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METHODOLOGY OF IMPROVEMENT OF ADHESION COEFFICIENT OF AUTOMOBILE TIRES

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Abstract
In this article, improving the expertise of traffic accidents based on the study of the braking process of motor vehicles Methodology and research methods are presented through theoretical studies based on the theory of car movement, experimental studies of the car braking process in different operating conditions, taking into account the structural characteristics of the car wheel.

Keywords: Transport, friction force, movement, brake, process, basis, car, truck.

Introduction

In most cases, traffic accidents are accompanied by the process of car braking, so it seems that the study of this issue is very important in the science of traffic accident investigation. The study of the car braking process is based on its definition, which depends on the coefficient of deceleration clutch and is carried out according to the simplest physical laws [2]. The grip quality of the road mainly depends on a number of factors that have nothing to do with the level of roughness and moisture (pollution), the car with the same qualities and the quality of the applied coating, in particular, the state of contact with the surface of the car wheel (the tread of his tire is important) geometric tread pattern etc.), its level inflation and its characteristics (diameter, profile height tire sidewall, etc.), wheel load (changes during braking due to redistribution of forces. The ability of the surface to perceive tangential forces when the loads acting vertically on the vehicle wheel interact with the corresponding surfaces is usually evaluated by the adhesion coefficient m. This ratio is the ratio of the maximum tangential reaction in the zone to the normal reaction Ni acting on the wheel

$$\mu = \frac{T_{max}}{N_i}$$

1) Friction coefficient at rest, which characterizes the wheel's sliding rotation
2) Coefficient of friction, which describes when the wheel turns
3) Coefficient of adhesion in the transverse movement of the object [3].

It is known that in contact with a pneumatic wheel, significant tangential forces arise due to tire deformation. These forces are directed from the edges to the center of contact. External forces applied to the wheel cause a change in the magnitude and direction of the tangential forces in contact. The nature of the distribution of the latter differs from the nature of the distribution of specific pressures. Therefore, in the contact zones where the tangential forces are relatively large and the specific pressure is small, the tread elements are most prone to slip relative to the road during wheel rotation [3].

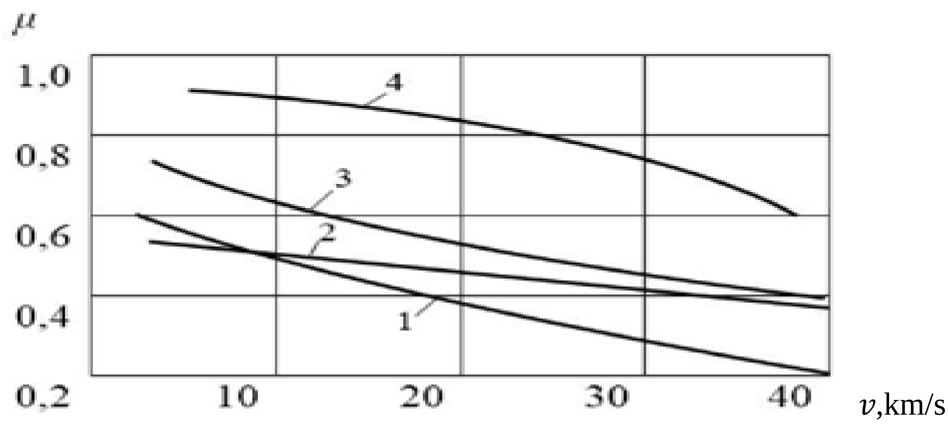
It is known that during the movement of the wheel with a relatively small value of external tangential forces, the sliding of the tire tread elements is observed only near the contact contour line, and in the rest, they are motionless relative to the road. As can be seen from the above, even when the driven wheel moves in the direction of the plane of rotation, the coefficient of rest adhesion should be taken into account only conditionally, in its pure form it can be obtained only for a stationary wheel. It is usually slightly higher than the coefficients of friction for sliding and lateral sliding. Most of the experimental data on friction coefficients correspond to wheel displacement [4].

The handling of the wheels is characterized by many parameters, for example, the type and condition of the road, design features and material of the tire, internal pressure in it, speed of movement, load. on the wheel, such as temperature conditions on the friction surfaces individually, in particular, on the total heat output during friction, as well as on the slip or slip ratio of the wheel. There is a lot of work on the adhesion of wheels to a supporting surface, but even so, the effect of each of these parameters on the adhesion coefficient is little studied. Therefore, in many published works, only average values of friction coefficients are given. Also, friction coefficient values change as tires and roads improve and need to be updated regularly.

