit-1, power circuit-2, control circuit, and commend circuit. The command and control circuits connected by uninterrupted power and power circuits connected with normal power (EB power). When power the cut-off, command and control circuit switchover to uninterrupted power, and it lead to smooth stop in machine. Thus, the changes have leads to reduce the fracture in cord manufacturing process.

Keywords: About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

This is In steel wire transformation and coatings, a renowned company is Bekaert.

• focus on sustainable & profitable growth.
• By implementing our worldwide market and technological leadership, strategy in the business segments and markets where we are active.
• By working for success together: with our customers, suppliers and other business partners, within our organization, and throughout the divisions and regions [1]. And regions possible. Figure 1 it shows the spools which wire represented on a diagram.

Fig. 1. Spools which wire is wounded

II. METHODOLOGY

A. Manufacturing Process

Fig. 2. Methodology

Figure 2 which represented as the incoming material prepares for drawing process. It connected to wire bunching process. Finally dispatch the material.
B. Incoming Material and Preparation

Figure 3 represents the Material and preparation used to incoming materials are prepared and through the bunching process.

C. Wire Drawing Process

A drawing process used to reduce the cross section of a wire by pulling the wire through a single, or series of, drawing die’s figure -3. Filament used as an individual element in a strand or cord standard, filament diameter is available 0.15/0.175/0.20/0.22/0.27/0.28/0.30/0.35/0.38 mm. wrap wound helically around steel cord. Figure 4 shows the wire drawing process [2]

D. Bunching Process

Steel cord manufactured from many grades and types of construction figure it shows the bunching process

E. Rewinding Process

Steel cord is received from bunching machine with high quality in a spool [3]. Then the steel cord is convert to customer spool according to specification length, hear the quality parameter of torsion, length, straightness, arc height and elongation are ensured and move to over control area [4]. Figure 7 and Figure 8 shows the steel cord application and Fracture types.
F. Components and Description

1. PNEUMATIC CYLINDER (SMC- CD255B80-20)
2. 5/3 DIRECTION CONTROL VALVE
3. 5/2 Directional Control Valve
4. SHAFT

Table-II: Estimation of Component

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<th>Qty</th>
<th>Amount</th>
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<td>M6x20 mm Bolt</td>
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Total Amount 52746

G. Fracture Trends

Fractures are calculated only 3 wire bunching process only, each month we monitor and followed in [5], production KPI. In addition, it is affected in next process 6 wire bunching process because of unable to run calculated length.

Formulas for Fracture per ton = Total number of fracture / Production volume in ton.

Figure 9 shows the pareto analysis of fracture on 3 wire bunching process.

We know as 80/20 Pareto rule, We take action as following

1. Power fracture
2. One filament fracture
3. One filament fracture is nothing but the fracture is happen at one input spool, it has happened due to entanglement from filament-produced machine (Drawing process), so that we select rest the fracture types of Power fracture and Entanglement fracture [7].

III. RESULT AND DISCUSSION

Figure 10 represents the fracture analysis 1 Power fracture

![Fig. 10. Fracture Analysis 1-Power Fracture](image)

A. Temporary Action
- We find alternate solution at low cost, until to change the domestic power to Industrial [6]

B. Corrective Action
- Approval request forward to central equipment modification team for what are the change we plan and how to implement and propose changed request.
- Classified the machine circuit such as Command circuit and power circuit and we focus on command circuit because of power consumption is very low.
- Command circuit, take-up, FT unit are controlled by uninterrupted power.

Figure 11 and Figure 12 represents the fracture analysis 2 and Prioritization of Matrix

![Fig. 11. Fracture Analysis 2-Entanglement Fracture](image)
Fig. 14. Before and After modification

Vibration Test provided at machine base. Before After

Fig. 15. Before and After Correction

Figure 16 and figure 17 shows the Better improve the our fracture per ton trends & Results,
Better improvement we faced from input change over time on 3 wire bunching process

Fig. 16. BF-2 Fracture per Tons

Fig. 17. Total input change over time on BF-2

Fig. 12. Prioritization of Matrix

Figure 13 shows the Potential Causes validation & before and after

C. Improvements

Figure 14 and figure 15 before and after modification and correction as
IV. CONCLUSION

This task work lead us a great exposure and awareness, to utilize our insight. A great deal of useful information is acquired in terms of reduction fracture in steel cord manufacturing process

Power fracture- Power Interruptions action taken for this particular problem **Machine input powers of control power (24V), 230V and Maine power (440V) devices are connected with relay & uninterrupted power source.

1. In such way of to controlled irregular stops of machine while power interrupted.
2. Minimum power consumption and investment cost.
3. Executed in All BF2, BFM, HKM machine.result of power fracture.Entanglement fracture or winding issue- Take-up spool shaft modification on Shxuing machine. Action taken for this problem Wire spool shaft was changed in all Shxuing machine and found Shaft run-out was minimized and also noise level unsafe risk are reduced.result 18% reduced from overall fracture and saving realised from actual.Machine vibration – Action taken Vibration pad (High impact rubber pad) was provided in machine base with position plate. Its lead to reduce the winding pitch variation. Result for this problem 5% reduced from overall fracture and saving realised from actual. Input Change over time- Action taken for the problem Better improvement we faced from input change over time on 3 wire bunching process as a result 50% of change over time is reduced. from 2800 Minutes to 1400 Minutes reduced per month.

REFERENCES

7. H. Y. He, “Master’s Thesis, University of Science and Technology Beijing; Beijing”, Study on Production Technology of High Carbon Steel, Dec.2010

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