Proposal for the Design of Automobiles Tires Production Line

Khaled Mohamed Ahmed sharaf
Military Technical College, Cairo, Egypt, khaledsharaf113@gmail.com

Supervisor: Metwally Mohamed Elsayed Moussa, Associate Professor
Military Technical College, Cairo, Egypt, metwallymoussa50@gmail.com

Abstract

The objective of this work is to present Proposal for the Design of Automobiles Tires Production Line on a land area of 5000 m^2 with better characteristics.

The number of cars in Egypt is increasing year after year. This need the improvement of the level of car service, Specially vehicle tire needs a high level of maintenance, in orders to achieve customer satisfaction. This could be done by constructing number of production lines of tires that are capable of achieving customer needs this lines produce tires have better characteristics this project aim to provide all types of tires with good characteristics by providing all the raw materials used in the local tire industry and required to be imported from abroad, with an interest in providing materials that are imported locally to save on the production price of the tire with an account All the required capital costs for the purchase of raw materials to build the production line, the purchase of furniture required for the needs of the administration, the purchase of raw materials and the purchase of machinery used in the industry

I. INTRODUCTION

A tire is a strong, flexible rubber casing attached to the rim of a wheel. Tires provide a gripping surface for traction and serve as a cushion for the wheels of a moving vehicle. Tires are found on automobiles, trucks, buses, aircraft landing gear, tractors and other farm equipment, industrial vehicles such as forklifts, and common conveyances such as baby carriages, shopping carts, wheel chairs, bicycles, and motorcycles.

Tires for most vehicles are pneumatic; air is held under pressure inside the tire. Until recently, pneumatic tires had an inner tube to hold the air pressure, but now pneumatic tires are designed to form a pressure seal with the rim of the wheel.

Natural rubber is the main raw material used in manufacturing tires, although synthetic rubber is also used. In order to develop the proper characteristics of strength, resiliency, and wear-resistance, however, the rubber must be treated with a variety of chemicals and then heated and pressed.

II- LITERATURE SURVEY.

Figure 1. history of tires

The wheel was invented around 3500 BC, becoming one of man's greatest innovations. In its earliest form, the wheel was a curved piece of wood. Leather was eventually added to make the ride softer. Over time, the leather was replaced by rubber. The original rubber tire was solid rubber, without air, and was used by slow-speed vehicles.

Benz invented the first gasoline car in 1888, fitted with metal tires covered with air-filled rubber. This was the beginning of the pneumatic tire, which was first seen by the public in a Paris-Bordeaux-Paris automobile race. The tread tire was introduced in 1905. The tread was designed to protect the tire carcass from direct contact with the road. It also improved the tire friction coefficient

The 1920s saw the development of tire materials. The DuPont Company industrialized synthetic rubber in 1931, allowing the increase in tire production, which used to be dependent on natural rubber. Synthetic rubber ushered in a turning point in tire production. The balloon tire, a low-pressure tire that had a greater contact area with the road surface, was introduced in 1923.

Tubeless tires were developed in 1947 to relieve the high cost of oil prices. Tubeless tires contributed to the reduction of the vehicle's weight, allowing for a significant savings in fuel costs.

A- Applications of tires :

1 - Automotive tires.
2 - Light–medium duty Tires: Light-duty tires for passenger vehicles carry loads in the range of 550 to 1,100 pounds (250 to 500 kg) on the drive wheel.

Figure 2. Light–medium duty Tires

3 - Heavy duty Tires: Heavy duty tires for large trucks and buses come in a variety of profiles and carry loads in the range of 4,000 to 5,500 pounds (1,800 to 2,500 kg) on the drive wheel. These are typically mounted in tandem on the drive axle.

Figure 3. Heavy duty Tires

4 - Other Applications of tires: Aircraft, bicycle and a variety of industrial applications have distinct design requirements.

