Fracture Reduction in Steel Cord Manufacturing Process

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Abstract*: Improve quality and productivity performance of a steel cord manufacturing system. The most importuned 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 regionspossible.Figure 1 it shows the spools which wire represented on a diagram.

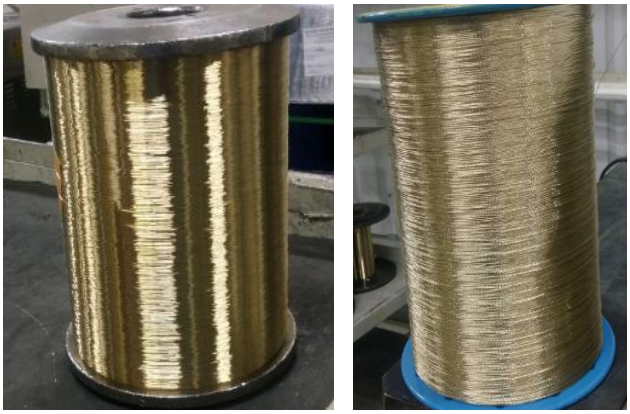

Fig. 1..Spools which wire is winded

II. METHODOLOGY

A. Manufacturing Process

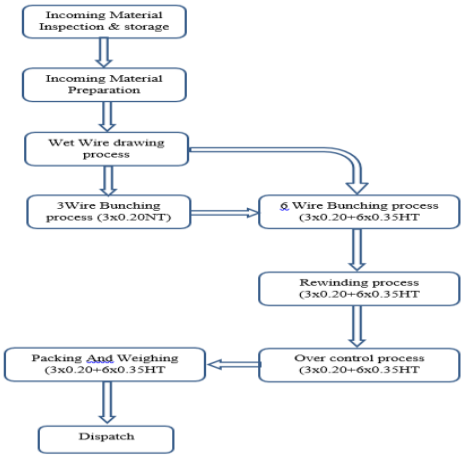

Fig. 2. Methodology

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

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B. Incoming Material and Preparation

Fig. 3.Material and preparation

Figure.3 represents the Meterial 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 diameterisavailable0.15/0.175/0.20/0.22/0.27/0.28/0.30/0.35/0.38 mm. wrap wound helically around steel cord. Figure 4 shows the wire drawing process [2]

Fig. 4.Wire Drawing Process

D. Bunching Process

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

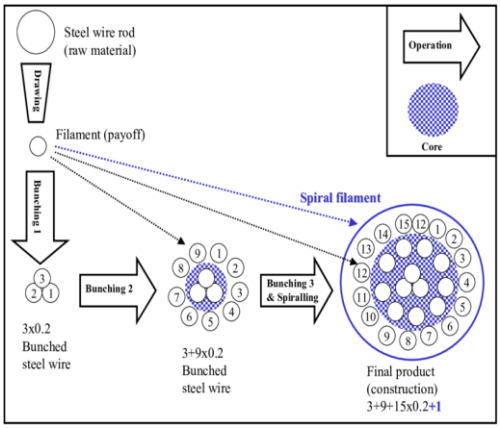

Fig. 5.Bunching Process

Figure 6 represents the steel cord types

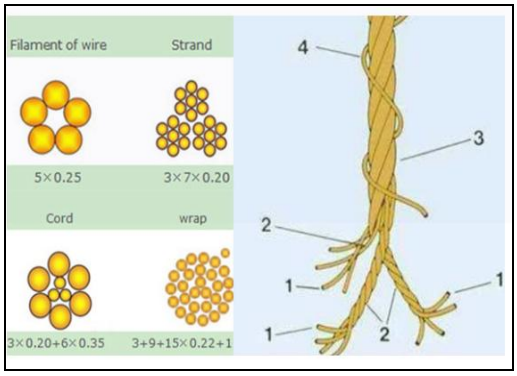

Fig. 6.Steel cord types

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 Fiogure 8 shows the steel cord application and Fracture types.

