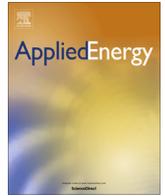




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Effects of resistive loads and tire inflation pressure on tire power losses and CO₂ emissions in real-world conditions [☆]

Naser Sina ^{a,b}, Sayyad Nasiri ^{b,*}, Vahid Karkhaneh ^b

^a Department of Mechanical Engineering, K.N. Toosi University of Technology, Tehran 19396-1999, Iran

^b Research and Applied Division of Automotive, Sharif University of Technology, Tehran 11365-11155, Iran

HIGHLIGHTS

- Study of tire power losses due to rolling resistance and slip is performed.
- Test conditions are chosen to comprise the change of resistive loads.
- Slip power loss is the determining factor when tractive force is significant.
- In some cases the minimum tire power loss obtained when the tire is under inflated.
- The variations of the tire power losses and CO₂ emissions are similar.

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ABSTRACT

Considerable portion of energy losses in a vehicle traced to tire. Energy losses in a tire are due to tire longitudinal slip as well as rolling resistance. Hence, both of aforementioned factors must take into the consideration to study the tire energy loss. Present paper aims to investigate the power losses in tires and to examine influence of road conditions and tire inflation pressure on them. To cover the real-world conditions, experiments were done on a gasoline-fueled passenger vehicle on an urban highway along two routes with same length and opposite gradients to comprise the change of road conditions. Then, by use of engine performance model which is prepared in dynamometer laboratory, the power losses in drive and driven wheels are conducted separately. According to the results, either in driven wheels or when cruising in negative gradient, the power loss due to rolling resistance is primary and as a result the tire power losses would be decreased as inflation pressure increases. But when the tractive force is significant, for instance in positive gradient, the role of slip power loss becomes substantial in drive wheels so that the sum of rolling resistance and tire slip losses must be evaluated. Results show that in positive gradient, the least tire power losses in drive wheels would be obtained when the tire is under inflated. In addition, CO₂ emissions during the tests obtained and it is seen that a reduction in tire power losses leads to decrease of CO₂ emissions.

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1. Introduction

More than 50% of petroleum productions used in transport sector in 2011, according to IEA¹ statistics [1]. Furthermore, the largest share of energy use within the transport sector comes from road transport and as it shown in Fig. 1, the share of road transport was

nearly constant during last decades. Therefore energy efficiency in vehicles is an important factor to global energy use.

In a vehicle, driving resistance can be categorized as: tire resistance, air drag, gradient resistance, and acceleration resistance. More resistance leads to reduce efficiency and increase energy consumption as well. Also, tire as the final element of the powertrain is the part which tractive force and relevant torque is applied to. Hence, tires play a crucial role in the energy efficiency and fuel consumption of a vehicle as well as other characteristics such as ride comfort, stability, acceleration, braking, and handling. Power loss in tires can be listed as rolling resistance losses and losses due to tire slip. When the subjective of a study is to perform energy

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* Corresponding author.

E-mail address: Nasiri@sharif.edu (S. Nasiri).

¹ International Energy Agency.

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