Not all of the above parameters have the same effect on wheel grip. The type and condition of the road surface, the speed of movement, the value of the specific pressures and the shear stresses in the contact have the most effective effect on the adhesion coefficient. The value of the friction coefficient directly depends on the type and condition of the road surface, and its values vary in a very wide range. This change is not related to the type of coverage, but to the condition of the coverage. When the wheel interacts with the hard surface of the road, the tread has much greater loads than the rubber covering material. At the same time, hard protrusions of the road, “digging” into the supporting surface of the tire, increase the grip of the wheel on the road. On wet and muddy surfaces, moisture or a film will significantly reduce the depth of the road voids in the tread rubber, which will reduce the adhesion coefficient. In addition, its value is the smaller the moisture layer between the tire and the road, the thicker it is [3].

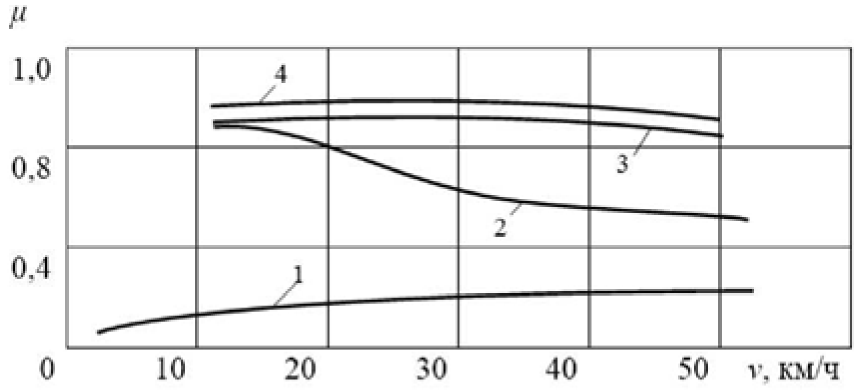
The adhesion coefficient for the same tire on different wet surfaces (asphalt, gravel road, tree stump, dirt road) has almost the same value and is mainly due to the hydromechanical properties of the liquid film between the tire and the supporting surface is determined by and to a lesser extent than on dry roads, depending on the type of surface. It should be noted that the coefficient of viscosity in dry asphalt concrete at high ambient temperatures (15-40 °C) can reach 1.1-1.2. This happens due to the "sticking" of the tread elements to the road surface during intensive braking due to the high temperature in the contact zone. A decrease in the adhesion coefficient with an increase in the speed of movement mainly occurs when the wheel slips or skids. Some exceptions are ice surfaces, where the viscosity increases with increasing speed. Many researchers say that on wet roads, with an increase in speed, there is a sharp decrease in the viscosity coefficient than on dry roads. In 1941, M.S. Zamakhayev summarizing the experience of a number of researchers, came to the conclusion that on wet roads, regardless of the place and methodology of the experiment, with an increase in speed, the coefficient of friction decreases intensively by 0.2 [4].

The dependence of the friction coefficient on the wheel speed on dry hard roads obtained by the German researcher Jante in 1953 is shown in the graph The graphs above show that the coefficient of friction on dry roads changes much less with increasing speed than on wet roads. The decrease in the friction coefficient with the increase in speed can be explained by the elastic-viscous deformations of the tread rubber. Since the progression of these deformations depends on time, at high speeds the tread does not have time to fully deal with the unevenness of the road surface. In addition, with an increase in speed, it becomes difficult for the tire elements in contact to "squeeze" moisture from the road surface. Thus the coefficient of adhesion. As the speed increases, the dynamic strength of the liquid film increases, so it becomes more difficult to break it and remove it from the contacting surfaces



Tests on dry coating; 2 and 4 - English language tests in wet concrete; 3 - tests on wet concrete

Fig.1. A graph of the coefficient of friction against speedwheel movement is as follows



Car speed

Fig. 2. A graph of the coefficient of friction against speed

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Wheel movement:[5]
1 - along the ice sheet; 2 - on a wet surface; 3 and 4 - dry clean surface.
From this point of view, it is especially interesting to try to theoretically solve the problem of the interaction (adhesion) of the tire with a solid body.
a surface covered with a viscous liquid layer was created by M. G. Becker [4]. If we assume that the tire tread is in contact with a solid road covered with a viscous liquid layer of thickness h, the rate of tire immersion in liquid m depends on a number of factors (wheel load G, liquid). layer thickness h, tooth width 2l and fluid viscosity η).