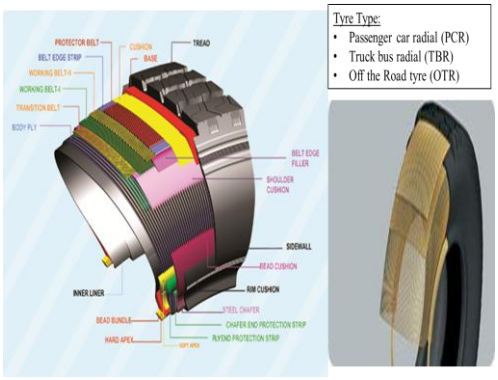

Fig. 7.Steel Cored Application

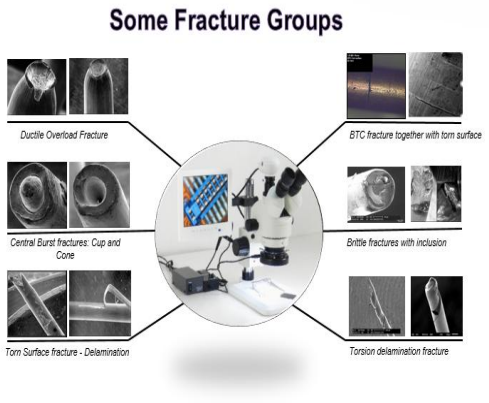

Fig. 8.Fracture Types

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

Estimation of Component				
S.No	***Part code***	***Name***	***Qty***	***Amount***
1	2144100	Pneumatic cylinder	1	3000
2	2144150	Cylinder fixture	1	1510
3	2144090	5/2 ,24V valve	1	1560
4	2144098	Shaft V1.1.5	1	45000
5	2144099	Rubber ring	2	300
6	2144111	Sleeve	3	450
7	2144123	Spring washer	20	200
8	2144124	Lock nut	1	70
9	2144125	Bushing rod	1	520
10	2144008	M12x80 mm Bolt	4	80
11	2144908	M6x20 mm Bolt	4	56
	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

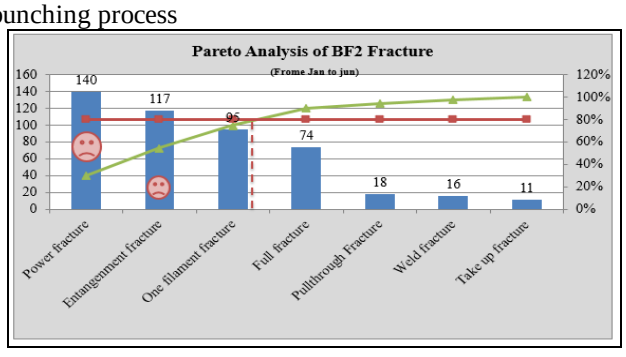

Fig. 9.Pareto Analysis of Fracture on 3 Wire Bunching Process

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

1. Entanglement 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 analysis1 power fracture

EB power trips trends		
Month	Sum of Totol Trips	Sum of Un-planned Trips
Jan	25	18
Feb	20	13
Mar	86	26
Apr	70	26
May	18	14
Jun	4	2
Jul	3	2
Aug	18	11
Sep	9	7
Oct	12	10
Nov	2	0
Dec	7	7
Grand Total	274	136

Fig. 10. Fracture Analysis 1-Power Fracture

A. Temporary Action

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

B. Corrective Action

- Approvel request forward to central equipment modification team for what are the change we plan and how to implemantation and proposal changed request.
- Classified the machine circuit such as Commend circuit and power circuit and we focus on commend circuit because of power consumption is very low.
- Commend circuit, take-up, FT unit are controlled by uninterrupted power.

Figure 11 and Figure 12 represents the fractureanalysis 2 and Prioritization of Matrix

