ANALYSIS OF THE INFLUENCE OF THE COEFFICIENT OF FRICTION BETWEEN WHEEL AND PAVEMENT ON ASPHALT CONCRETE ROADS ON TRAFFIC SAFETY

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Abstract. *This article examines the primary factor affecting traffic safety in the interaction between vehicle wheels and the road surface, which depends on weather conditions, the quality of the pavement material, and the composition of asphalt concrete. Standards are used to determine the coefficient of friction.*

Keywords: *automobile wheels, traffic safety, weather conditions, asphalt concrete composition, coefficient of friction, dry and wet conditions.*

Introduction

In our republic, large-scale measures are being implemented to increase the service life of highways, improve their operational indicators, and develop and implement new technologies that serve to increase the efficiency of repair processes established by current standards. The New Uzbekistan Development Strategy for 2022-2026 defines tasks, including "Improving road infrastructure and accelerating the development of the road network". Currently, global climate warming, in particular, the increase in air temperature in recent years, exacerbates the problem of plastic deformation of asphalt concrete pavements. Also, one of the urgent problems is the assessment of traffic safety on highways as a result of changes in wheel track deformations on asphalt concrete pavements under the influence of natural and climatic factors, the strength of the pavement, the coefficient of adhesion on the pavement surface, and the smoothness of the pavement.

The construction and operation of asphalt concrete pavements on highways requires an approach in accordance with the requirements of SHNK-2.05.02-07, SHNK 3.06.03-08, and KMK 3.06.03-96. Taking the above into account, the issues of improving traffic safety in the territory of "Tashkent Avenue," which passes along the M-39 highway of international importance, were thoroughly analyzed. In this area, the high density of traffic flow, high traffic speeds, and the high level of interaction between pedestrians and vehicles were assessed as the main factors increasing the risk of road accidents.

The main goal of the research was to assess the anti-slip properties of the road surface by determining the adhesion coefficient and, on this basis, to scientifically substantiate the level of traffic safety. For this purpose, one of the modern measurement methods widely used in determining the technical and operational condition of road surfaces - the Cooper Pendulum Skid Resistance Tester (CRT pendulum) device - was used. Measurements were carried out on various sections of the road surface using the CRT pendulum device, taking into account real operating conditions. During the measurement process, micro- and macro-irregularities of the coating surface, properties of friction in dry and wet states were determined, and quantitative values of the adhesion coefficient were recorded. The obtained results were compared with the requirements of

current regulatory and technical documents, and the level of road surface traffic safety was assessed.

The analysis results showed that a decrease in the clutch coefficient leads to an increase in the braking distance of vehicles, a decrease in control stability, and an increase in the probability of road accidents, especially in humid conditions. Therefore, it is important to constantly monitor this indicator and take timely engineering and technical measures in cases of deviation from the established norms. The texture of the road surface characterizes such factors as the noise level caused by the interaction between the tire of the car wheel and the pavement, the comfort of the seats inside the vehicle, the quality of adhesion, resistance to sliding, and tire wear.

One of the factors that significantly affects traffic safety on highways is the adhesion quality of the pavement surface. According to the analysis of statistics of road traffic accidents (RTA) caused by road conditions, failure to ensure the quality of adhesion leads to the occurrence of up to 40% (RTA) [1]. This indicator is an important property of the pavement surface, reflecting the interaction of the vehicle with the pavement surface. Because the clutch force ensures the safe deceleration and stopping of the car. The adhesion force formed in the contact zone between the tire and the surface of the coating is called sliding resistance.

The texture of the pavement surface is one of the most important transport and operational indicators of the road, causing vehicle wheel adhesion to the pavement. The textures and frequencies of various pavement surfaces by the World Road Association are presented in Table 1.1 (Descornet 1990).

