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"Productivity Improvement by Using Quality Control Tools – A Case Study of Chartered Rubber Products"

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Abstract: *Small – scale industries are the foundational pillars of Indian economy. Here we are doing a case study on Chartered rubber product to improve its productivity. They are following various orthodox customs, improper utilization of available space & inaccurate arrangement of machineries with respect to one another. Hence they are taking a lot of time for undertaking various tasks, and also more human effort is required. Thus with the help of SLP technique & with the help of various quality control tools, the non-value adding activities are eliminated. Thus the Productivity has been increased with reduced human efforts & employees work satisfaction.*

Keywords: *Systematic Layout Planning, Plant Layout, Productivity Improvement*

I. Introduction

During the ancient times Wooden Wheels were used for animal carts for transportation, but due to its limitation, it undergone through various changes. The outer ring of the wheel provides attire (dressing) to the wheel of vehicle, to provide wear – resistance surface on the periphery of the wheels, thus from the word attire the word tire was developed & it was used to represent the metal band used to dress wheels. In 1835 Charles good year & Dietz were the first to patent a rubber cushioned tire or a rubber cushion applied to an iron tire or rim. An Irishman named as John Dunlop also made an automobile pneumatic tire in 1839 for his son, as he used to have severe headaches while riding bicycles in irregular road surface, but was not of practical use due its limitations, so his patent was declared as invalid. R.W Thomson, a Scottish civil engineer had made the pneumatic tires in the year 1845 for his horse driven carriage. Tread is the outer most portions or the top most portion of a tire, which makes direct contact with the road surface. While manufacturing a rubber tire about ¾ of the cost is incurred in manufacturing its casing, while about ¼ manufacturing its cost depends on thread of rubber tire. When a vehicle use the same tire for a long distance & for a long duration of time, its tread gets wear out, hence it will not be safe to use it, hence it should be replaced. It is not economical to replace old worn out tire with new tire but by re-treading a new life can be given to the old tire at about 20 % of the cost of the entirely new tire& also save about 90% of material required for manufacturing a new tire. The current generation tires can last up to 600000 miles, if they are re-treaded 2 to 3 times.

Small – scale industries are the foundational pillars of Indian economy. Here we are doing a case study on Chartered rubber product to improve its productivity. They are following various orthodox customs, improper utilization of available space & inaccurate arrangement of machineries with respect to one another. Hence they are taking a lot of time for undertaking various tasks, and also more human effort is required. Thus with the help of SLP technique & with the help of various quality control tools, the non-value adding activities are eliminated. Thus the Productivity has been increased with reduced human efforts & employees work satisfaction.

II. Literature Review

Wiyaratn et al (2010), in their paper "Improvement Plant Layout Using Systematic Layout Planning for Increased Productivity", have studied about the amount of equipment's and tools in an iron production. Authors have stated that, this is a method which shows step- by-step process of plant design from input data and activities to evaluation of plant layout. The authors also have stated that with the help of SLP new layout can be designed, which improves the flow of processes with new plant layout and helps to increase productivity in industries [1]. Shewale et al (2012), in their paper "Improvement in plant layout using Systematic layout planning for increased productivity", have studied on the amount of equipment's and tools in compressor production & stated that with the help of SLP, the distances travelled between various stations can be reduced and the new layout will decrease the flow of material and hence resulting in reduction in waste and increased production [2]. Mahendra Singh (2012), in his paper "Innovative practices in Facility layout planning", have studied on various types of basic Facility layout and advanced facility layouts. Their study was also aimed on

the application of innovative practices in Facility layout planning. He stated that SLP can be an effective stage for playing out the services to customers [3]. Subodh et al (2014), in their paper "Productivity Improvement in plant by using Systematic layout planning (SLP) – a case study of medium scale industry, have discussed about the problems faced by a medium scale auto ancillary company & also stated that the material handling time, labor cost, transportation cost etc. can be successfully minimized by SLP technique [4].

III. Problem Identification

3.1 Flow of Material

In chartered rubber products, long distances (162.4ft) are required to be covered for handling of semi-finished product from cooling tank to hydraulic press. Hence lot of time is being wasted.

