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## UNIQUE INNOVATIVE ECOTECHNOLOGIES FOR PROTECTING FROM CORROSION METAL-CAPACITIVE STRUCTURES

*Currently, corrosion losses in industrialized countries reach 3-5% of national income. This is especially true of metallurgical and chemical enterprises, oil and gas pipelines, watercraft and others, where elements and structures operate in highly aggressive environments of 4-5 degrees. The total damage from corrosion is billions of dollars due to emergencies, environmental disasters and so on. According to statistics, the lack of corrosion protection is the cause of almost 25 percent of accidents*

*As a result of corrosion, metals are converted into various compounds – oxides, hydroxides or salts, in the form of which they are in nature. It is difficult to take into account indirect losses from downtime and reduced productivity of equipment that has undergone corrosion, from disruption of the normal course of technological processes, from accidents caused by reduced strength of metal structures. Up to 10 percent of the produced metal is lost due to corrosion.*

*There are also indirect losses that are difficult to predict or predict. These are losses from downtime and reduced productivity of equipment that has undergone corrosion, from the disruption of normal technological processes, from accidents caused by reduced strength of metal structures, environmental pollution, insurance benefits and, most importantly, from fatalities. Corrosion research suggests that corrosion protection is first and foremost the correct surface preparation and then the sealant or paint. As a result of experiments and tests, the substance CONTRRUST was obtained and patented – a universal eco-material based on plants-modifier-converter, which converts rust into helatic metal polymers. The composition, properties and uses of the material, named and patented as CONTRRUST, have been thoroughly researched and implemented.*

**Keywords: research, rust, protective coatings, effective means, ecology, careless metal polymers, composition, eco-material plant.**

### INTRODUCTION

Losses from metal corrosion account for 3-5% of national income. 10% of the produced metal is lost, and 25% of accidents occur due to loss of strength of structures

due to corrosion [1]. The aim of the study was to find, investigate and implement such materials and technologies to avoid huge costs metal products with environmentally friendly means.

The task was to find the right material with the right adjustable composition and properties, as well as safe and effective ways to use it. Research and experience of long-term operation of metal products show that the most important factor in protecting and preventing corrosion is a reliable and correct preparation of metal surfaces for painting. Preventing corrosion is easier and more reliable than stopping and repairing damaged parts and products.

Many studies of corrosion processes and the location of protective coatings are known. There are also many substances with similar effects, such as "Loctite 7505" Super Rust Killer (USA) for cleaning surfaces, inhibitors, sprays, impurities, etc. But they are not resistant to high temperatures and are not applied to wet surfaces. Ecologically safe, effective water-based plant-based products have not been presented [1, 2]. There is already a patented eco-modifier-converter "CONTRRUST". Patent 11 (11) 61544 L. Vysotska [3, 4]. Published several monographs and dozens of articles on the use of eco-modifier "CONTRRUST" authors (V.I. Savenko, V.M. Vashenko, L.M. Vysotskaya, A.A. Plugin, O.A. Mashkov, I.V. Kushchenko, V.P. Korolev, O.D. Zhuravsky, A.M. Karateev, S.Y. Maximov, O.M. Kovalchuk and many others), many reports at international conferences [7, 8].

#### **THE MAIN RESEARCH**

The main experiments, determination of properties and testing of the composition of the modifier CONTRRUST were carried out empirically in laboratories and in production. Theoretically, formulas of compounds and equations of chemical reactions were compiled [1, 2]. At the stage of patenting production and wide implementation and certification tests were conducted at research institutes of the National Academy of Sciences of Ukraine, Lutsk National Technical University, Kyiv National University of Construction and Architecture, Azov State Technical University, Ukrainian State University of Railway Transport, etc. .. also field tests at construction, transport, industry, etc. in different cities of Kyiv, Kharkiv, Mykolaiv, Sevastopol, Mozyr, etc. with positive results [7]. The transformative technology of "CONTRRUST" with an average thickness of rust within 300um results in 100 per cent of purity. "CONTRRUST" is an ultimate protection against corrosion, rust modifier, protective primer of high efficiency, non-toxic, environmentally safe, one component. The main components which make up are: tanning extracts, succinic, citric, oxalic acid and other food acids, water [3, 4]. Fabricated in three modifications: a) liquid; b) viscous substance; c) powder.

Does not contain any toxic elements such as lead or zinc chromate, phosphate acid, safe for human life and health during its manufacture and use, not flammable, easy to use. Can be used in hardly-accessed areas of any configuration. Replaces corrosion removal, and serves as the primer layer. Replaces interim working primer [5]. Positive effect on the welding. Restores and protects surface. Should be applied to tenacious layer of iron scale. Has good diffusion. Blocks centers of corrosion in metal shells. Dries quickly. No need to too wash off the surface. Converts rust of 100-300 microns thick into protective anticorrosive film -primer, which blocks the surface from repeated corrosion over time. Product consumption: 40-120 ml/m<sup>2</sup>.

Economic effect reaches 60%.

