

A Review on Design and Analysis of Tyre Envelope Expander for Tyre Retreading Process

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Abstract: This paper describe the rapid development of tyre retreading process. When the sole portion of a tyre wears out, a fresh sole can be applied on it or the whole tyre up to tread can be changed, this process called retreading process. In retreading process there are many value added process like Inspection, Tread Application, enveloping, curing etc. This Enveloping process consumes more time and more manpower required. To overcome this problem, the new machine (envelope expander) is invented. But this machine has drawback like it expand envelope over it tensile limit which reduce life of envelope. This drawback is direct effect to the retreaded cost of tyre. This review research studies overall cost of retreaded tyre.

Keywords: Retreading, envelope expander, Cold process

1. Introduction

Before starting the paper. It is necessary to know the meaning of „tread“. The grooves which are cut on the tyre surface are called tread. These treads make sure the gripping action between the road surface and tyre. After the use of tyre the depth of treads turn into less and a slippery action takes place between road surface and tyre. Now, here option is available the choice either to change the tyre with a new one which is very costly or to retread the tyre which is less costly as compared to the cost of new tyre. Retreading process can also repair minor cuts so that it can grip firmly the cushion and sole of new tread. The defects on the side walls of tyre, beads and punctures. A tyre can be retreaded or not this is entirely dependable on the type of use of tyre and situation of tyre for ex. car tyres, 2 or 3 times; Light truck tyres 4 to 5 times; Heavy truck tyres 8 to 9 times; Air craft tyres up to 14 times. Retreading process in dividing in to two types.

- Hot retreading
- Cold retreading

1) Methodology of hot retreading process

- Tyre arrives in the Retreading Center, it is cleaned carefully with water so, that dirt as well as dust and mud should all be removed effectively.
- Tyre is left for some time so that it may waterless or a drying device can be used for this purpose.
- Initial examination is carried out to ensure that casing is suitable for retreading process or not. It is

systematically examine inside and outside and marked with yellow colored chalk.

- **Buffing:** The principal objective of buffing is to prepare the worn out tread surface of tyre. The original tread design and the several of the under tread is also removed to provide the casing with necessary dimensions and surface texture. Vulcanized rubber solvent spreads uniformly. Take another dip of solvent if required. After the application of enough solvent a cushioning strip is permanently fixed and tyre is gradually rotated so that whole circumference of tyre is enclosed and uncured tread compound is extruded or applied as a strip of necessary length directly to the casing.
- A tyre is constantly revolving and a painting brush depth in vulcanized rubber solvent is located over the surface of tyre. In this way
- The tyre is located in a mould and air pressure is maintained so that it expands uncured material takes the place of the mould temperature of 150OC the tread and after certain time the mould is opened and tyre is take out from the mould. These mould are used in the production of new tyres. For every size of tyre a new mould is required so it is a costly process and almost outdated now a days.
- A modern approach has been made in this segment since last 20 - 25 years cold process retreading procedure has been becoming more common and efficient due to is low cost, easy handling and more profit margins.

2. Methodology of cold retreading process

- Tyre arrives in the Retreading Center, it is cleaned carefully with water so, that dirt, dust and mud should all be removed successfully.
- Tyre is left for some time so that it may waterless or a drying device can be used for this purpose.
- Initial examination is carried out to ensure that casing is suitable for retreading process or not. It is systematically examine inside and outside and marked with yellow colored chalk.

- *Buffing*: The principal objective of buffing is to prepare the worn out tread surface of tyre to accept a retread. The original tread design and underneath tread is also removed to provide the casing with necessary dimensions and surface texture. The co-efficient of friction of tread surface is increased so that it can hold firmly the cushion and sole of new tread.
- A tyre is constantly rotating and a painting brush depth in vulcanized rubber solvent is located over the surface of tyre. In this way vulcanized rubber solvent spreads uniformly. Take another dip of solvent if required. After the application of enough solvent a cushioning strip is permanently fixed and tyre is gradually rotated so that whole circumference of tyre is enclosed and uncured tread compound is extruded or applied as a strip of necessary length directly to the casing.
- Now tyres are take down from the machines and suspended over supports. The tyre envelope under a cover so that in the premould procedure the uncured cushion has to be vulcanized although pre mould tread has to be kept in position. Tyres from hangers are relocated by hoists and chains positioned in fixed position in horizontal furnace. The pressure nozzle tip is coupled to envelope air pressure is continued and lid of furnace is closed. An on/off switch button is switched on. A temperature of 99OC is0020kept for 3-4 hours. This action makes an adhesive action between vulcanized coating as well as cushion pad and sole of treads. After 4 hours the electricity is stop andlet to cool in the furnace for 1 to 2 hours. The tyre is detached from the furnace and allowed to cool till the worker become able to take out the envelope from tyre.
- *Final inspection*: To make sure that all the imperfections which were allocated before the process have been removed or not. If tyres pass in the final inspection then; they are kept in store room for the requirement of supply.

