The main technologies of protection against corrosion of the body and welds of LADA VESTA and LADA LARGUS cars used in agricultural production

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Abstract. Protection of passenger cars involved in agricultural work and maintenance of agricultural machinery from corrosion contributes to accident-free and long-term operation. A special feature of passenger cars used in agricultural production is the seasonality of its use. The durability of the body, the most expensive element of the car, during normal operation is regulated by the corrosion resistance of the panels. The most susceptible to corrosion are the wings, sills, underbody, and wheel arches. The article deals with the main models of «AVTOVAZ» cars and methods of applying paint coatings to the elements of body parts. The advantages and disadvantages of cataphoresis and anaphoresis coatings are also considered.

1. Introduction
The penetration of gas, oil and other products into the environment as a result of corrosion leads not only to material losses, but also to a threat to the life support of man and nature. If the damage to replacement and repair of equipment can at least be calculated, then the damage to the environment cannot be calculated.

Protection of passenger cars involved in agricultural work and maintenance of agricultural machinery from corrosion contributes to accident-free and long-term operation. As already mentioned, the losses caused by corrosion to the fleet of cars engaged in agriculture are estimated in many millions of rubles. They include both direct and indirect costs. Direct costs include the cost of materials for repairs, indirect costs include losses from forced machine downtime and reduced operational capabilities until they are completely out of order.

A special feature of passenger cars used in agricultural production is the seasonality of its use. During long-term storage (without preservation), under the influence of moisture, sunlight, wind, temperature fluctuations and other factors, a number of parts and coatings are destroyed and deformed, and malfunctions occur, which are sometimes difficult to detect even after disassembly during repair.

The development of corrosion is influenced by the conditions in which passenger cars operating in agriculture are operated. Chernozems and swampy soils, waste water, especially with a high content of manure, juices of grasses and cereals are the most aggressive. In the most dangerous conditions are machines that serve the devices for applying fertilizers, herbicides and pesticides. Particles of these substances, dissolved in atmospheric moisture, form electrolytes (acids and salts) that cause severe corrosion. The creation of mechanized livestock farms and complexes has expanded the scope of
application of passenger cars serving them. Increased corrosion is caused by the saturation of the surrounding air with ammonia, carbon dioxide, hydrogen sulfide and high humidity in the premises.

The durability of the body, the most expensive element of the car, during normal operation, is usually regulated by the corrosion resistance of the panels. The most susceptible to corrosion are the wings, sills, underbody, and wheel arches.

It should be borne in mind that the corrosion resistance of the body after its repair can significantly decrease, since when plastic deformation of individual sections of the steel part, it becomes inhomogeneous in structure, which contributes to the formation of foci of electrochemical corrosion. A similar effect can be given by the heterogeneity of metal coatings – after repair, the adjacent sections of panels are found to differ in composition and properties from the factory primers, paints, and putties [1-3].

Application of anti-corrosion coatings is carried out by special installations that work on the type of spray gun equipped with nozzles in the form of thin straight or curved tubes that allow spraying coatings in hard-to-reach areas of the body. The Czech installation is widely used in domestic practice.

«AVTOVAZ» activities to improve the anti-corrosion protection of vehicles are focused on the development of new materials with improved decorative and protective properties, materials with increased corrosion resistance, advanced materials for surface preparation and priming, and new paint technologies [2].

2. Features of paint coating application

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If you compare the materials that were used in the 70s of the last century with today’s, you can easily see how they differ both in application technology and in their protective properties. Then the coatings were applied by anaphoresis, and their best performance in tests in the salt mist chamber (CST) was 100…150 hours. At present, modern two-component cataphoretic primers are used as the first primer for painting the bodies of LADA GANTA, LADA VESTA and LADA LARGUS cars, their protective properties are more than 1500 hours per KST. These materials, in contrast to anaphoresis, can be painted and galvanized steel [3].

The second primer is responsible for the resistance of the paint coating to impact and abrasive effects, it also aligns the surface for enamel painting. Today, the plant uses several types of primers: the car bodies of JSC AVTOVAZ are painted with EP - 0228 primer, AND the Lada VESTA and LADA LARGUS use polyester primer. The advantages of this coating are obvious: providing the greatest resistance to chipping, better adhesion to enamels, good gloss and appearance. And the technology excludes such a labor-intensive operation as «wet» grinding [4].

For the final paintwork of the bodies of front-wheel drive VAZ cars, two-layer metallized enamels produced by foreign companies BASF, PPG and the domestic company «Russian paints» are used. The color range of car enamel has about 10 colors, which allows you to meet the needs of customers as much as possible [5].

Increasing requirements for corrosion resistance of the body forced the Volga automobile plant to increase the use of galvanized steel on car bodies (from 11 % of the body weight to 82%). This level of use of galvanized steel in combination with additional treatment of hazardous areas with special protective compounds and a high-quality complex of paint and varnish coating guarantees protection from through-corrosion for up to six years. The use of galvanized steel for LADA LARGUS had a significant impact on the formation of the body welding complex and was taken into account in the design of all welding stations and lines, the main of which were created with the participation of specialists from COMAU (Italy). However, further growth in the use of galvanized steel for the production of LADA LARGUS instead of uncoated is impossible without a deep modernization of existing equipment.
15 types of adhesives and mastics based on plastisol epoxy polyurethane are used to provide anti-corrosion resistance and sealing in welds and flangings for protecting the bottom of car bodies. These materials are constantly being improved and adapted to the specifics of the paint technology at the factory. Special attention is paid to sealing edges and welded joints [6].