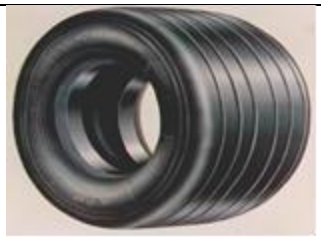

Figure 4. Aircraft tire

III. MATERIALS OF TIRE

Rubber is the main material used in manufacturing tires, and both natural and synthetic rubbers are used. Natural rubber is found as a milky liquid in the bark of the rubber tree . To produce the raw rubber used in tire manufacturing, the liquid latex is mixed with acids that cause the rubber to solidify. Presses squeeze out excess water and form the rubber into sheets, and then the sheets are dried in tall smokehouses, pressed into enormous bales, and shipped to tire factories around the world. Synthetic rubber is produced from the polymers found in crude oil. [1]

The other primary ingredient in tire rubber is carbon black. Carbon black is a fine, soft powder created when crude oil or natural gas is burned with a limited amount of oxygen, causing incomplete combustion, and creating a large amount of fine soot. So much carbon black is required for manufacturing tires that rail cars transport it and huge silos store the carbon black at the tire factory until it is needed.

Sulfur and other chemicals are also used in tires. Specific chemicals, when mixed with rubber and then heated, produce specific tire characteristics such as high friction (but low mileage) for a racing tire or high mileage (but lower friction) for a passenger car tire. Some chemicals keep the rubber flexible while it is being shaped into a tire while other chemicals protect the rubber from the ultraviolet radiation in sunshine.

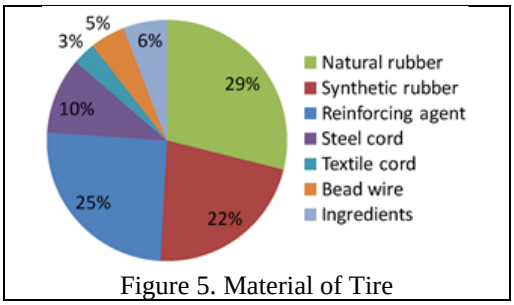

Figure 5. Material of Tire

Construction of Tire :

The main features of a passenger car tire are the tread, the body with sidewalls, and the beads. The tread is the raised pattern in contact with the road. The body supports the tread and gives the tire its specific shape. The beads are rubber-covered, metal-wire bundles that hold the tire on the wheel.

Computer systems now play a major role in tire design. In addition to tests of tread design and tire body construction, computers can simulate the effects of different types of rubber compounds. In a modern passenger car tire, as many as twenty different types of rubber may be used in different parts of the tire. One rubber compound may be used in the tread for good traction in cold weather; another compound is used to give increased rigidity in the tire sidewalls.[2]

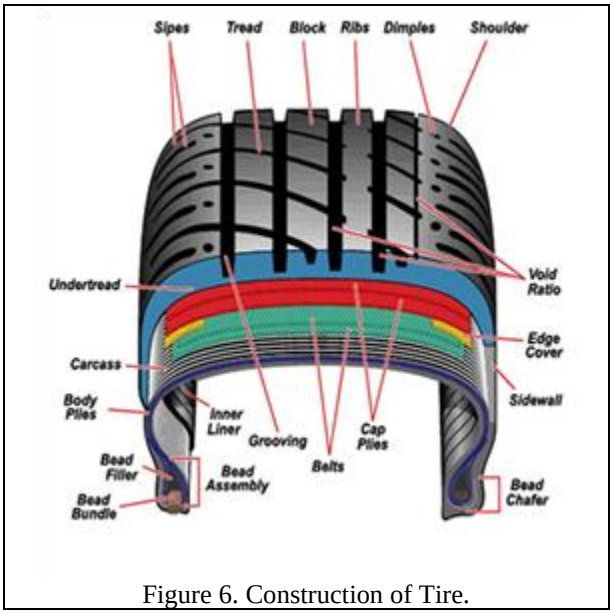

Figure 6. Construction of Tire.

