Nabel Kadum Abd-Ali. The Effect of Carbon Black on the Mechanical Properties of Sidewall Tyre Rubber. University of Technology. Mechanical Engineering Department. Ph.D. Supervisor: Dr. Husain Jasim Al-Alkawi & Dr.Dhafir Sadeq Al-Fattal. 2013 . 135p.

Abstract:

The sidewall component of a tire is an important part and mounts up to 20 percent of the whole tire by weight. One of the main requirements of the truck tire sidewall are flexing resistance, tensile strength and tear resistance, as well as resistance to weather conditions experienced by tires during use, like exposure to sunlight. Therefore, the requirements and changing circumstances led to develop the design of parts of tires, and sidewall is more susceptible to these conditions, the properties of truck tire sidewall will be studied. It is produced by Al-Dewaniya Tires Factory- Iraq, according to the specifications designed by Italian Perilli Co. for about 30 years ago, which prompted the development of the mechanical and physical properties of those components.

The results of studying the effect of rubber type such as Natural rubber (SVR 05), synthetic rubber (SBR1502) and introduction of a new type of synthetic rubber (BR_{cis}) that filled with carbon black (N550), showed the increase in NR loading and the uses of BR_{cis} were the reason behind the improvements in tensile and tear strength . Also compression set increases with the increase of SBR and decrease of NR and the use of BR_{cis} with different percentages in NR/SBR blend shows improved results. In fatigue test distinguished results were in (40/50/10) and (40/40/20) for (NR/SBR/BR_{cis}) blending and as an optimum properties, the recipes that have (NR/SBR/BR_{cis}) blending with percentage (40/60/0), (40/50/10) and (40/40/20) for truck tire sidewall Compound were the best in comparison with Al-Dewaniyha recipe, the names of these recipes were stock 4, 5 and 6. The tensile

strength improvement percentages are 4.37, 8.08 and 10.72; the tear strength improvement percentages are 15.48, 20 and 18.06; the fatigue life improvement percentages are 14.33, 28.67 and 28.67 for stocks 4, 5 and 6 respectively.

Also, the results of studying the effect of Nano-carbon black particles type such as N550, N326, N330 and N660, explained that N326 and N330 give a greater reinforcing effect, where these grades have improvements in tensile, tear, cure characteristics and crack growth test results. As an optimum properties, the recipes that have (NR/SBR/BR_{cis}) blending with percentage (40/60/0), (40/50/10) and (40/40/20) with N330 were the best in comparison with the Al-Dewaniyha recipe, these recipes were stock 16, 19 and 22. The tensile strength improvement percentages are 26.55, 17.68 and 20.1; the tear strength improvement percentages are 115.16, 115.48 and 108.71; the fatigue life improvement percentages are 100, 128.6 and 85.7 for stocks 16, 19 and 22 respectively.

Finally, for flexing at variable amplitude loading, the results of Paris' law overestimate the experimental life under sequence loading and $\mathbf{Nf}_{Paris}$ is not conservative for all stocks, also Miner's rule did not give acceptable results at variable amplitude loading at both sequences (Low-High) and (High-Low). A safety factor of (2) and (1.5) were suggested in this work to predict safe cumulative fatigue life under (Low-High) sequence using the Paris' law and Miner's rule respectively, while a safety factor of (2.5) and (2) were suggested to predict safe cumulative fatigue life under (High-Low) sequence using the Paris' law and Miner's rule respectively.

KEYWORDS: crack growth, rubber, tyre sidewall, flexing fatigue, Paris law, Miner's Rule.