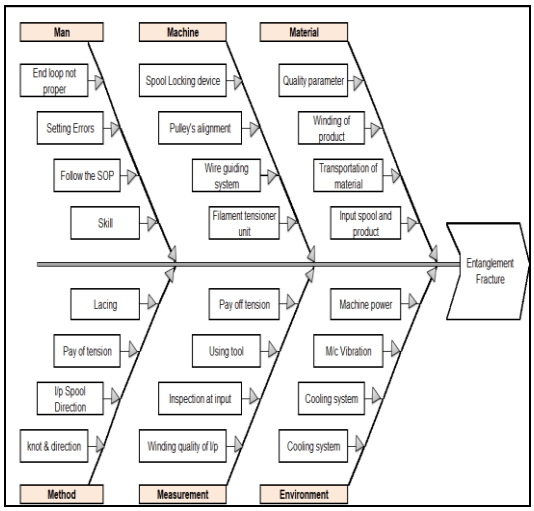

Fig. 11. Fracture Analysis 2-Entanglement Fracture

Prioritization of Matrix					
Type of 6M	Causes	Validation	Low	Medium	High
Man	Skill	Skilled operator handled to the machine and fracture found in all Shift	X		
	Follow the SOP	Input loading direction / lacing /knot appearance are checked & found Ok	X		
	Setting Errors	Pay off Take up Tension / MMI setting / Dance arm Gap have in as per setting chart	X		
	End loop not proper	verified until 3 day in all produced spool and found in normal	X		
Machine	Filament tensioner unit	1.Breake disc / Tension spring/shaft /indentation pin have good condition	X		
		2.Break belt / Spacer / Belt locking pin are found damage condition		X	
	Wire guiding system	1.Outer & Inner Guiding pulley's are found ok		X	
		2. Reversing wheel at 4001 & 4004 / FT G.wheel bearing found wear out		X	
	Pulley's alignment	Pulley's alignment are checked & found Ok		X	
	Spool Locking device	Spool holder/shaft / pin are found ok	X		
Material	Input spool and product	Input spool are produced from Shx 1009 ,1010, 1011, 1012	X		
	Transportation of material	Trolley surface &Spool flange / Surface condition found ok	X		
	Winding of product	Winding checked & ok found in flat winding		X	
	Quality parameter	100% inspection of Diameter/ Ovality/ visual parameter and found Ok	X		
Method	Lacing	All Lacing found in as per procedure		X	
	Pay of tension	Pay off tension setting SOP		X	
	I/p Spool Direction	Input spool direction physically checked found ok		X	
	knot & direction	Knot are checked and found all in as per Procedure	X		
Measurement	Pay off tension	Pay off tension checked and found Outer =400 G and inner 600 G		X	
	Using tool	Arca meter and hanshimith meter are calibrated and arca range 1 kg used		X	
	Inspection at input	Filament damage / serration / Visual inspection are checked and found ok		X	
	Winding quality of input Spool	Winding quality measured by visually during machine running and abnormal Ovality found at some input spool's			X
Environment	Machine power	Eb power fluctuation and unplanned power cut occurred minimum 1/machine/month			X
	M/c Vibration	Machine vibrations checked SHX machine and Found BF 2 machine found ok,		X	
	M/c Temperature	SHX & Bf2 Machine temperature have < 52 degree at Cradle & Torsion shaft	X		
	Cooling system	Water cooling system used and found ok	X		

