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STUDY OF INFLUENTIAL FACTORS ON COEFFICIENT OF FRICTION BETWEEN TYRE AND ROAD INTERFACE

GOPALAREDDY[*], Dr. K. M JAGADEESHA [1]

[*]Assistant Professors, Mechanical Engineering Department, Cauvery institute of technology, Mandya, Karnataka, INDIA

[1] Professor, Automobile Engineering Department, PES College of Engineering, Mandya, Karnataka, INDIA.

Email: [*]gopalreddykonkal@gmail.com, [1] kmjagadeeshmys@gmail.com

Abstract

One of the basic safety requirements on roadways is the skid resistance. It plays major role particularly during wet and rainy conditions. Friction on pavement surface plays an important role in keeping a vehicle safe on the road surface. It can dramatically influence braking distance and on acceleration with safety. Recent statistics show that a large number of traffic accidents occur due to a loss of control on vehicle by the driver. This is mainly due to a loss of friction between tyre and road. Friction (coefficient of friction) which is a parameter of tyre/road interaction, mainly depends on the state of the road (dry, wet, snow, ice) and is closely related to the tyre parameters (inflations pressure and tread depth).

In this paper, much concentration has been accorded towards the study the factors influence on co-efficeint of adhession between tyre and raod inter face, with the help of flat bed tyre testing machine and by numerical methods, the co efficient of adhesion has been examined on different road conditions by varying the inflation pressure, vertical load on tyres.

***Keywords**:* coefficeint of friction, pavement surface

1. Introduction

Since vehicle tyres are the only part that vehicle body maintains contact with the road, information about the tyre-road friction is critical to vehicle’s longitudinal, lateral and roll dynamics and control. Particularly, for Acceleration, braking and stability of the vehicle.

Due to the difficulties in directly measuring the tyre-road friction coefficient, in recent years some studies focused on the estimation of tyre-road friction coefficient based on pavement surface, tyre parameters and load on tyres. Friction is an important road parameter that unfortunately is very

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difficult to measure. The devices used for friction measurement are not very complicated but the friction forces they try to measure are very sensitive to a number of parameters that are difficult to control. The most important factors that affect the friction coefficient are: Road surface, Tyre factors, Weather conditions, Vehicle speed and Wheel slip and drift angle.

In a friction measurement there are often three bodies involved, the measuring tyre, the road surface and some kind of contaminant interacting with both tyre and road like for example water (wet friction), dust or wear particles etc. The friction values measured depend to a great extent on all three bodies, their material properties, the local contact pressures, relative velocities etc. of the road parameters, the texture is the most important and the influence of macro texture has also gained most interest in road friction research. A large number of friction measurement devices are used in different universities or in different countries, but generally the situation is the same with a variety of different devices in different countries but in this paper Flat bed tyre testing machine is used to study coefficient of friction.

2. Experimentation details

As we discussed earlier, there are so many expermentle methods used to measure the coeffiecient of friction between the tyre and surfaces in dfferent countrys or in different univrsitys. In our work we used flat bed type tyre testing machine.

Fig.1.Flat bed tyre testing machine

The coefficient of friction can be measured with principle that whenever a load applied on the moving vehicle the frictional force will act in the opposite direction of the motion. In actual case

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friction is created between wheel tyre and road, where road is stationary member and tyre is rotating. But in our project to make fabrication simple we made tyre as stationary member and model of the surface as moving member.

Using nut and screw mechanism tyre will be vertically loaded on the both the sides and this load will be considered as normal load and it will read directly with the help of the "S" transducers. A pulley is fixed to the foundation by means of bolts and nuts. This carries a steel thread in its grooves for the purpose of loading. The thread is connected to a hook which is welded to the box and dead weights are added to this thread. These weights will be considered as frictional force.

According to coulomb's frictional law

$$\mu = \frac{F_T}{F_W} \quad (1)$$

Where μ= coefficient of road friction.

F_T= Frictional force.

F_W= Normal load.

By this we are going to measure the co-efficient of road adhesion.

The set up available in the laboratory is to measure the co-efficient of friction of motor-cycle tyres. Also provisions are made to measure the vertical load directly with help of S" transducers and digital indicator.

Main component of this set are

1. Fixture
2. Loading arrangement – "S" type transducer with digital indicator.
3. Boxes for different road surfaces.
4. Side plate.
5. Pulley.

i. Loading arrangement.

By using this we can find how much load is applied on wheel assembly. This is done by, strain gauge is connected to each side plate as shown the Fig.6.1 then we apply the load by screw lever mechanism on tyre. This load is measured by strain gauge and we can read it directly on digital indicator.

ii. Boxes for different road surfaces.

Three boxes are made for different road surfaces such as mud, cement, tar. The wheel assembly placed on the box and it is loaded in straight position without any deflection. The box at front side consists of hook which is welded to it for the purpose of loading. The box move slides in base with helps steel balls placed which underneath oh the box.

iii. Base plate.

