CORROSION PROTECTION OF AGRICULTURAL EQUIPMENT BY MICROCRYSTALLINE WAX COMPOSITIONS

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Because of the specific features of agricultural production, the machinery and tractor fleet is in use no more than one or two months out of the year. For example, grain-harvesting combines and other combines operate for 25-35 days; drills, cultivators, potato planters, and similar equipment operate for 10-15 days. The remainder of the year, the equipment is usually stored in an open area (in the category of "severe conditions" according to GOST (All-Union State Standard] 9.014—78), where it is subject to corrosion and aging [1]. The costs for repair and maintenance of machinery and structures average 15-25% of the original costs. Hence, preservation of equipment in the interseasonal nonoperating period is an extremely important task. During this period, the external surfaces are protected against corrosion by means of preservative compounds.

A number of the compositions used in agriculture (GOST 7751—79) and techniques for external preservation do not fully meet the requirements. The widely used naphtha/asphalt compositions are prepared on the farms immediately before preservation, by dissolving asphalt in naphtha; this results in nonproductive consumption of naphtha and requires strict adherence to safety rules and standards. Lubricating greases of the PVK type [gun grease] must be heated to the melting point (80-100°C) before application, and this increase the preservation and depreservation costs.

For many preservatives, the protective life is considerably less than 12 months; solidols [calcium greases] prepared from natural or synthetic fatty acids will protect for up to 6 months in open storage, and NG-204u oil up to 2 months. In comparison with the PVK grease, the film coating NG-216 and the water-base was dispersion Avtokonservant cost 3-4 times as much and give the same protective life. Some preservatives (for example PÉV-74) based on organic solvents are unsuitable for the protection of rubberized fabric components of agricultural equipment.

The most acceptable preservative for the external surfaces of agricultural equipment is the water-base microcrystalline wax composition ZVVD-13 (specification TU 38-101-78). Tests on this product in regions of the country with a temperate continental climate have shown that it gives good protection against corrosion and atmospheric aging for 12 months on metal, rubber, rubbrized fabric, wood, and plastic components, and also on paints. However, the demand for the product is still not being met. Within the framework of the goal-oriented combined scientific and technical program for metal corrosion protection, development work is being carried out to obtain more promising inhibited wax compositions.

Combined studies have been performed to determine the protective capabilities of the most promising preservatives based on microcrystalline waxes, with the simultaneous development of rational mechanized technology for the application of these materials. It has been established [2] that the level of protection given by microcrystalline wax compositions can be raised by the incorporation of multifunctional contact inhibitors (primarily amines) with a cathodic, anodic, and blocking effect. These inhibitors are sorbed and chemisorbed by the metal surface. In many cases they have a tendency to be adsorbed specifically — the intensity of adsorption being determined by the zero-charge potential of the metal being protected.

The microcrystalline wax formulations also include synthetic surfactants (cationic, anionic, or nonionic) that displace water from the metal surface and improve the freeze-resistance of the dispersions and of the protective films based on these dispersions. Thus, inhibited water-base wax compostions (IWWC) not only shield the metal surface mechanically and give it hydrophobic properties, but also protect it from corrosion damage by retarding electrochemical reactions.

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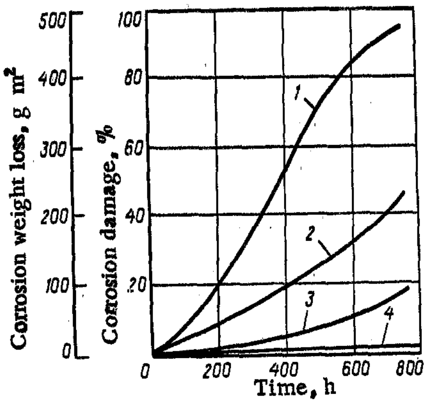

Fig. 1

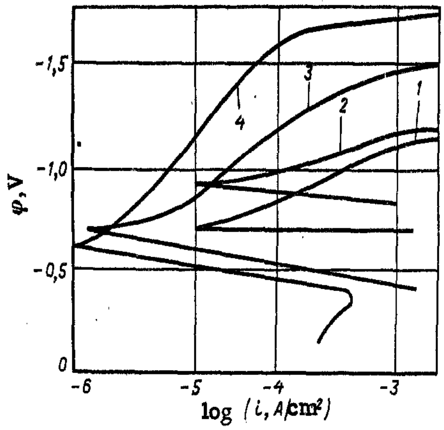

Fig. 2

Fig. 1. Corrosion weight loss and degree of corrosion damage of steel panels protected with various protective compositions, as functions of exposure time in electrolyte solution at 20 ± 2°C: 1) naphtha—asphalt; 2) PEV—74; 3) ZVVD-13; 4) IWWC.

Fig. 2. Potentiostatic cathodic and anodic polarization curves in 0.1 N aqueous Na_2SO_4 solution, taken in tests on steel specimens coated with various protective compositions (i is the potential relative to a silver chloride electrode; ϕ is the current density): 1) without coating; 2) PEV-74, 3) ZVVD-13, 4) IWWC.

IWWCs in several modifications have been subjected to comparative laboratory, test-stand, and field test evaluations.* Tested as comparison samples were the preservative compositions ZVVD-13 and PEV-74 and a naphtha—asphalt composition. The protective properties of the preservatives were rated inn accordance with GOST 9.041—74 and by a gravimetric method after removing the protective compositions by solvent vapor degreasing.