$$v = \frac{G \cdot h^3}{4 \cdot \eta \cdot l^3} \qquad [6]$$

It follows from this formula that the speed at which the tire tread reaches the hard road surface is inversely related to the viscosity of the liquid and even more so to the width of the tread. In turn, the viscosity of the liquid covering the road depends on the time spent on the road. With recent rainfall, the road surface is covered with a transparent, low-viscosity water film. Therefore, water is easily squeezed out of the contact zone by the tire tread elements. If the road is wet with water for a long time, when it is mixed with dust, a liquid with high viscosity is formed, which reduces the speed at which the tire m “dips” into it.. Load on the wheel G has a positive effect on affects the speed at which "dry" friction conditions are reached.
At the same time, under the considered conditions, the main influence on the interaction of the wheel with the supporting surface is the width of the dictionary 21. With its large width, the extrusion speed of the film is so small that only a light car speed. ensuring no slipping and sliding.
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According to Prof. R. A. Meyer, the adhesion coefficient at a speed of 10 km/h decreases from 0.7-0.8 to 0.4 at a speed of 65 km/h on a clean wet cement-concrete pavement. With an increase in speed to 65-80 km / h on a dry road, the coefficient of friction decreases by only 0.1.[7]
E. A. Chudakov studied the coefficient of friction during the lateral movement of the wheel at low speed. They showed that during the start of the movement, the sliding of the tread elements in contact occurs at different times. Then, as the lateral movement of the wheel increases, the number of sliding elements simultaneously increases, and all the tread elements in contact will

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slide simultaneously. Increasing the number of sliding elements at the same time increases and eventually all tread elements in contact will slide simultaneously. An increase in the number of simultaneously sliding elements in contact leads to a slight increase in the friction coefficient. Its growth is observed only on a dry surface and at very small limits of the change of sliding speed. With further increase in this speed, it remains approximately constant if the tires are not fully locked, and decreases when it is fully locked.

I. V. Kragelsky, based on the molecular-mechanical theory of friction, proposed the following formula for determining the sliding friction coefficient of two solid bodies

$\mu=(a+b+v)e^{-ev}+d$

where m is the coefficient of sliding friction;

v - sliding speed;

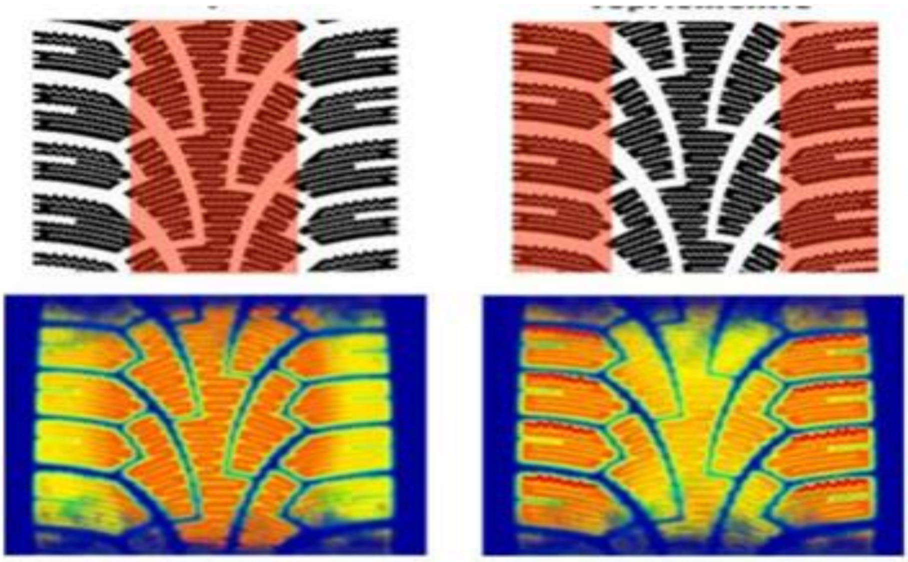
a, b, c and d are some parameters.[8]

From the consideration of this formula, it follows that with increasing speed, the value of the friction coefficient exceeds the maximum.

S. M. Zuckerberg, based on the experimental data he received, it is necessary to determine the coefficient of adhesion when moving a tire on dry fine-grained asphalt, the following relations are used:

$$\mu=(a+0{,}1\cdot v)\cdot e^{-c\cdot v}+\frac{1}{v^2+25}+m,$$

Where m is constant. This formula allows taking into account the elasticity of one of the interacting surfaces [8].



a) when moving b) when braking

Fig. Analysis of pressure distribution in the contact patch during acceleration and braking [9].

Summary

Currently, the following friction coefficients are distinguished: coefficient of adhesion at rest, coefficient of adhesion during sliding or sliding; coefficient of adhesion during lateral movement of the wheel, their differences and very little attention has been paid to the mechanics of formation in the interaction of the tire with the supporting surface. In addition, the adhesion of the wheels to the support surface depends on a large number of different parameters and effects It became possible to study and solve the important scientific-practical task of increasing the effectiveness of the rules, methods and mathematical models proposed on the basis of theoretical research.

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