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# THE IMPORTANCE OF ANTI-SLIP TECHNOLOGICAL MATERIALS IN THE WINTER SEASON

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**Abstract**
*This article examines the importance of technological materials in combating slippage on highways in the winter season.*

**Key words**
*Snow-ice, sand, cohesion coefficient, road.*

Spraying of technological materials in the fight against freezing after snowfall in winter depends on geographical, climatic and ecological factors. The purpose of the use of technological materials is to prevent winter slippage, and on this basis, an accurate meteorological forecast, especially about precipitation, is important.

To prevent freezing, data from meteorological observation stations that measure air temperature, road surface temperature and humidity, and monitor the road network are used. Preparedness for pre-treatment of road surfaces with technological materials in case of danger of frost formation or other types of winter slippery conditions is announced. Due to the danger of icing and the negative perception of the use of technological materials by road users, it is important to know how accurate the forecasts of ice formation are by meteorological observation stations on the road network.

Reasonable use of technological materials and properly directed measures help to reduce the number of traffic accidents. The fight against winter slippage, first of all, in areas where dangerous and emergency situations are likely to occur: steep ascents and descents, inside residential areas, small radius turns, hard-to-see road areas, bus stops , should be carried out at intersections, artificial structures, approaching them and other places where sudden braking may be required.

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In mountainous areas, the fight against winter slippage should begin with steep, long uphill road sections. Special attention should be paid to external curves in the plan located on the windward side of the mountain ridge, which is the northern direction of the mountain slopes, as well as to junctions and intersections of mountain roads and artificial structures on them (bridges, avalanche galleries, reserves). (walls etc.) [16 ].

The following technological material is used to combat winter slippage:

Sand is used to increase the coefficient of adhesion of car tires to the road surface (Table 1).

Table 1

| Coating condition | Brake distance, m | Shortening the braking distance compared to the icy road |
|---|---|---|
| Icy road (at -1°C) | 143 | It does not decrease |
| After sandblasting | 55 | 2.6 times |
| Clear wet road surface | 20 | 7,15 times |

It was determined that the maximum size of sand particles should not exceed 1.3 cm. There is a risk of damage to vehicles and injury to pedestrians when using large particles. [17]

Research conducted in Russia [18] showed that the best effect in the fight against winter slippage is achieved by using quarry sand with a grain size of 2 - 3 mm (but not more than 8 mm). The effectiveness of sand is reduced if it contains particles of silt or silt that contaminate the road and increase its slippage.

At the same time, the use of sand in the fight against winter slippage has a number of other disadvantages. One of them is weak adhesion to the coating. Thus, in Canada, when vehicles move at a speed of 50-60 km/h, it was found that slip increases after 10-15 cars pass over a sand-treated surface [17].

The coefficient of compaction, although it increases with the rate of sand consumption, is very insignificant. Thus, when the level of sand consumption increases from 100 to 1100 g / m$^2$, for every 100 g / m$^2$ it increases only by 20 - 30%, when the level of sand consumption increases from 0 to 100 g / m$^2$, compared to the untreated surface the coupling coefficient increases by 50 - 70%.

Table 2

| How to make frosting | The coefficient of friction at the speed at which the car is moving (km/h),φ, | | |
|---|---|---|---|
| | 20 | 40 | 60 |

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| | | | |
|---|---|---|---|
| Not processed | 0,09 | 0,12 | 0,14 |
| The cost of sandblasting, g/m². | | | |
| 100 | 0,16 | 0,18 | 0,20 |
| 1100 | 0,20 | 0,24 | 0,26 |

In 2006, the research conducted by "Rosdornii" showed that the compaction coefficient increases with the increase in the size of the sand grain when the snow-ice volume increases (Table 3). [19]

Table 3

| Processing of accumulated snow and ice | Coarseness (size) modulus of sand | Coefficient of mixing ($\varphi$) | | | $\varphi$- change in, % |
|---|---|---|---|---|---|
| | | Ice | Condensed snow | Average value | |
| Sand: small | < 2,0 | 0,208 | 0,217 | 0,212 | 20 |
| middle | 2,0 - 2,5 | 0,240 | 0,240 | 0,240 | 36 |
| large | > 2,0 | .0,239 | 0,245 | 0,242 | 37 |
| Not processed | - | 0,197 | 0,156 | 0,176 | 0 |

The use of large and medium sands increases the adhesion properties of snow and ice piles by 16% compared to fine sands, which increases traffic safety. It was found that the friction properties of the surface treated with medium or coarse sand are 3-4 times higher than those treated with fine sand. This gives preference to the use of medium and large sands to combat winter slippage on roads and city streets.

The sand used for road maintenance contains moisture, which causes it to freeze in winter. Usually, sand humidity should not exceed 15%. The level of sand moisture affects its volumetric mass. Studies have shown that the increase in the volume of sand occurs at 5-7% moisture, and therefore, in this case, the minimum volumetric mass of sand is about 1.5 t / m³. When the humidity of the sand increases from 2 to 30% and is equal to about 1.85 t / m³, it leads to an increase in volumetric mass.

To prevent the sand from freezing, reagents, their aqueous solutions at low temperatures, and often sodium chloride are added to it. The amount of reagents depends on air temperature and sand humidity.

The minimum air temperature stored for a long time (3-5 days) is taken as the calculation temperature. By adding such amount of salt to the sand, it forms a non-freezing solution with the moisture in the sand. So, at a calculated temperature of about - 18 ° C and 10% humidity, sodium chloride should be added to the sand in an amount of about 3% of the sand mass.

A large group of chemical materials have the ability to reduce the temperature of aqueous solutions. This group primarily includes chlorides, and the most common of them are sodium chloride and calcium chloride. Due to the high cost of calcium chloride, it is not yet possible to use it in its pure form. Therefore, sodium chloride is most commonly used. However, sodium chloride solidifies in winter, which makes its use almost impossible.

In this regard, a mixture of sodium chloride (90%) and calcium chloride (10%) is currently used. When thoroughly mixed, the sodium chloride crystals separate from the calcium chloride particles. Due to the fact that calcium chloride has a stronger hygroscopicity and forms aqueous solutions that freeze at a lower temperature than sodium chloride solutions, the crystals of the latter are covered with a non-freezing solution. [9]

Chlorides, which have high technological properties, nevertheless have a negative effect on some materials and green areas. For this reason, in the following years, efforts are being made to create special reagents that do not increase the technological efficiency of chlorides, but are free from their own shortcomings.

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