3. Literature review

I found that very rare researches has been done on tyre retreading and among these papers I describe summary of some certain research paper.

A. Determination of time delay and rate of temperature change during tyre curing (vulcanizing) cycle^[1]

- *Objective*: For superior quality of product and to decrease the cycle time needs fluid flow analysis inside the tyre bladder. How the temperature difference decreases and for searching out the delay time in OTR tyre curing process.
- *Conclusion*: Decrease of delay time will increase product quality as well as it reduces utility cost.

B. Applying a mathematical approach to improve the tire retreading process^[2]

- *Objective*: Examination is executed on database of tyres" exploitation from a company of public passenger transportation. Numerical results are taken as inputs to the proposed model.
- *Conclusion*: Traveling distance is reducing by increase of number of retreading.

If a developed model is applied, it is conceivable to take the right decision for each tire whether to retread it or discard it after it has been worn out.

C. An experimental analysis on life cycle of tyre retreading^[3]

Objective: To examine the life of new and retreaded tyre.

D. Influence of retreaded tyres on vehicle active safety results of steady-state circular tests and severe lane-change manoeuvre^[4]

- *Objective*: Road tests of new and retreaded tyres. Analyzed in the aspect of vehicle active safety. The tests include steady-state circular tests and severe lane-change manoeuvre.
- *Conclusion*: The favorable steer ability characteristics – moderate understeer. With these tyres the driver found it most tough to keep the straight path after completion of the simple lane change manoeuvre. Effect of retreaded tyres on vehicles active safety is noticeable

E. A case study on tyre retreading of s. T. Workshop^[6]

- *Objective*: To study the Tyre retreading process of tyre of ST Buses. It is also establish different defects of tyre, its remedies, and causes.
- *Conclusion*: For VIKRANT tyre, tyre life can be growth up to 74.30% after retreading. For JK tyre tyre life can be growth up to 65.60% after retreading. For CEAT tyre tyre life can be growth up to 23.60% after retreading. For BIRLA tyre tyre life can be growth up to 61.56% after retreading. Retread tyre is not appropriate for costly item`s transportation as well as for lengthy distance travelling due to safety point of view. The cost/km of retreaded tyre is less than new tyre.

4. Conclusion

- In Retreading process number of process are carried out. Each and every process can done efficiently than retread tyre are safe.
- For retreading tyre traveling distance is decreasing by increase of number of retreading.
- First time retreaded tyre life is 70% life compare to new tyre as well as second time retreaded tyre`s life is 40% compare to new tyre.
- Per km Cost of tyre is reduced by using retreaded tyre.
- The retreaded tyre is not used for expensive and precise items.

- Retreaded tyre's strength is depend on number of ply is used. When 2 plies is increased than it breaking energy is increased by 20%.
- Without varying the outer diameter of tyre and by changing, the strength of tyre can be increased,

References

- [1] Mukund Pandya, R N Patel, SKP Amarnath, "Determination of Time Delay and Rate of Temperature Change.
- [2] Košťal P., Krmela J., Frydryšek K., Ružiak, The Chosen Aspects of Materials and Construction
- [3] Jilek P., Šefčík I., Dušák L. Rocking of all-metal Steel Belted Tyres. Procedia Engineering, 2016.
- [4] Krmela J., Drdaková J., Kováč I., Vido P., Pastorek M. Determination of Mooney-Rivlin, Parameters of Rubber Used for Rubberizing of Steel cords as an Input for FEA Models of Tire.
- [5] Krmela J., Krmelová V. Replacement of Belt Structure for FEA of Tire. Procedia Engineering.