# DEVELOPMENT AND RESEARCH OF PROTECTIVE COAT ON BASIS OF "STIKOR" COMPOSITION

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**Summary.** The results of physic, mechanical, electrochemical and electric tests of paint coat "Stikor" on the base of thermoplastic polymer – polystyrol are presented. This coat possesses high corrosion resistances and can be recommended for defense of internal surfaces of the specialized railway vehicles transporting a mineral fertilizer.

Key words: protective coat, "Stikor", corrosion, sample, test, adhesion, strength.

## INTRODUCTION

Railway transport is one of the most metal consuming industries. Almost all knots and details of railway vehicle, upper structure of the way, bridges, contact network and equipment are made of metal.

During the process of exploitation surfaces of hardwares undergo by influences of atmospheric-climatic factors, transported products of chemical industry, mineral raw materials, fuels which together with high shock and cyclic loadings capable to cause not only even and local corrosion of metal but also corrosive tireless damages and corrosive cracking. Metal corrosion results the decline of bearing strength of constructions, contamination of the transported loads, causes the disrepairs of devices, equipment, systems.

In order to prevent the corrosive and corrosive-tireless destructions, provision of reliability, safety of load, economic grounded longevity, minimum expenses on permanent and capital repairs on the stage of producing and during exploitation there being conducted measure for the corrosion protection of hardwares.

Modern technology of loads transportation by railway transport is characterized by considerable intensification of portage processes with the increase of the specific loadings on an equipment. One of characteristic examples of such exploitation is a process of mineral fertilizers transportation.

Mineral fertilizers carriage body with rampe is a basic part of carriage, and some elements of frame are made from the low-alloyed special steels ( $10XHД\Pi$  and  $09\Gamma 2Д$ ), which differ by rather low corrosive stability. Use of non-rusting steels and alloys with

higher content of chrome and nickel, and also the non-ferrous metal is restricted because of their high price.

One of effective methods of fight against corrosion is an application of paintwork coats which differ by simple technology of causing, together with this the coats damaged by corrosion are easily restored. For this purpose epoxide, polyurethane, chloridevinil, glyptal, vinil coats are usually used.

According to the Protective Coats Committee of American Association of engineering and technical workers of carriage economy epoxide coats provide a good corrosion protection, and also well resist to abrasive influences. However under hard conditions of railway transport exploitation they carry badly the direct atmospheric influences and during senescence become fragile and covered by cracks. This promotes the penetration corrosion-active matters to protected metal and causes subpellicle corrosion which further causes total destruction of coat of metal construction which is being protected.

Polyurethane coats have the improved combination of protective properties; however they differ by a lot more low hardness.

Increase of longevity of the special transport vehicles - mineral fertilizers carriages intended for transportation of mineral fertilizers, that work in the conditions of aggressive environment, experiencing complicated corrosive-abrasive influence in the industrial atmosphere, mudded by aggressive gases and dust, is one of major factors of labor growth productivity and decline of economic expenses in sphere of railway transport.

## **OBJECTS AND PROBLEMS**

The presented article describes the developed of composition of paint anticorrosive coat with the base of "Stikor" composition – polysterene varnish, containing following: polystyrene, coal-tar resin, solvent, aluminum oxide

The base of «Stikor» is made by polysterene- thermoplastic polymer of mainly linear structure. It is amorphous, transparent, fragile product with low dehumidification, proof to the action of aggressive environments (lyes, acids, salts), but collapses by concentrated nitric and icy vinegar acids. Thermal destruction of polystereneflows with noticeable speed at temperatures, little higher then 260 C. Amount of adhesion of film-forming substance depends on matter on its polarity, therefore adhesion of film to the metallic surface was increased by introduction of plasticizer - coal resin, providing the most stable physic and mechanical indexes. Coal solvent was chosen as a solvent. The oxide of aluminum was brought in composition of «Stikor», executing the role of filler. Due to the scaly structure of particles, it possesses ability of shield the polymeric basis from influence of thermogas stream. In addition it has high adsorption characteristics and able to concentrate the molecules of polymer on the surface and form the dense oriented adsorption layers of mechanical extra-strength [Firsov 1983].

## **RESULTS OF EXPERIMENTAL ACTIVITY**

The sign of destruction of polymer is diminishing of his mass, decline of elasticity, durability and other properties. In the conditions when film of coat is exposed to the action of aggressive environments, high temperatures and oxygen of air its durability goes down intensively, and it quickly "gets tired" from thermooxidation destruction of polymer with violation of adsorption and chemical connections and embrittlement.

For research of physic and mechanical properties and corrosive firmness of coats initial standards were prepared according to the described below method.

Before plating of coat substrate from steel CT.3 were cleared, deprived of fat. Composition was inflicted on cylindrical standards in one layer by an area  $1 \text{ sm}^2$  for the controlled potential measuring and in 2 layers on plates for all other tests. The thickness of coats made 30-80 MKM. All tests were conducted in standard solution of 3%- odium of chloride and in terms, imitating affecting coat by factors on during exploitation.

For comparative description of properties of coat and produced presently by industry for defense of internal surfaces of metal constructions there were chosen coats - epoxide  $\Im\Pi$  -793 and polyurethane VP-41.

Quality control of basic metal and paint coats on the basis of polysterene primarily was conducted visually, determining the type of corrosive destruction and change of microgeometry of basic coat surface, character of removing layer by layer, cracking or other defects, and then using traditional standard methods [Semenova 2002].

Before the beginning of research of coat inoxidizability there was determined its initial physic and mechanical properties: adhesion, durability on a blow and durability on a bend. The results of tests are shown in a Table. 1.

