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Expert opinion
On determining the possible use of *Hydroeffect* repellent
as an ice-melting agent

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Contents

pp.

Introduction.....	4
1 General part	5
2 Testing of water-repellent characteristics of <i>Hydroeffect</i> hydrophobizator	8
Conclusions	10
References	13

INTRODUCTION

Testing of Hydroeffect hydrophobizator as an ice-melting agent is held by the laboratory of ecology department and by State Road Scientific Research Institute of roadbed.

Research Object – *Hydroeffect* hydrophobizator (hydro isolation means) given for testing to *Orientir* _Lviv Enterprise.

The aim of the research is to establish the possibility of using repellents as an ice-melting agent (IMA) on the roads of Ukraine. Surveys are done to determine the repellent properties of *Hydroeffect* hydrophobizator for reducing the coefficient of the vehicle's wheels grip with the road surface.

The result of the research is an expert opinion for determining the possibility of using *Hydroeffect* water repellent with the results of studies.

1 General Part

Winter slipperiness includes all types of snow and ice formations on the surface of the road surface, leading to a reduction of the coefficient of the vehicle's wheels grip with the road surface [1].

The main types of winter slipperiness formed under the influence of rainfall with variable air temperature tags are listed in Table 1.

Table 1

N	Kind of winter slipperiness including forecast	Aggregate state precipitation	Formation	Priority treatment coverage by IMP
1	2	3	4	5
1	Icing (vitreous ice)	liquid	freezing rain, water or mist	preventive basis
2	Grainy raid	vapour	Frost fog on cooled coating	preventive basis
3	Grain frost	vapour	freezing of supercooled fog	preventive basis
4	Slob	solid	snowfall, snow drifts during	preventive basis

			blizzards	
5	Snow inking	solid	seal loose snow	basis
6	Snow and ice inking	solid	freezing waterlogged snow	basis

Icing is usually formed at temperatures from $+3^{\circ}\text{C}$ to -5°C and relative humidity over 90 % in the absence of reagents on the surface. Icing appears on the surface in the shape of a smooth or glassy film or a rough matte white crust.

Loose snow (slob) is formed on the surface during snowfalls or blizzards. Snow is compacted the most intensively at temperature about 0°C .

Due to ice-melting materials being scattered untimely, and while cleaning of loose snow is carried out with the help of vehicles, under their pressure the snow turns to snow or snow-and-ice inking.

Combating winter slipperiness includes measures to prevent and eliminate ice and snow-and-ice inking, preventive treatment of the coating to prevent ice and to weaken grip of ice with the surface of the roadway, spilling friction material with chemicals for melting snow and ice followed by its removal beyond the carriageway.

There are several traditional processing methods to combat winter slipperiness on the roads. The most commonly used are listed below:

- Processing pavement with chlorides of crystalline or liquid stage;
- Spreading coating with friction material (including heated material);
- Processing coating with sand-salt mixture;
- Mechanical cleaning of snow crust using heap road engineering.

The following materials are used to eliminate ice and snow-and-icy inking:

- Solid – sodium chloride (deicing salt), sand and salt mixture, squamous calcium chloride, a mixture of sodium chloride and calcium, natural kainite of Stebnykivskyi potash plant and others;
- Liquid – solutions of calcium chloride, sodium chloride, bischofite (magnesium chloride), liquid wastes of chemical plants that contain salt.

The most favourable means among the chemicals that are currently spread all over to overcome the winter slipperiness from an economic point of view are the

metal chloride salts: sodium chloride (NaCl – cooking salt), calcium chloride (CaCl₂) and magnesium chloride (MgCl₂).

Salt can be used in pure form (chemical method to combat winter slipperiness) and mixtures of friction materials (screenings of crushing stone with a grain size up to 3 mm, sand - chemical-friction method) that significantly increases the grip coefficient of tires on the road. This mixture is better fixed on the surface of the ice, contributes to its removal from the road surface, and grains of the friction material enable increased surface roughness.

All these methods of combating winter slipperiness have a negative impact on the highway environment, strength and durability of the pavement and are aimed at eliminating the formation factors of winter slipperiness that lead to adverse road conditions, thus increase driving time.

The feasibility and necessity of applying *Hydroeffect* water-repellent as an ice-melting product is reviewed in this work.

TESTING OF WATER-REPELLING CHARACTERISTICS OF *HYDROEFFECT* HYDROPHOBIZATOR

Testing of *Hydroeffect* hydrophobizator as an ice-melting agent is held by the laboratory of ecology department and by State Road Scientific Research Institute of roadbed.

The quality certificate issued by Ukrainian exporter "Nanotekhnocom" states that "Hydroeffect" is a water repelling agent made for constructing materials, i.e. hydrophobizator. Tests prove that it is a mix of components having following characteristics:

- silicones (6,81% of total weight)
- mineral particles (0,2% of total weight)
- solvents – water (93,0% of total weight)
- sulfates, chlorides, iron (minor particles)
- pH – 6,5
- density – not less than 1,2g/cm²

- emulsion stability – 1,9 hour
- freezing point - not higher than 4,0°C
- slightly turbid, transparent colorless liquid
- noncombustible
- non-toxic
- non-explosive.

Hydroeffect is a penetrating agent meant for protecting surfaces from water damage. It allows to reduce water absorption of the surface while preserving its gas—permeability. Being applied on the surface of material the agent permeates into pores and creates insolvent amorphous mass that fills the pores and micro cracks, expels moisture and provides waterproofing.

When treating the road surface with *Hydroeffect* repellent asphalt coating is protected from water penetration. When icing occurs *Hydroeffect* Hydrophobizator prevents cohesion with the road surface.

Coating samples treated with Hydrophobizator and mere coating samples were used in order to prove deicing characteristics of the agent. Test results allowed to compare the characteristics of both kinds of samples.

Following preparations were held during testing:

- water-repelling agent was applied on the samples surface
- 25ml of water were poured on the samples treated with the agent as well as samples not treated with water-repellent. Then the samples have been held in the freezing chamber until the ice coating appeared
- samples with the ice coating were tested on detachment ice from the asphalt by means of force indicator

Tests results:

1) Comparing asphalt samples after ice coating appeared has proved that:

- ice depth on the sample treated with Hydrophobizator equals to 10,8mm
- ice depth on the untreated sample is 10,1mm.

The difference between the ice depth shows that some water permeated the pores of untreated asphalt sample.

2) While testing ice detachment from asphalt surfaces the following efforts were put into effect

- 0,39kH for sample treated with hydrophobizator
- when testing the sample the ice destruction occurred on the verge of ice and asphalt sample
- 0,74 kH were put into effect while testing the untreated sample
- the ice was destructed in the ice covering itself, the surface of asphalt and the ice has not been destroyed.

CONCLUSIONS

1. The tests proved that *HYDROEFFECT* hydrophobizator water-repellent agent can be used as the ice-melting material in order to prevent winter slipperiness on different categories of roads in different climatic zones of Ukraine.

2. *HYDROEFFECT* hydrophobizator has necessary characteristics to prevent from water permeation into asphalt surface.

3. Application of *HYDROEFFECT* hydrophobizator will increase list of ice-melting materials and will reduce the expenses of winter road maintenance.

4. Application of *HYDROEFFECT* water-repellent will prevent from winter slipperiness and promote road safety in winter.

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