

Numerical investigation of the effect of tyre inflation pressure on fuel consumption in automobiles

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Abstract

The recent Deregulation of the downstream oil sector in Nigeria has seen a 66.7% increase in petrol cost, this has consequently led to an increase in the overall cost of operating vehicles especially those for commercial purposes. Vehicles tyre pressures have been identified as a key factor in reducing fuel consumption thereby leading to improved operating cost, thus this work aims at studying how the tyre inflation pressure affects the fuel consumption of vehicles and to proffer optimum inflation pressures that will improve the fuel efficiency of the said vehicles. A sample survey of vehicles at a University campus in Nigeria was carried out to ascertain the level of tyre pressures deviation from the recommended values. The survey was then extended to a major commercial transport operator. Based on the results obtained from the survey a three-dimensional Static simulation was carried out using the SolidWorks software to determine the optimal inflation pressure, after which a mathematical model was developed using statistical method (Linear Regression method) with MATLAB to relate the inflation pressure and the fuel consumption. From the survey conducted in the University, only 2 out of the 100 vehicles studied, representing two (2%) conformed to the manufacturer's recommended pressure. The remaining ninety-eight (98) vehicles, representing ninety-eight (98%), deviated from the recommended value. A mathematical model with the modeling equation ($F(p) = 0.02073p^2 - 2.849p + 112$) with a RMSE (Root Mean Square Error) of 0.1166 was obtained, this model is used to predict the amount of fuel consumed and relates the value to the tyre inflation pressure. Validation of the model was obtained using the cross-validation technique and by comparism with other published literature. Results from the static simulation and design studies shows that the recommended tyre pressure is optimal pressure which improves fuel efficiency.

Keywords: Tyre inflation pressure, static simulation, fuel consumption, road surface, solid works

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