№	Terms of test	Adhesion,	Durability at a bend on a	Durability at a
		point	scale ШГ-1, mm	blow, H*sm
1	3 % solution of NaCl, 30 days	1-2	1	500
2	Steam and air mixture (humidity 100%, t - 40-6 C)	1-2	1	450-500
3	Industrial atmosphere	1-2	1	480-500
4	Thermosenescence, t = +60  C, 120 hours	1-2	1	500

Table 1. Physic and mechanical properties of "Stikor" coat

Data, received on adhesion of protective coat is correlated with the results of research on a change of durability at and bend and blow, that testifies its stable and high physic and mechanical characteristics.

The results of tests on coat firmness to the abrasion are resulted on Figure 1. They are presented as graphic dependence of change of specific mass of sample ( $\rho_M$ ) of coat from the time of influence of abrasive (quartz sand).

Taking into consideration firmness of material in relation to abrasion, expressed by the size of corner  $\alpha$  and time till complete abrasion, depending on mass and thickness of coat, the best results were shown by epoxide coat EP-793 ( $\alpha$  - 21, t=117 minutes), after that «Stikor» ( $\alpha = 20$  With, t= 95 minutes) and then worst polyurethane UR-41 ( $\alpha = 18$  With and t = 75 mines).



Fig. 1. Change of specific mass of standard from the time of abrasive influence

Research of corrosive stability of coat was conducted in "hard" conditions, which were conducted cyclically during 30 days. Every day's cycle included the next influence:

1. Fertilizers suspension with a temperature of  $45 \pm 2 \text{ C}^{\circ}$  during 9 hours.

2. Fertilizers suspension with a temperature of  $20 \pm 2 \text{ C}^{\circ}$  during 15 hours

The results showed, that after 30 cycles of test coats marked  $\Im\Pi$ -793 and «Stikor» showed loss of surface lustre, adhesion was 1-2, and coat marked VP-41 there was noticed an appearance of point corrosion and, in separate cases, removing of layer by layer of protective film from a metallic surface with adhesion of 3-5. Change of samples weight of used coats during one cycle of tests is shown on Figure 2.



Fig. 2. Change of sample mass during influence of mineral fertilizers

Comprehensive description of protective properties of coats is given by speed-up electrochemical and electric tests. Controlled potential and capacity-ohmic methods were used in the presented work.

Controlled potential research allow to define the size of change of stationary potential ( $\Psi$ ) and degree of decline of closeness of passivating current (I) serve as a criterion for the comparative speed-up estimation of protective ability of anticorrosive compositions. Controlled potential curves were taken off on control-potential at a speed of involute 3 B/hour in three-electrode cell. Results of the tests are shown on Figure 3.



Fig. 3. Anodic controlled potential curves

The analysis of data of controlled potential curves shows that in the case of samples,  $\Im\Pi$ -793 and «Stikor» which were covered by composition there is an effect of change of stationary potential in a positive side and the closeness of passivating current was diminished.

The increase of anodic polarization of metal with paint coat testifies about the intensive flowing of oxide reaction formation. The protective film formed here hinders passing of electrochemical corrosion, and greater part of current is outlaid on the selection of oxygen.

Capacity –ohmic method enables to study kinetics of destruction of paint films on metal in electrolytes and with its help it is possible to get valuable information about the mechanism of process. With the change of a capacity and resistances it can be judged about the change of protective properties of paint coats, their adhesion and firmness in the conditions of exploitation.

Results capacity -ohmic researches resulted on Figure.4.



Fig. 4. Change of electric descriptions of protective properties of «Stikor» compositions

During the research of "Stikor" composition there was set that it has high enough values of resistance of  $13-14 * 10^3$  Om after 1 day of tests and 5-7 \*  $10^3$  Om after 5 days of tests and low values of differential capacity and insignificantly yields by its characteristics to epoxide coat of  $\Im\Pi$ -793.

During longer tests it is marked a decline of resistance size and increase of capacity which shows flowing of corrosion processes under film.

The decline of resistance values and increase of capacity testifies about flowing of corrosive processes under tape.

## CONCLUSION

There was conducted a complex of physic, mechanical and electrochemical researches of the developed coat «Stikor», basis of which is a thermoplastic polymer - polysterene.

It was set that the coat possesses high atmosphere resistance, moisture resistance, temperature stability, it has high indexes on adhesion, wearproofness, blow and bend at a blow.

Electrochemical researches and tests in aggressive environments showed, that the proposed coat coat possessed good protective properties and hinders to the origin of corrosion.

With the complex of properties this coat on the base of "Stikor" composition can be compared with widely used epoxide coats, thus, his physic and mechanical properties, especially firmness to the blow is higher.

Coat «Stikor» can be recommended for a defense of metallic knots of the specialized mobile composition, transporting mineral fertilizers, and also mine constructions which work in the conditions of aggressive factors influence and high humidity of atmosphere environment.

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#### РАЗРАБОТКА И ИССЛЕДОВАНИЕ ЗАЩИТНОГО ПОКРЫТИЯ НА ОСНОВЕ КОМПОЗИЦИИ «СТИКОР»

#### Жданова М.Н., Жданов С.А.

Аннотация. В статье представлены результаты исследования физико-механических, электрохимических и электрических свойств лакокрасочного покрытия «Стикор» на основе термопластичного полимера полистирола. Показано, что данное покрытие обладает высокими антикоррозионными свойствами и может быть рекомендовано для защиты внутренних поверхностей специализированного подвижного состава, перевозящего минеральное удобрение.

Ключевые слова: защитное покрытие, «Стикор», коррозия, образцы, испытание, адгезия, прочность.