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TYRE ROLLING RESISTANCE FROM TYRE HYSTERESIS AND DIMENSIONS

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Rolling resistance of tyre is dependent both on tyre dimensions and compound characteristics such as hysteresis. Separate equations have been developed to correlate the above factors with tyre rolling resistance. This paper establishes a one to one correspondence between the rolling resistance equation in terms of whole tyre hysteresis ratio and the equation in terms of tyre dimensions. The two expressions have been successfully tested for a wide range of tyres. The excellent correspondence of these data indicates the generality of the concept.

Key words : Natural rubber, Tyre rolling resistance, Hysteresis, Aspect ratio.

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INTRODUCTION

Rolling resistance of tyre is a property of interest of tyre and automotive industries because of fuel efficiency requirements and environmental considerations. Hence, in the last few years, extensive research has been conducted on this topic covering different aspects like tyre material properties, tyre construction, test methods, empirical modeling etc. Schuring (1980) and Schuring and Futamura (1990) published comprehensive review articles.

The present paper combines two rolling resistance equations developed earlier by Pillai and Fielding-Russell from different approaches and explores the correspondence between the two.

Empirical approach

Pillai and Fielding-Russell (1991) first developed an empirical relation for tyre rolling resistance F_R in terms of tyre dimensions and viscoelastic property as

$$F_R = \frac{K\ W a}{\tau^{1/3}\ (2r\text{-}s)} \qquad (1)$$

where K, W, a, r, and s are constants including the viscoelastic property, section width, aspect ratio, tyre diameter and wheel diameter, respectively. The authors showed from equation (1) that F_R increased or decreased or remained constant depending on how the aspect ratio change was accomplished, viz., by changing section height, section width and/or wheel diameter.

Energy balance method

It is known that a rolling tyre dissipates energy. Therefore, to maintain a tyre at constant speed, an amount of work equal to the quantity dissipated should be sup-

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