IV. MANUFACTURING PROCESS OF TIRES.

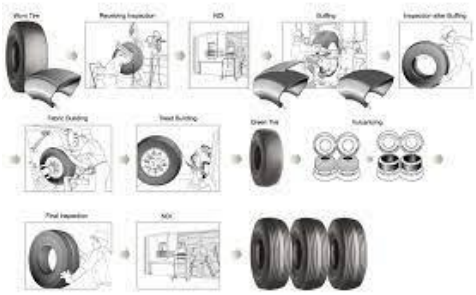

Figure 7. The Manufacturing Process of tires

A- Steps of Manufacturing Process of tires.[3]

1- Mixing of raw materials to form the rubber compound.
2- Each mix is then remilled with additional heating to soften the batch and mix the chemicals.
3- The batch goes through a mixer again, where additional chemicals are added to form what is known as the final mix.
4- Once a batch of rubber has been mixed, it goes through powerful rolling mills that squeeze the batch into thick sheets. These sheets are then used to make the specific parts of the tire.

Figure 8. The rolls of sidewall rubber

5- The rolls of sidewall rubber, the books containing tread rubber, and the racks of after the green tire is made, it is put in a mold for curing.
6- The green tire is made; it is put in a mold for curing. Shaped like a clam, the mold contains a large, flexible balloon.
7- Steam is pumped into the balloon, expanding it to shape the tire against the sides of the mold.
8- After cooling, the tire is inflated and tested.

B- Quality control.

When a new tire design is being manufactured for the first time, hundreds of tires are taken from the end of the assembly line for destructive testing. Some of the tires, for example, are sliced open to check for air pockets between body plies, while others are pressed down on metal studs to determine puncture resistance. Still other tires are spun rapidly and forced down onto metal drums to test mileage and other performance characteristics.

A variety of non-destructive evaluation techniques are also used in tire quality control. X-ray videography provides a quick and revealing view through a tire. In an X-ray tire test, a tire is selected at random and taken to a radiation booth where it is bombarded with X-rays. A test technician views the X-ray image on a video screen, where tire defects are easily spotted. If a defect shows up, manufacturing engineers review the specific steps of tire component assembly to determine how the flaw was formed.

C- Tire Size Writing.

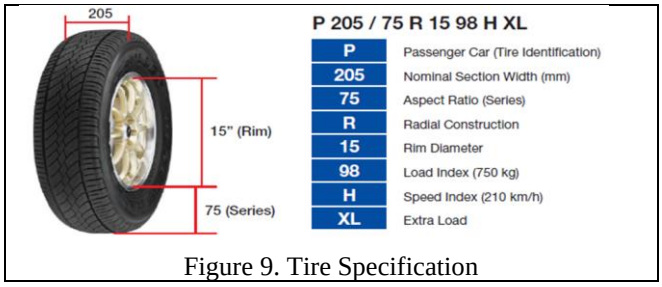

Figure 9. Tire Specification

D- Performance characteristics.

Inflation is key to proper wear and rolling resistance of pneumatic tires. Many vehicles have monitoring systems to assure proper inflation.

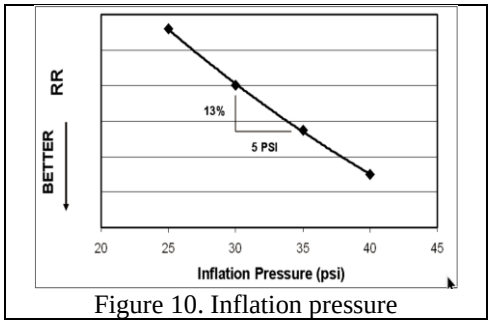

Figure 10. Inflation pressure

V. BASIC MACHINE TOOLS

A-

First machine.

Figure 11. Inner heel building

Second machine

Figure 12. Heel Rolling - Bonding

Third machine.

Figure 13. Soft Rolling & Tread Rolling

Fourth machine.

Figure 14. Molding

Fifth machine.