1.1- schedule

Lining surface properties	**Frequency range**	
	Wavelength	**Wave frequency (cycles/m)**
Microtexture	<0.5 mm	>2.000
Microtexture	0.5-50 mm	20-2.000
Microtexture	50-500 mm	2-20
Smoothness	0.5-50 m	0.02-2



Figure 1. View of the texture of the road surface (asphalt concrete)

Quality of road surface adhesion. The quality of road surface adhesion is an important indicator affecting the safety of vehicle traffic. In the Republic of Uzbekistan, the quality of adhesion is assessed by the magnitude of the adhesion coefficient. The coefficient of adhesion is

understood as the ratio of the maximum shear stress acting along the road in the contact area of the road surface with the blocked wheel to the normal reaction in the contact area of the wheel and the pavement.

$$\varphi_x = \frac{R_{x\,max}}{R_z} = \frac{P_{tis}}{R_z} \qquad (1)$$

When determining the driving mode of a car moving in traction mode, it is necessary to find the maximum value of the horizontal reaction, equal to the force of adhesion of the wheel to the road. The ratio between the force of adhesion in a moving wheel and the vertical reaction is called the coefficient of longitudinal adhesion of the tire to the road and is denoted by. Fig. 2 shows a diagram of the forces acting on the driving wheel of a car moving uniformly on a hard surface. In this case, the vehicle wheel is subjected to vertical loads, vertical reactions, pushing forces, and resistance forces to oscillations directed opposite to the pushing force.

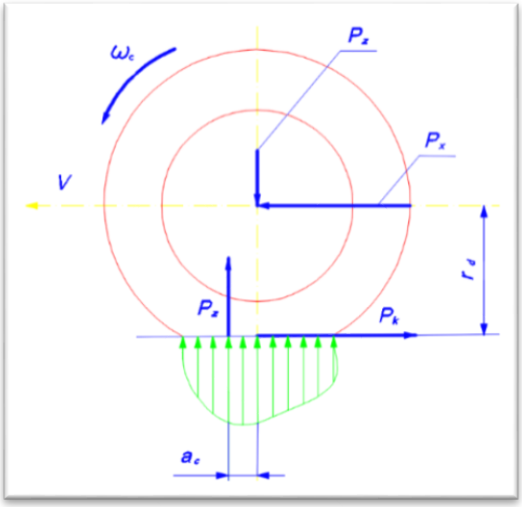


Figure 2. Diagram of forces during the movement of a car wheel

The value of the coupling coefficient depends on many factors. Its value is affected by:

- coating roughness;
- speed of the measuring device;
- complete or partial wheel blockage;
- contamination of the coating;
- air temperature, etc.

As a study, the adhesion quality of the road surface of the Tashkent highway of the international highway M-39 was determined using a British pendulum. "Cooper Pendulum Skid Resistance tester CRT pendulum" is a device that measures the coefficient of adhesion of road surfaces and is considered a leader in this field. Manufactured in the British Kingdom. The mechanical device is designed to determine the coefficient of adhesion of road surfaces not only in a dry state, but also in a wet state. This device is very easy to use and has high accuracy compared to other methods for determining the coefficient of adhesion of road surfaces. The "Cooper Pendulum Skid Tester" device was first improved in 1960 in the United Kingdom's transport exploration laboratory to determine the coefficient of adhesion of road surfaces. The device is designed for engineers to assess the coefficient of adhesion of the surface of the pavement in laboratory and real conditions in wet and dry conditions.

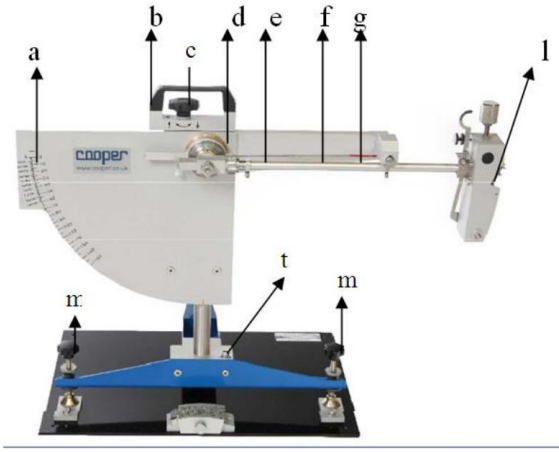


Figure 3. The main components of the device are:

a) counting system;

b) handle;

c) pendulum lowering-lifting screw;

d) needle securing-releasing screw;

e) lever;

f) needle;

g) needle tip;

l) rubber sample tested for friction and wear;

m) auxiliary screws (used to ensure the device stays level on the surface using a circular needle);

n) circular needle.