The laboratoy tests were performed in a G-4 humidity cabinet under conditions of periodic condensation of moisture (GOST 9.054—75, Method 1) and in an electrolyte solution (GOST 9.054—75, Method 4). Other tests were run on steel panels with and without preservative coatings, in which polarization curves were taken in the potentiostatic mode in a 0.1 N Na_2SO_4 solution. The IWWCs passed a 720-h test cycle in the G-4 humidity cabinet, with no breaks in continuity of the coating or corrosion spots on the surface of the steel panels that had been coated with the IWWC. In the tests in the electrolyte solution, the IWWC formulations gave better protection than the ZVVD-13 by a factor of 2.4, better than the PEV-74 by a factor of 8, and better than than the naphtha—asphalt compostion by a factor of 18 (Fig. 1).

The stationary potential of specimens with the IWWC was found to be 0.25-0.28 V more positive than the stationary potential of the control specimen (Fig. 2). The corrosion current at the stationary potential of the specimens with the IWWC was to 1.5 orders of magnitudes lower than the corrosion current of the control specimen. It was established that the inhibitors introduced into the water-base wax compositions retard the anodic and cathodic reactions of the corrosion process, with a predominance of cathodic control with respect to the depolarizer.

Steel indicator specimens protected with the preservatives were subjected to test-stand evaluations in an industrial-district atmosphere (GOST 17332—71). The IWWC gave 3-4 times better protection of the indicator specimens in comparison with the ZVVD-13 composition (Fig. 3). Tests on the IWWC at two farms in Vladimir Oblast showed that these compositions give reliable protection of grain- and silage-harvesting combines, plows, cultivators, and other agricultural equipment for up to one year of interseasonal storage in open areas.

Tests on indicator specimens in livestock buildings and in mineral fertillizer storage buildings at three farms in Vladimir Oblast showed (Fig. 4) that the protection given by the IWWC in corrosive vapor/air and liquid-phase media is lower by a factor of approximately 2 in comparison with the protection given in the industrial-district atmosphere. This can be explained on the basis of mechanical breakdown of the protective films in the immediate

*E. A. Puchin took part in performing these tests.

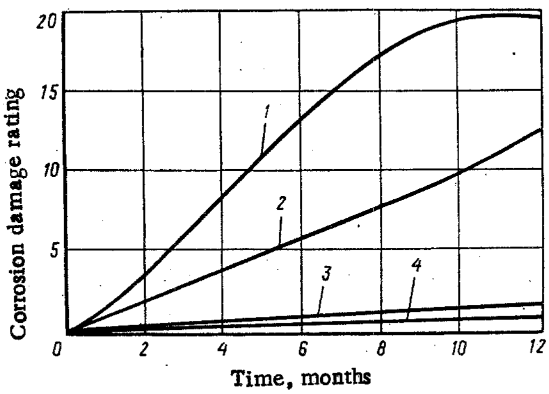

Fig. 3

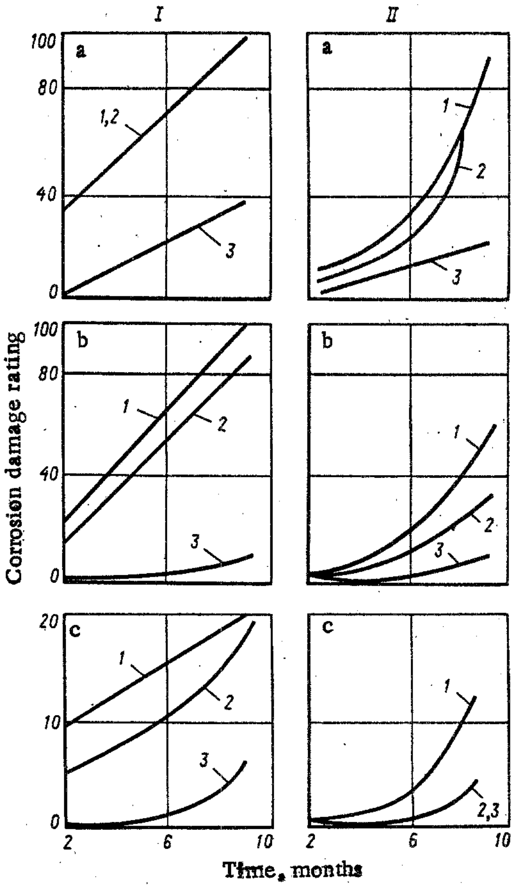

Fig. 4

Fig. 3. Degree of corrosion damage of steel specimens coated with various protective compositions, as a function of exposure time in test-stand evaluations and in the atmosphere of an industrial district. Notation same as in Fig. 1.

Fig. 4. Degree of corrosion damage of indicator specimens coated with various protective compositions, as a function of exposure time: I) in livestock buildings; II) in mineral fertilizer storage buildings at floor level (a) and at respective heights of 1.5 and 2.5 m above floor (b, c): 1) ZVVD-13; 2) IWWC; 3) PVK grease.

vicinity of the floor, and also the predominance of additive action of the inhibitors over synergistic action.

Optimal conditions have been determined for air-spray application of IWWC: working pressure 0.2-0.3 MPa, spray nozzle diameter 1.2 = 1.5 mm; application density 0.05-0.07 kg/m^2. The following equipment is recommended for IWWC application(OZ-9995 unit of GOSNITI, OZ-9905 apparatus of GOSNITI, air spray nozzles KRU-1, SO-72, and others [3].

When IWWC is applied in place of the lubricating grease PVK, labor productivity is increased by a factor of 1.52; the total labor required for preservation is reduced by a factor 2, and the preservation cost by a factor of approximately 2. The expected saving from the introduction of the IWWC is 1500 rubles per metric ton of the composition.

LITERATURE CITED

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