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HYSTERESIS RATIO METHOD TO ASSESS THE CONTRIBUTION OF TYRE COMPONENTS TO ROLLING RESISTANCE

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The hysteresis ratio values of the belt, tread and the carcass sections, cut from three P195/75R14 size tyres of different construction were determined. The fractional contribution of each component to the tyre structural hysteresis ratio at zero inflation pressure was estimated using the respective component volume fraction. The sum of the fractional hysteresis contributions of each tyre component agreed with its structural hysteresis ratio determined independently. The contribution of the belt package was approximately 10 per cent irrespective of tyre construction. The contribution of tread ranged between 25 and 50 per cent and that of carcass, about 30 to 55 per cent depending on the tyre construction.

Key words : Belt package, Carcass, Hysteresis ratio, Tread, Tyre rolling resistance.

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INTRODUCTION

The contributions of the tyre components like tread, belt package and carcass to total tyre rolling resistance are of special interest to tyre design engineers. Clark and Schuring (1988) estimated the contributions by numerical thermal modelling method. Collins *et al.* (1965), Willett (1973) and Elliott *et al.* (1971) experimentally measured the contributions of different components to the tyre energy loss using the viscoelastic modulus values and the stress-strain cycles of tyre components.

$$F_R = h \cdot W \cdot d \cdot w / A \quad ....(1)$$

where W, d, w and A are tyre load, tyre deflection, footprint width and area respectively. Here the term 'h' is defined as the fraction of the energy lost to the total energy input into the tyre as the footprint goes through a loading/unloading cycle and is a dimensionless number.

Equation (1) has been related to the aspect ratio and tyre dimensions and applied to examine the effect of change of aspect ratio on rolling resistance (Pillai and Fielding-Russel, 1991; Pillai, 1993). One to one correspondence between h and F_R has been experimentally established earlier (Pillai, 1995). Pillai (2000) combined the whole tyre hysteresis ratio model with tyre as a spring model and showed that the hysteresis ratio h, tyre stiffness K and footprint dimensions w and A are the primary factors that affect rolling resistance.

If the hysteresis ratio of the physical structure of the tyre at zero inflation is h(0), then the h value of an inflated tyre can be taken as h(0) modified by the contained air pressure. The h(0) of the tyre structure itself is a parameter combining the effect of the tyre material hysteresis values and design