3.2 Poor Storage Facility

Chartered rubber products are not utilizing their plant to its full potential in an optimum way. The raw- material is stored in the plant in an unplanned manner. The raw-materials are also stored in the area allocated for packaging.

Fig 1 Poor Raw Material Storage

IV. Data Collection

4.1 Manufacturing Sequence:

Chartered rubber products are basically manufacturing two types of tread rubber. They are producing 1) Cold or Conventional Tread Rubber 2) Pre-cured Hot Tread Rubber in the same layout.

4.1.1 Conventional Process:

The following are the material flow pattern at Chartered Rubber Products for producing hot cured or conventional tread rubber.

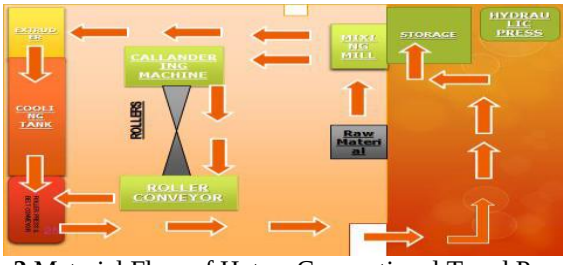


Fig 2. Material Flow of Hot or Conventional Tread Process

The following are the sequence followed by the Chartered Rubber Products for producing hot tread rubber. The Raw materials such as natural rubber, synthetic rubber, wax etc. & chemicals such as carbon black, sulphur etc. is weighed in weighing machine. After weighing the above mentioned materials are brought to the mixing mill. About 40 minutes, the compounds are processed in mixing mill & a sheet is prepared. This prepared sheet is now brought to the extruder, & is fed to the mouth of extruder by one operator, while one operator would check the size & thickness of the extruded rubber. Now extruded rubber is cooled in the cooling tank for sometimes & then brought to the roller press. At the same time the rubber sheet is also fed to the calendars assembly, where it is stretched to require shape & size to form rubber cushion. This Rubber cushion is fed to the roller press & thus both the extruder rubber & cushioned rubber are sandwiched together to form hot rubber. This hot rubber after passing through the conveyor is rolled manually by one employee. This rolled rubber is packed by one operator for transportation.

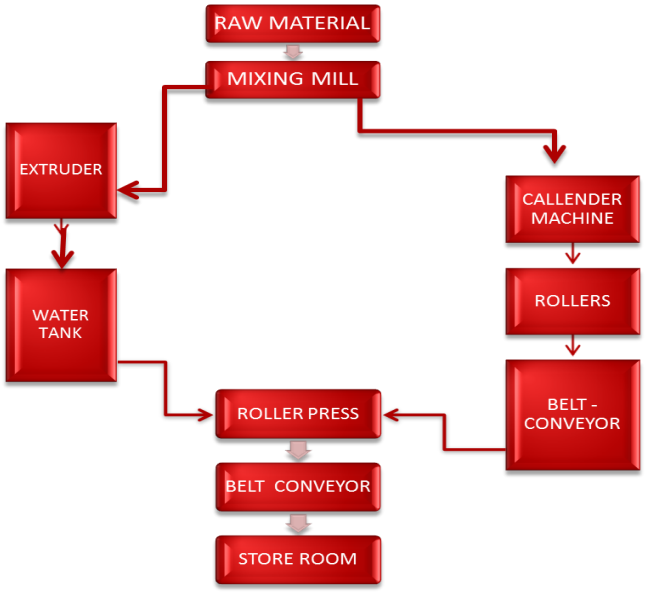


Fig 3 Manufacturing Sequence for Hot or Conventional Tread Rubber

4.1.2 Pre-cured Process

The following are the material flow pattern at Chartered Rubber Products for producing pre-cured tread rubber.