This is a plate made up of metal, on which four steel balls are placed. On this the box containing road surface moves forward when it is loaded. The base plate is fixed to foundation.

Using nut and screw mechanism tyre will be vertically loaded and this load will be considered as vertical or normal load and dead weights which are added to the wire string will be considered as frictional force. The vertical load will be directly read on "S" transducer digital indicator and frictional force is read from knowing how much dead weight load is added.

3. Results and discussions:

i. Effect of vetical load on co efficient of adhesion

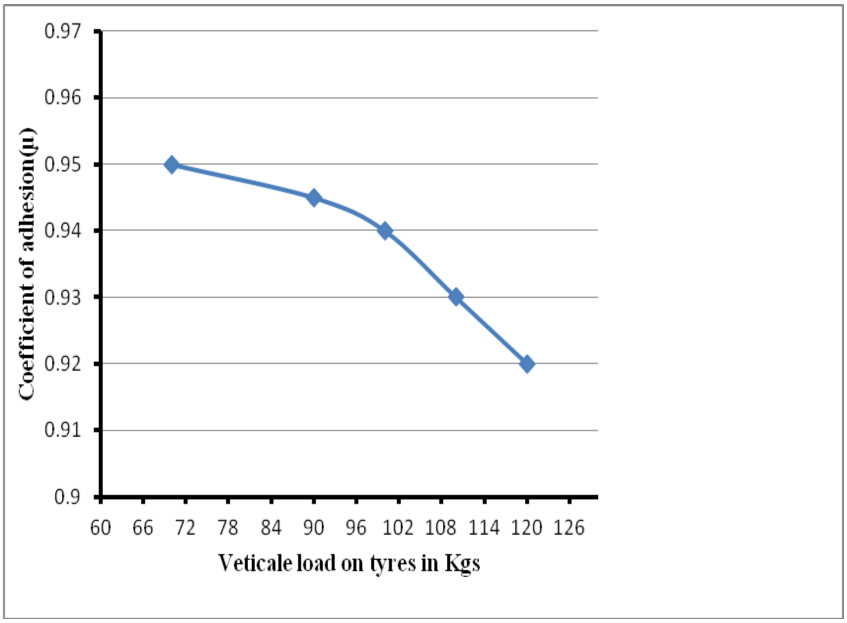

Fig.2. Variation of co efficient of adhesion v/s vertical load.

From fig.2, it is clear that increasing the vertical load on tyres results in decreasing co efficient of adhesion of different vehicles tyres. The vertical load on the tyre of different vehicles applied gradually from 70 to 120kgs.

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ii .Effect of surface condition on co efficient of adhesion:

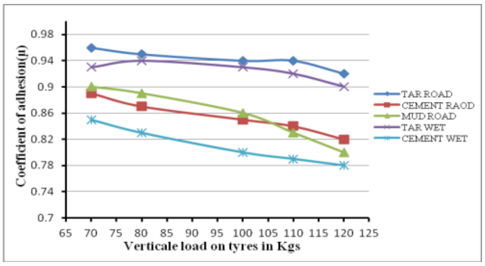

Fig.3.Variasion of co efficient of adhesion v/s Vertical load on different surface conditions

From fig.3. It is clear that the co efficient of adhesion of tyres varies on different surface conditions. The tar road dry surface has maximum co efficient of adhesion and cement wet road has least co efficient of adhesion.

iii .Effect of tyre inflation pressure on co efficient of adhesion

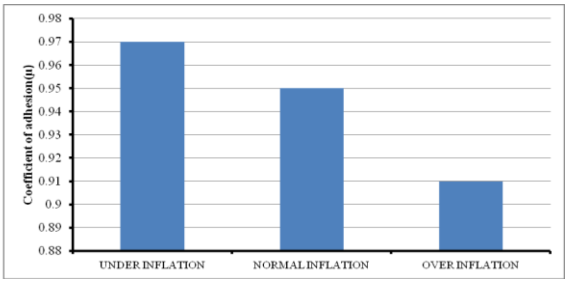

Fig.4.Variasion of co efficient of adhesion v/s different tyre inflation conditions

From fig.4. It is clear that the co efficient of adhesion of different vehicles tyres varies under the inflation conditions. Under inflation tyre has maximum co efficient of adhesion than over and perfect inflation tyres and over inflation has less co efficient of adhesion.

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4. Conclusion

Following conclusion are drawn from the investigation of present work

1. Increasing the vertical load on tyres results in decreasing co efficient of adhesion of different vehicles tyres.
2. The co efficient of adhesion of tyres varies under the inflation conditions. Under inflation tyre has maximum co efficient of adhesion than over and perfect inflation tyres and over inflation tyre has less co efficient of adhesion.
3. Surface conditions makes very large difference in variation in co efficient of adhesion, the tar road dry surface has maximum co efficient of adhesion and cement wet road has least co efficient of adhesion.

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