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Study of the effect of a new polymeric anti-corrosion coating in transport-technological machines on noise and vibration

[1]Botir D. Ibragimov
Head of the department of Automotive and production engineering, Tashkent State Transport University, Tashkent, Uzbekistan, ibragimov.bd@mail.ru, bd.ibragimov@tstu.uz
[2]Nurillo T. Ergashev
PhD researcher of the department of Automotive and production engineering, Tashkent State Transport University, Tashkent, Uzbekistan, ergashevnurillo657@gmail.com
[3]Shotemur B. Shoikromov
Assistant of the department of Automotive and production engineering, Tashkent State Transport University, Tashkent, Uzbekistan

Abstract: The article explores the issues of increasing the durability of components and parts of the car body with polymeric anti-corrosion materials.
Cars are constantly exposed to corrosion processes, and the durability of metal parts depends on the intensity of corrosion. This indicates the need for research and the importance of scientific and technical work in this area. Under laboratory conditions, on the basis of local raw materials, an anti-corrosion coating was synthesized - epoxy polyurethane with an additive. Corrosion protection was determined by the method of weight loss of metal plates in various aggressive environments, adhesion and corrosion protection, as well as the influence of noise and vibration. Field tests were carried out on MAN CLA 26.280 after its preliminary preparation.

Keywords: polymer protective coatings, anti-corrosion coating, epoxy resin, noise, vibration.

1.Introduction

In the world, research work is being carried out to increase the durability of transport and technological machines, to reduce the level of vibration, noise with the use of multifunctional protective coatings. In this aspect, obtaining anti-corrosion, noise- insulating, vibration-damping coatings of multifunctional significance is an urgent problem. All this indicates the exceptional importance of the problem of combating the corrosion of metals and the great importance of scientific and technical work in this area.

To protect metals and alloys from corrosion, thermosetting polymers such as epoxy, phenol-formaldehyde, polyester, furan, and other oligomers are widely used [1,2]. Coatings based on polymeric epoxy resins are resistant to alcohols, hydrocarbons, alkalis, salt solutions, mineral acids and lubricating oils.

Polymer protective coatings are applied to the surface of the product in the form of hot resin in order to protect it from the external environment. Resin coating can be

done by dipping, thermal or whirl spraying, as well as by conventional brushing.

Thus, anti-corrosion coatings obtained by applying epoxy resins filled with mineral fillers have good adhesion to metal surfaces, mechanical strength and chemical resistance.

The vibration-damping properties of polymers depend on the structure of polymers. One such polymer is epoxy polymers. The relaxation spectrum of the epoxy polymer (ED-16) shows a maximum associated with the unfreezing of the mobility of segments in globular formations at 404 K , and at 413 K, a secondary maximum of mechanical losses associated with the mobility of segments in more ordered symmetrical formations [3,4,8,9].

2. Materials and Methods

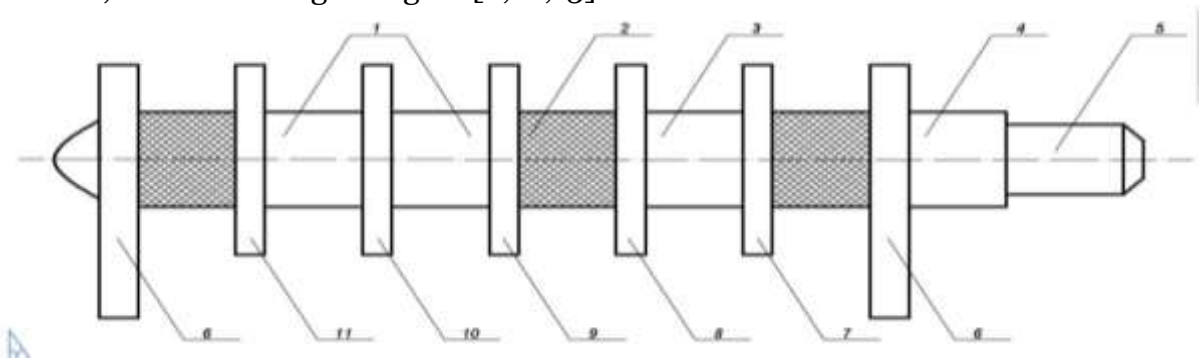
Objects and methods of research. For the study, epoxy resin ED-16, epoxyurethane coating, dump truck MAN CLA 26.280 and road machine MAN CLA 18.280 operated in "Kamchikavtoyul" were used.

Results and discussion. To develop a multifunctional anti-corrosion coating, we chose a thermosetting oligomer - epoxy resin of the ED-16 brand as an object of study, to give the polymer plasticity, flexibility and promote the transformation of hard, brittle resins into elastic materials capable of accepting any desired shape, we used plasticizers - dibutyl phthalate (DBP), dioctyl phthalate (DOP), hardener - polyethylene polyamine (PEPA), epoxy urethane coatings.