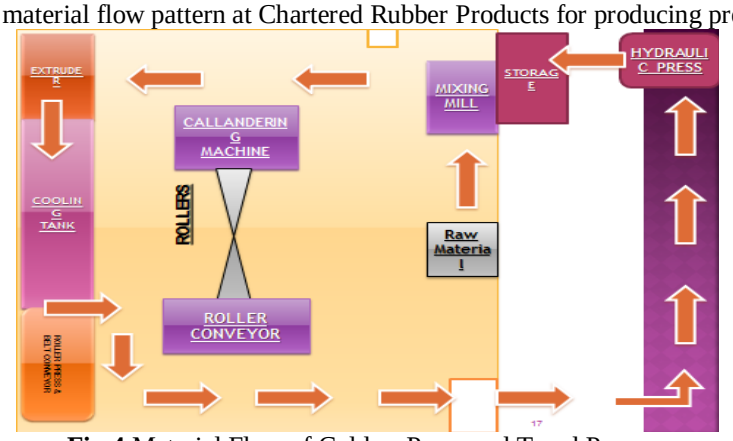


Fig 4.Material Flow of Cold or Pre-cured Tread Process

About 40 minutes, the compounds are processed in mixing mill & a sheet is prepared .This prepared sheet is now brought to the extruder, & is fed to the mouth of extruder by one operator, while one operator would check the size & thickness of the extruded rubber. Now extruded rubber is cooled in the cooling tank for sometimes & now this extruded rubber is brought to the hydraulic press. In hydraulic press, with the help of dyes of different patterns, size, & shapes tread pattern is prepared over the extruded rubber. This final product is brought to the plant for final packing & is packed by one operator for transportation.

Fig 5 Manufacturing Sequence for Cold or Pre-cured Tread Rubber

Thus based on the manufacturing sequence & material flow, the operations & current locations of machineries with respect to each other & their inter-dependency can be well understood.

4.2 Existing Plant Layout

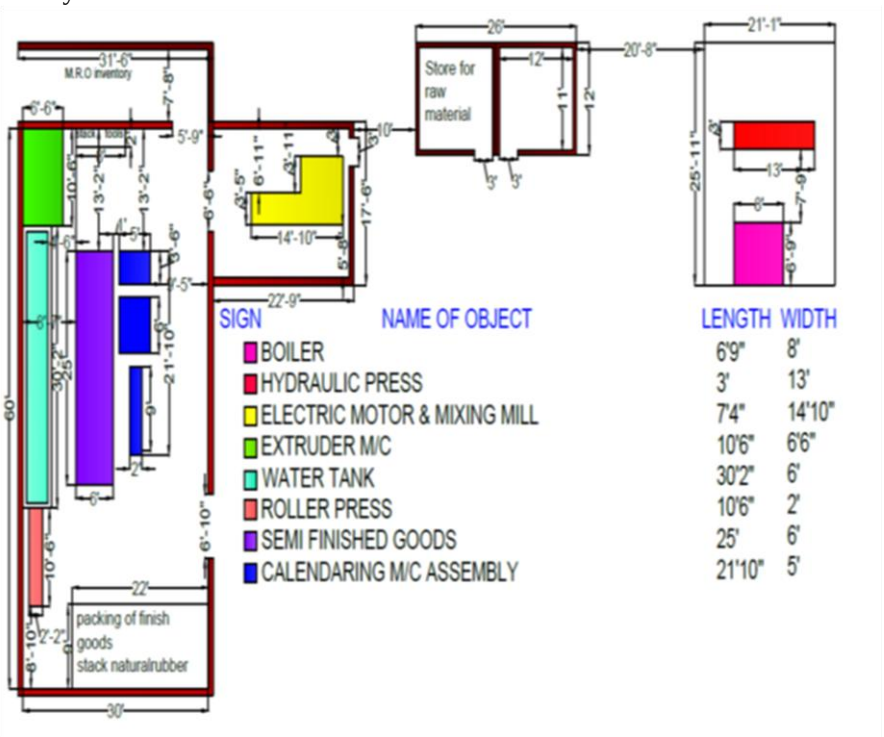


Fig 6 Existing Plant Layout of C.R.P at G.I.D.C

4.3 Relationship Between Equipment Size And Area

Table: 1 Relationship between Equipment's Sizes and Area

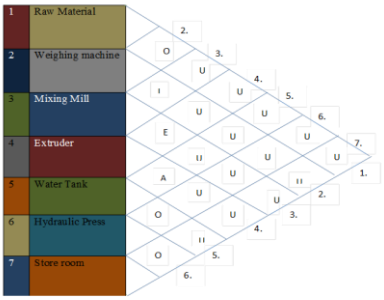
EQUIPMENT	NO OF EQUIPMENT	EQUIPMENT AREA IN SQ.FT
Mixing mill	1	14.10*3.5
Extruder	1	10.6*6.6
Cooling tank	1	30.2*3.6
Roller Press	1	1*1.5
Calendar machine	1	3.6*5
Rollers	1	5*6
Belt conveyors	2	9.6*2
Hydraulic press	1	3*13
Boiler	1	8*21.1