Figure 15. Curing

A- Time of Basic tire manufacturing process.

operation	time
- Compounding and warming .	245 s
- Inner Heel Building.	275 s
- Heel Rolling .	130 s
- Bonding.	127 s
- Soft Rolling .	200 s
- Thread Rolling .	207 s
- Molding .	115 s
- Curing .	195 s
- Tire De _molding .	95 s
- Primary inspection .	120 s
- final inspection.	160 s

Figure 16. Time study to produce one tire

VI. LAYOUT OF TIRE PRODUCTION LINE

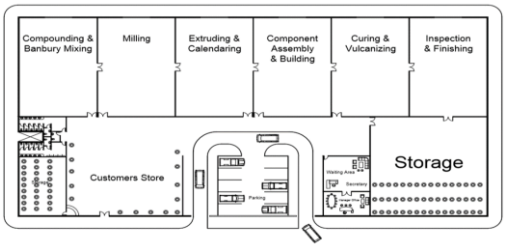

Figure 17. Layout of Production line of tire

Main Sections :

1- Reception Department :

This department is important because it is the only department that deals with customers. Therefore, it takes great attention.

- Main sections of reception department :

a- Parking zone for vehicle to be received.
b- Reception office.
c- Customer reception hall.
d- Operation hall.
e- Cashier.

2- Management Department.
a- General manager
b- Marketing manager
c- Financial manager
d- Store manager

VII. LINE SAFETY

Fire safety of factories include preventive and protective measures to be taken to eliminate the causes and sources of fire, and if a fire starts, prevent its disastrous action in the personnel, and ensure protection of building, equipment's, machines, etc.[4]

In the factory :

1- Always keep your workplace clean to protect yourself and other from injury .
2- Do not leave tools or parts on the floor where you or somebody else may trip over them .
3- Immediately clean up any spilled fuel , oil to prevent yourself or others from slipping on the floor .
4- Be careful when handling heavy objects .

VIII. COST

The main goal is to estimate the cost of some main items in order to get an approximate value of total cost.[5]

A- Land cost :
The net area =5000m2 square meter costs about 750 L.E
Landcost=5000*750=3,250,000 L.E

B- Cost of administration building .
1- Construction
The total cost of administration construction =750.000 L.E
2- Air condition
Each condition cost about 6000 L.E
Total of air condition=6000*8= 48,000 L.E
3- Furnishing

-For first manager Furnishing cost about 7000 L.E
-For 3 engineering managers Furnishing cost about 3000 L.E
-For employers the office cost 2000 for Furnishing
-For security Furnishing cost about 1000 L.E
-For 2 security office cost 1000*2=2000 L.E
-For reception Furnishing cost about 2000 L.E
-Total cost of Furnishing = 17.000 L.E

4- Machines :
Total cost 18.000 $

Conclusion

From the current study the following can be drawn :

1- Main application of tires we:
a- Light medium duty.
b- Heavy duty
c- Other users such (air craft and bicycle tires)

2- The materials used in tires production are:
a- Synthetic ruubber
b- Nutural rubber
c- Fabric and wires
d- Carbon bluck
e- steel
f- Other chemical compounds

3- The construction of tire is :
a- Radial tire construction utilizes body ply cords extending from the beads and across the tread so that the cords are right angles and parallel to each others, the belts may be cord or steel .
b- Bias tire utilizes body ply cords thay extend diagonally from bead to bead at angles 30 to 40 degrees with successivly plies laid at opposing angles forming crisscross pattern to which the tread is applied.

4- The manufacturing steps are:
a- Mixing of raw materials to form the rubber compound.
b- Each mix is then remilled with additional heating to soften the batch and mix the chemicals.
c- The batch goes through a mixer again, where additional chemicals are added to form what is known as the final mix.
d- Once a batch of rubber has been mixed, it goes through powerful rolling mills that squeeze the batch into thick sheets. These sheets are then used to make the specific parts of the tire.
e- The rolls of sidewall rubber, the books containing tread rubber, and the racks of after the green tire is made, it is put in a mold for curing.
f- The green tire is made; it is put in a mold for curing. Shaped like a clam, the mold contains a large, flexible balloon.
g- Steam is pumped into the balloon, expanding it to shape the tire against the sides of the mold.
h- After cooling, the tire is inflated and tested.

i- **Basic machine tools :**

a- Inner heel building.
b- Heel Rolling – Bonding.
c- Soft Rolling & Tread Rolling.
d- Molding.
e- Curing.
f- X-ray inspection machine.

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