As a result of the conducted research, the coefficient of adhesion of the road surface was determined using the "Cooper Pendulum Skid Tester" device on the 23-24 km section of Tashkent Avenue, which passes along the M39 international highway. The measurement results are presented in the following graph (Fig. 4). The following reduction formulas were used to determine the coefficient of adhesion of the road surface. Formula for the coefficient of adhesion for 50 km/h

PSV=S+52.2-C

here. C - the average value of the obtained 4 test results, C - the average value of the obtained 4 test results. The values in Table 1.2 are used, which are evaluated by the coefficient of adhesion of dangerous sections of the highway.

1.2-table

Adhesion coefficient:	PSV≤50	50≤ PSV≤65	PSV≥65
Permissible lane markings	unsatisfactory	good	excellent

Formula for the coefficient of adhesion for 60 km/h

FR60=FRS*exp (60-S/Sp)

FRS - the average value of the results of 4 tests obtained

exp - constant value

S - 10 km/h for the Cooper Pendulum Skid Tester device Sp - car speed

For a speed of 60 km/h, the constant minimum value of the adhesion coefficient should not be less than 50.

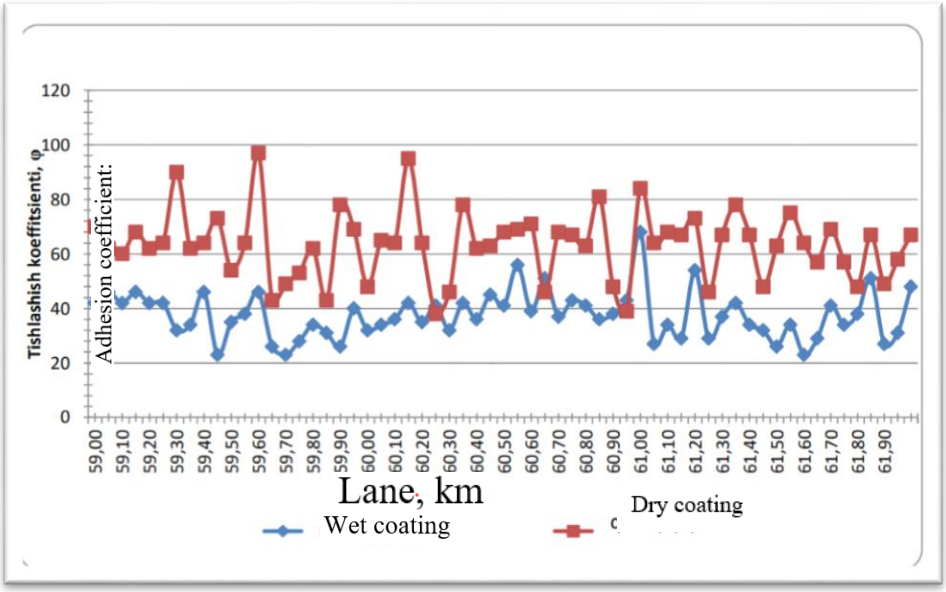


Figure 4. Change in the coefficient of adhesion of the road surface depending on the condition of the surface of the pavement.

From the analysis of the results of the study of the adhesion coefficient of the pavement of sections 23 - 24 km of Tashkent Avenue, passing along the international highway "M39," the following conclusions are drawn:

Conclusion

Based on the analysis of the conducted research and measurement results, it can be concluded that the adhesion properties of the road surface on some sections of Tashkent Avenue between 23-24 km, passing along the M-39 highway of international importance, do not meet the level of current regulatory requirements. This situation is explained by the insufficient timely maintenance and repair of the road surface. In particular, on sections from 23+10 km to 24+10 km, as well as at points 23+60, 23+75, 23+80, 23+90, 24+00, 24+10, and 24+20 km, a decrease in the adhesion coefficient was revealed, and it was noted that these sections have reached an unsatisfactory state. This reduces the interaction of vehicles with the road, decreases the speed of movement, limits the possibilities of ensuring traffic safety, and increases the probability of road accidents.

At the same time, it was established that the clutch coefficient on the remaining sections of the road studied within the framework of the study meets the normative values, and it was determined that safe movement of vehicles at specified speeds can be ensured on these sections. To increase the surface roughness of the coating, it is recommended to use modern technological machines for synchronous material distribution (Chipsiler 19, C hipseler 26, Chipseler 32, Chipseler 40 and Regis 19, Regis 26), manufactured in France. Timely implementation of repair and maintenance work on highways leads to an increase in the service life of roads, ensures traffic safety, and reduces costs.

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