Fig. 12. Prioritization of Matrix

Figure 13 shows the Potential Causes validation & before and after

S.no	Input Spool Winding Quality Causes	Method	Cause validation at Before				Cause validation at After project			
			SHX 1009	SHX 1010	SHX 1011	SHX 1012	SHX 1009	SHX 1010	SHX 1011	SHX 1012
1	Controller at Slave A093	Visually	Beck 10	Bec 10	Bec 10	Bec 10	Beck 10	Bec 10	Bec 10	Bec 10
2	Controller at Master A090	Visually	Bec 100	Bec 100	Bec 100	Bec 100	Bec 100	Bec 100	Bec 100	Bec 100
3	Program version	HIM	NDE -2.5	NDE -2.5	NDE -2.5	NDE -2.5	NDE -2.5	NDE -2.5	NDE -2.5	NDE -2.5
5	Machine speed in M/mint	HIM	900	900	900	900	900	900	900	900
6	Winding pitch	HIM	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
7	Take up tension (Accept Range 750G to 850G)	DTMB 2000 @ -2	889	914	804	930	800	780	804	810
8	Dancer fluctuation	Visually	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
9	Machine Vibration at Running Length (Full length/spool=170830M)	HIM	25000	150000	88000	81000	25000	150000	88000	81000
10	Machine Vibration (MM/S) (Accept Range < 3.0 to 4.5)	Vaib. Meter	4.8 to 6.1	3.7 to 5.8	2.7 to 4.8	3.3 to 5.2	2.1 to 4.0	2.4 to 3.8	2.0 to 4.1	2.7 to 4.3
11	Belt Condition	Visually	ok	ok	wear	ok	ok	ok	wear	ok
12	Belt tension in Hz (65±5)	Frq.Meter	52.5	67.5	57.2	50.5	62.2	65.8	64.9	60.9
13	Spool shaft Condition	Visually	ok	ok	ok	ok	ok	ok	ok	ok
14	Take up Shaft Runout in MM at spool entry (Accept Range < 0.15mm without load)	Dial Gauge	0.24	0.21	0.19	0.26	0.11	0.12	0.12	0.1
15	Take up Shaft Runout in MM at spool Rest (Accept Range < 0.1mm at without load)	Dial Gauge	0.12	0.11	0.08	0.11	0.07	0.09	0.08	0.07
16	Winding condition @ Full spool	Visually	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat
17	Winding condition during Spool running @ BF2	Visually	Oval	Oval	Oval	Oval	ok	ok	ok	ok
18	WS 50 Spool condition	Visually	ok	ok	ok	ok	ok	ok	ok	ok
19	Travers limit sensor	M.Meter	No Noise	No Noise	No Noise	No Noise	No Noise	No Noise	No Noise	No Noise

Fig. 13. Potential Causes validation & before and after

C. Improvements

Figure 14 and figure 15 before and after modification and correction as

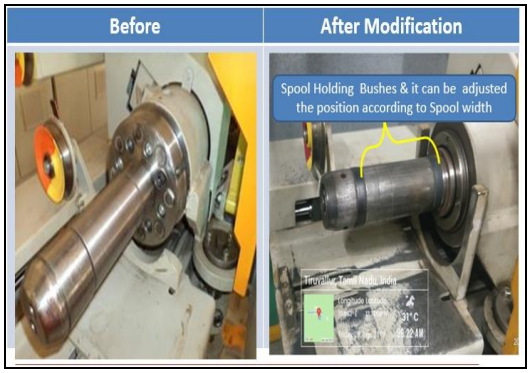

Fig. 14. Befor and After modificationtion

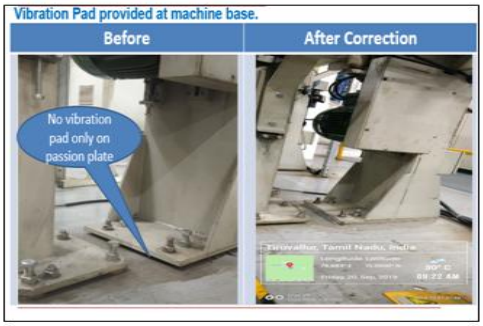

Fig. 15. Befor and After Correction

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

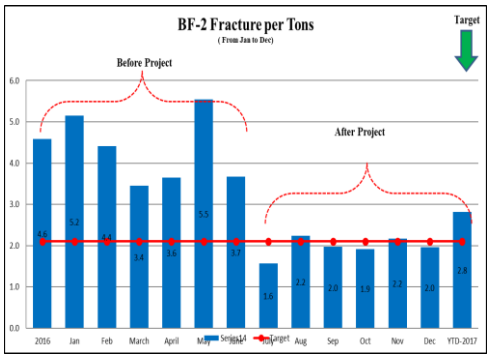

Fig. 16. BF-2 Fracture per Tons

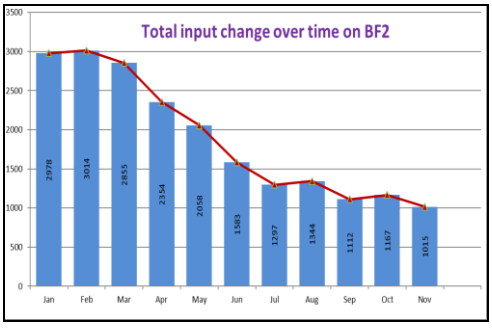

Fig. 17. Total input change over time on BF-2

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 fracturein 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 powerinterrupted.
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.

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