V. Data Analysis & Proposed Solution

5.1 Relationship Chart:

A relationship chart is a chart which shows the relationship between each department. Thus with the help of relationship chart, one could easily find out the inter-departmental importance & it's relationship. Hence relationship chart helps to design a new optimum layout by considering the inter–dependency & inter-relationship between various departments. Here we have made two relationship charts, one each for cold process & hot process.

5.1.1 Relationship Chart For Cold Process



A	Absolutely Necessary
E	Especially Important
I	Important
O	Ordinary Closeness Okay
U	Unimportant

Fig 7 Relationship Chart For Cold Process

5.1.2 Relationship Chart For Cold Process

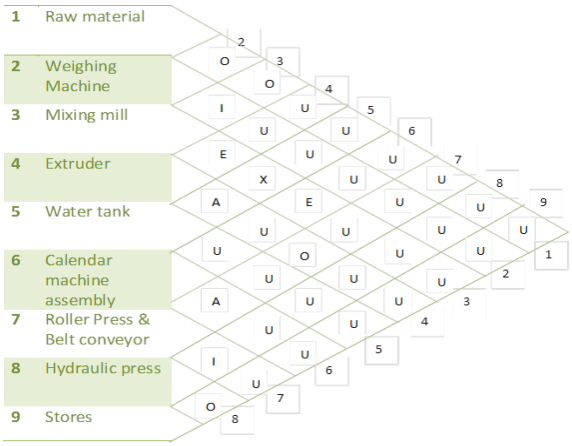


Fig 8 Relationship Chart For Hot Process

5.2.1 Flow Process Chart for Cold Tread Process

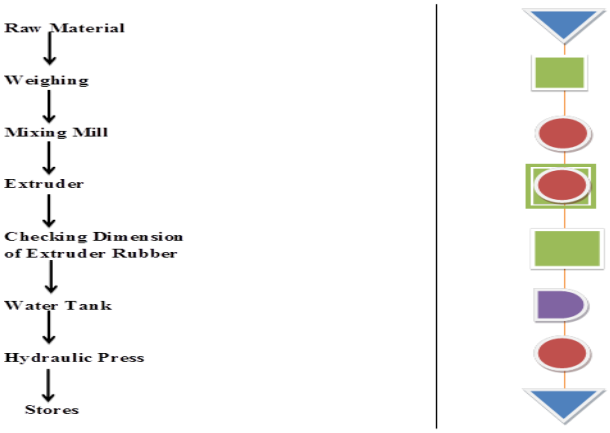


Fig 9 Outline Process Chart for Cold Tread Rubber

5.2.2 Flow Process Chart for Hot Tread Process

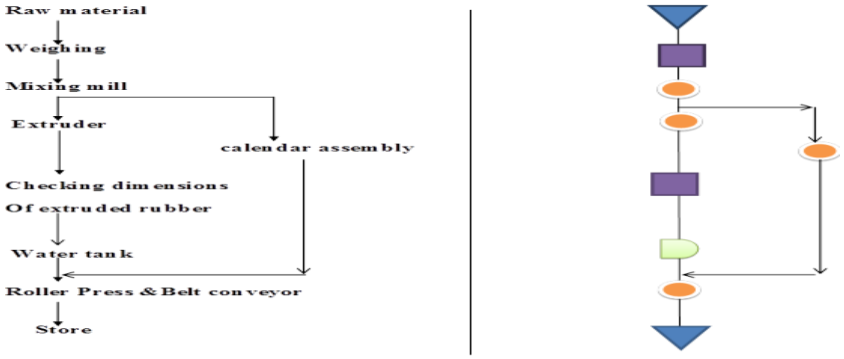


Fig 10 Outline Process Chart for Hot Tread Rubber

5.3 Distance Travelled Between Operations

Table: 2 Distance Travelled By Components in Present Layout

FROM	TO	DISTANCE
Raw-material	Mixing mill	60ft.
Mixing mill	Extruder	37.4ft.
Extruder	Water tank	0
Water tank	Hydraulic press	162.4ft.
Mixing mill	Calendar assembly	26.3ft.
Calendar assembly	Roller Press	22.9ft.