Wax-based preservation compounds are designed for additional protection of hidden sections (thresholds, doors, racks, etc.), they are processed all the bodies.

LADA LARGUS occupies a special place in the model range of AVTOVAZ JSC. LADA LARGUS cars are actually assembled at a new factory – in a separate building located on the territory of AVTOVAZ JSC.

The total length of the LADA LARGUS conveyor is 1700 meters. Four lines of conveyor assemble the interior and the same number – the chassis. The conveyor has created extremely comfortable conditions for workers: the body is dominated by light colors, almost sterile cleanliness everywhere, and fresh air-conditioned [7].

At each workplace – a special memo for collectors: what details and in what order should be received for a particular operation and what measures should be taken in case of failures.

Welding of the body frame is fully robotic: 350 robots from the German company Kika work on eight automatic lines. The robot not only performs welding of parts, but can also take and move parts and assemblies for subsequent operations. According to technologists, similar robots are used in factories of leading European companies, in particular Porsche [8].

3. Features of body painting on «AVTOVAZ»
In contrast to the existing paint lines at «AVTOVAZ», the new workshop transports LADA LARGUS bodies through 10 consecutive baths for degreasing, phosphating and applying cataphoretic soil on special electric carts. These carts can submerge themselves in any bath with any dive trajectory. While in the bath, the cart makes small fluctuations, which improves the quality of washing the body not only from the outside, but also in the hidden sections of the body. The process of pre-preparation of the body consists of nine stages. And the applied soil cannot be scratched even with a nail.

Then, when the cataphoresis coating is dried, the body goes to the areas where anti-noise mastics are applied, welding seams are sealed, and anti-noise mats are laid. Flanges and welded joints are 100% protected by polyvinyl chloride polymer mastic. The bottom is also completely processed with anti-noise, abrasive-resistant plastisol mastic [9].

After drying the anti-noise mastics and polishing the cataphoretic soil, the body enters the secondary soil application chambers. Body treatment is carried out with the help of six robots of the company Eisenmann. Depending on the future color of the car, a light or dark-colored primer is applied. Polyester secondary primer has increased protective and decorative properties, as well as high filling and high adhesion, which eliminates the material and labor-intensive operation of «wet» sanding.

After drying and «dry» grinding of the secondary soil, the body comes to the paint chambers, where the base enamel and protective varnish are applied [10].

These coatings are applied on two lines using 26 robots. Modern equipment allows you to paint the bodies of LADA LARGUS cars within one batch in 10 different colors. For a high speed of color alternation, a modern method of washing equipment is provided, which provides paint replacement within 30 seconds.

In the LADA LARGUS paint complex, the main attention is paid to quality. During the entire technological process, the body undergoes intermediate evaluations. Acceptance control is performed at the end of the paint line. After passing the acceptance control, the LADA LARGUS body goes to the site of conservation of hidden sections with an anti-corrosion compound, and then - to the storage unit, from where it will go to the Assembly line. If a discrepancy is detected, the body is transferred to a special chamber equipped with systems for local grinding, painting and drying [11].

The work of the paint complex is designed in such a way as to ensure maximum cleanliness of the air and premises. To clean the air in the shop, there is a developed system of air conditioners. The
painting process takes place at a constant temperature of 20 degrees. To maintain the desired microclimate, special cooling and heating devices are installed in the shop [12].

On the territory of the workshop, the appearance of potential atmospheric pollutants is excluded. In particular, in order to avoid the need for intra-shop transport, all paint materials are prepared in the paint preparation Department. There are 16 systems for preparing and feeding enamels and two systems for primers. The length of paint pipelines reaches 36 kilometers.

Disposable white coveralls are used as uniforms for workers in the paint shop. Before entering the paint chamber, the painter passes through the airlock, where he is blown by the supply ventilation [13].

4. Conclusion

In the conditions of operation, storage and repair of machines, the correct choice and application of anti-corrosion agents, and above all various types of protective coatings and technologies, which should not only reliably protect metal work surfaces from corrosion, but also do not require large costs for application and ensure minimal labor costs, are of great importance in preserving agricultural machinery. To sum up, there are five levels of anti-corrosion protection of VAZ cars:

1. Level of 1980: cars VAZ-2104-07, 21213 - protection from through corrosion for up to three years (parts made of non-galvanized steel with anaphoretic priming).
2. Level of 1985: cars VAZ-2108-099, 2115 («Samara») - protection from through corrosion for up to four years (a small number of parts made of galvanized steel with cataphoresis priming).
3. Level of 1997: cars VAZ - 2110, 2170 («Priora») - protection from through corrosion for up to six years (52% of the body weight-mainly one-sided galvanized steel with cataphoretic priming).
4. Level of 2002: cars VAZ - 2123, 1118 («Kalina») - protection from through corrosion for up to six years (up to 50% of the body weight-mainly double-sided galvanized steel with cataphoretic priming).
5. 2018 Level: LADA LARGUS cars - protection from through-corrosion for up to ten years (up to 90% of the body weight is mainly double-sided galvanized steel with cataphoretic priming).

Guided by the principle of reasonable sufficiency in relation to the domestic and Western markets for LADA VESTA and LADA LARGUS cars, the task of achieving guaranteed protection against through-body corrosion for six years was set and implemented, which corresponds to the world level for cars of this class.

In the future, «AVTOVAZ» plans to increase the guaranteed protection against through-body corrosion for its new cars to 12...15 years due to the use of double-sided galvanized steel (95% of the body weight) and new-generation cataphoretic primers.

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