The anti-corrosion coating was obtained on the basis of local raw materials by synthesizing epoxyurethane with an additive, and tests were carried out to determine the physicochemical and operational properties of the coating.

Determination of the anticorrosive properties of epoxyurethane with an additive was carried out under laboratory conditions according to GOST, 10% hydrochloric acid (HCl) served as an aggressive medium.

Determination of the corrosion properties of the resulting epoxyurethane coating with the addition of GOST 28084-89 consisted in preparing a set of metal plates of tinplate, mild steel, aluminum alloy D-16, copper M. The plates were preliminarily cleaned, treated with alcohol, and after drying, they were weighed and assembled on a steel bolt. The assembled set was placed in a vessel with a liquid and kept for 120 hours at a temperature of 80 ± 2 °C (Fig. 1.). Then the package with the plates was removed, washed, dried and weighed again [6,10,13].



1-brass gasket, 2-insulating gasket, 3-steel gasket, 4-nuts, 5-fixing bolt, 6-brass stands, 7-duralumin, 8-cast iron, 9-brass, 10-steel, 11-copper

Fig. 1. A set of metal plates for determining corrosion

The change in the specific gravity of the plate (x) mg/cm² after interaction with the test liquid is calculated by the formula:

$$x = \frac{m - m_1}{S} \quad (1)$$

where: m is the mass of the plate before testing, mg
m 1 - the mass of the plate after the test, mg;
S is the total surface of the plate, cm^2.

The result was taken as the average value of three parallel determinations.

The results of the analyzes are shown in table 1.

Table 1
Results of analyzes on anticorrosive properties and adhesion of the synthesized anticorrosive coating

Sample	Weight, g		Mass loss	Note	Adhesion, score
	Before testing	After testing			
Copper M	5.1072	5.1069	0.0003	Persistent	1
Steel D-16	10.8331	10.8330	0.0001	Persistent	1
Aluminum AL-9	2.0691	2.0690	0.0001	Persistent	1

From table 1 it follows that the resulting coating has sufficient chemical resistance, the weight loss of the plates is not significant, so for steel it is 0.0001, for copper 0.0003, aluminum 0.0001.

Adhesion. The quality of the synthesized anti-corrosion coating was tested to determine the adhesion of GOST 15140-78 by the method of lattice or parallel cuts, while the number of exfoliated squares is recorded. The adhesion is evaluated according to a five-point system (Table 1) [5].

Noise. The tests were performed according to the international standard GOST 33555-2015, 17187 (IEC 61672-1:2002) sound level meters [7]. The standard establishes acceptable noise levels that affect the driver in the cab of the vehicle and test methods.

Vibration. Vibration was measured in accordance with the system of labor safety standards at the workplaces of machines. The purpose of the measurement is to control the compliance of the actual vibration parameters at the workplaces of machines with the permissible vibration values in accordance with GOST 12.1.012-90.

Operational tests were carried out in natural conditions at the Kamchik pass (Namangan region, Pap district). The MAN CLA 26.280 dump truck and MAN CLA 18.280 road vehicles were working at full load. Observation was carried out every 1 thousand km. During visual analysis, no changes in the form of strokes and cracks were observed on the surfaces.

The operation of the car was carried out in the warm and cold seasons, the mileage was 8.35 thousand km for the MAN CLA 26.280 dump truck and within 4.8 thousand km for the MAN CLA 18.280 road vehicles, respectively, the temperature difference did not affect the strength and adhesion of the coating.

Noise and vibration were measured on an ASSISTENT device (BVEK.438150-005RE). And the ASSISTANT noise and vibration analyzer is designed to measure average (equivalent), exponentially averaged and peak levels of sound, infrasound and

ultrasound; sound pressure levels (SPL) in octave and one- third octave frequency bands in the sound ranges, corrected levels of vibration acceleration of general and local vibration and vibration acceleration levels in octave and one-third octave frequency bands in the ranges of general and local vibration. Used to measure the characteristics of machines and mechanisms, in scientific research.

It is established that the applied anti-corrosion coating absorbs noise by 7-9%, vibration by 5-6%.

3. Conclusion: Our research on the application of anti-corrosion coatings on corroded metal surfaces of cars showed the possibility of increasing the reliability and service life of parts and the car as a whole.

The method we have chosen - anti-corrosion coating during operation gave positive results. Based on research in the field of corrosion processes, laboratory tests and field operation, the following conclusions can be drawn:

the physicochemical and operational properties of the resulting coating are determined;

operational tests of these vehicles were carried out in natural conditions with applied coatings for two months, the mileage was 8.35 thousand km for the MANCLA 26.280 dump truck, and within 4.8 thousand km for the MANCLA 18.280 road vehicles, respectively , paint consumption amounted to about 2 kg and positive results were obtained;

tests were carried out to determine noise and vibration and it was found that the applied anti-corrosion coating absorbs noise by 7-9%, vibration by 5-6%.

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