5.4 Solution Based On SLP

Based on SLP, the relationship chart has been constructed and on the basis of the chart, the relationship between equipment has been identified & on that basis a new plant layout has been constructed. The new – layout is as shown in the figure11 given below.

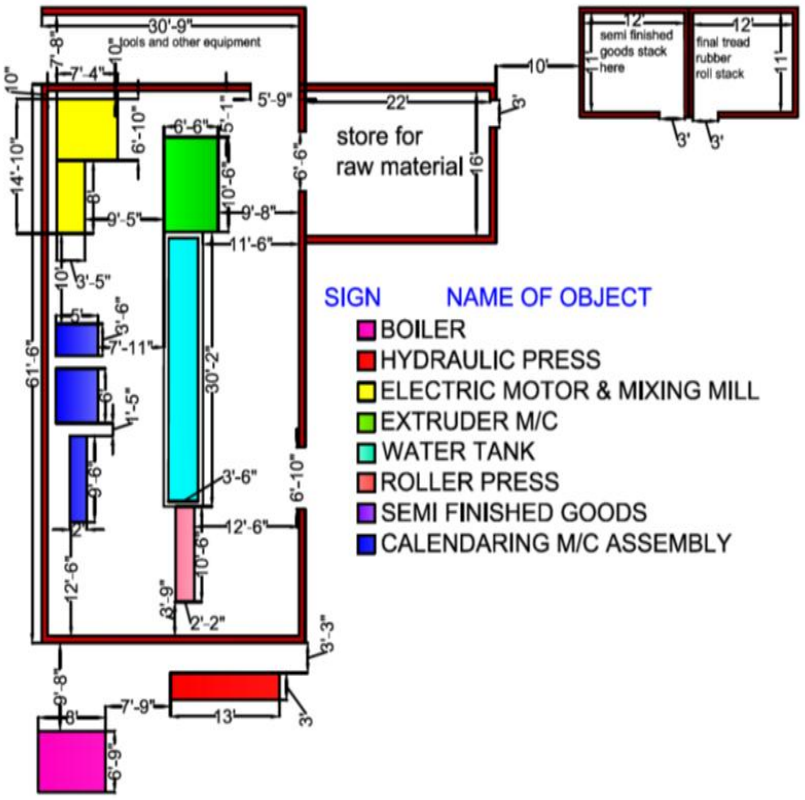


Fig 11 New Layout

5.5 Total Distance Travelled In New Plant Layout

The table shown below indicates the total distance travelled in the work station.

Table: 3 Distances Travelled By Components in New Layout

FROM	TO	DISTANCE
Raw-material	Mixing mill	40.4ft.
Mixing mill	Extruder	16.3ft.
Extruder	Water tank	0
Water tank	Hydraulic press	33ft.
Mixing mill	Calendar assembly	18ft.
Calendar assembly	Roller Press	16ft.

5.6 Comparison of Distance Travelled

Table: 4 Comparison of Distance Travelled

From	To	Distance Travelled In New Layout	Distance Travelled In Old Layout	Difference
Raw-material	Mixing mill	40.4ft.	60ft.	19.6ft.
Mixing mill	Extruder	16.3ft.	37.4ft.	21.1ft
Extruder	Water tank	0	0	0
Water tank	Hydraulic press	33ft.	162.4ft	129.4ft.
Mixing mill	Calendar assembly	18ft.	26.3ft.	8.3ft.
Calendar assembly	Roller Press	16ft.	22.9ft.	6.9ft.
TOTAL		123.7ft.	309ft.	185.3ft

VI. Conclusion

Here on the basis of SLP we have studied & analysed the layout & working process of Chartered Rubber Products. We have identified the degree of necessity of placing the equipment close to each other with the help of SLP. We tried to eliminate the wasteful elements from the plant & on the basis of SLP we have designed a new plant layout. The new layout on the basis of SLP reduces about 185.3ft of the distance travelled during the entire manufacturing process. Hence the entire manufacturing time gets reduced. Thus the over-all productivity of the Chartered rubber gets increased.

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