Table 1

<b>Specifications</b>	
Specifications	Values
Appearance	Liquid
Color	Brown
Smell	nice (dried fruit )
Density	1,07-1,12 g/cm <sup>3</sup>
pH	0,5 - 3
Freezing temperature of	-5 °C
Drying time at temperature (20 ± 2 )° C	1-2 h
After-treatment color	dark-blue
Thickness of iron salts after the modification of the rust layer on a steel surface	30-50 microns
Adhesion Paint	2 points
Resistance of the converted rust layer on the modified surface to the statistical effects of water, crude oil , petroleum products at a temperature of (20 ± 2 ) ° C	at least 72 hours

### ADVANTAGES AND ANTI-CORROSION PROTECTION

A rust converter with excellent penetrating ability and is used as a universal primer (preservative, inter-op prime coating without disturbing the surface roughness) and provisional coating (first prime coat layer) with good adhesion up to minimally prepared surface and for repair of old coats as well as for strengthening of a dross to the metal surface.

Blocks corrosion centers in metal surface holes, dries quickly, doesn't need washing down thereof from a metal surface, quickens a technological process of metal surface coating and increases terms of exploitation of exploitation of metal constructions without decreasing a normative exploitation in different environments according to the requirements of ISO 12994. It provides with reliable adhesion strength relative to lacquer and insulation coatings [6].

"CONTRRUST" substitutes sandblast, mechanical surface cleaning (local places, welding seams are cleaned), it is recommended for processing of rust damaged surfaces metal constructions and in cases when mechanical or sandblast cleaning is complicated or economically inexpedient drying within 20-30 min. Under normal conditions, it forms dark-blue or black layer which is complicated ferric/ferric acid organic compounding, which provides with anti-corrosion protection. Protective layer may be used as a primer under different lacquer and insulation materials.

The application of rust converter "CONTRRUST" allowed is surface painting 3rd - 4th level of cleaning from oxides with application of technological schemes of surface preparation 19, 23, 24 Table 4, under GOST 9.402-80. If the technological process requires a preparation of a surface for SA 2,5 and other, the rust converter "CONTRRUST" is applied to blocking the corrosion centers which appear due to oxygen and moisture joining [7]. Increasing the life of the coated system by 2-4 times (in closed spaces - in 6-9 times), and even longer – for other types of coatings. Reduction of labor costs, the cost and timing of metal- construction works by 50-70%.

Complete safety and ease of use in any way (by brush, roller or spray, syringe, etc.). Use without respirators and expensive arsenal of tools and accessories, indispensable in the treatment of metal structures of particularly complex configuration, from seaport facilities to underground and above ground pipelines.

Blocks and suppresses hidden deep corrosion due to high diffusivity and organic components.

Surface quality is maintained for many months (in an enclosed space more than a year). With the normative requirements of GOST of Ukraine 9.402-80 only "24 hours".

"CONTRRUST" is used at any time of the year for the treatment of steel pipes, cable sheath, roofs, reinforcing mesh, nodes pairing, tanks, reservoirs, pipelines, metal structures in mines, power plants and at nuclear power plants in the service station, ship repair and building, railway works, underground constructions, food processing equipment, to detect corrosion cells in pressure vessels and structures of special products, in particular stainless, as well as micro-cracks and pitting during the manufacture of steel materials for special purposes and in many sectors of the economy, in closed inaccessible spaces on stationary and moving civilian and military objects (bulkhead ballast tanks, holds, submarines, tankers, tanks, armored vehicles, tanks for drinking water and food storage, vehicles, on the valve of sandwich panels, ventilated facades, walls and new type roofing, etc.).

Can be used to isolation of steel and concrete structures in accordance with the requirements of EN 1504-7 "Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity - Part 7: Reinforcement corrosion protection".

Before applying the "CONTRRUST" the surface needs to be cleaned from grease, dirt, ill keep paints, primers, isolation. Formation and loose rust is to be removed with a metal brush, and wiped with a damp cloth.

"CONTRRUST" is applied to dry or wet surface with a continuous uniform layer without streaks in any convenient way: brush, roller, means towels, airless spray, etc.

After applying the rust converter it does NOT need to be rinsed or cleaned, and after drying the coating can be directly applied in accordance with needed coating requirements

## **RESULTS**

When repairing a vehicle (body, bottom and in other accessible places) use a metal brush to clean the surface and an emery paper to polish the surface, thus, the surface should remain only with the "noble" rust, that is "red rust" Passages and channels in the hardly available spaces are to be cleaned by any sharp tool (a thin knife, etc.) [8]. Fatty place should be degreased. Other dismantled parts of the car (caliper, metal disk, etc.) should be heated to +16+35 °C (heat from sun shown might be enough) and treated with "CONTRRUST". Having assured that the surface is dried up and no rust spots remain on the surface and if there are still present should be treated with rust-converter locally, the primer should be applied (sealer, insulation), in hardly accessible places - should be splashed inside. For the treatment of the inner surface of the car through the hole thresholds introduce a rubber tube to the end of the threshold, pour a rust converter, gradually pulling the tube out. At negative temperatures, the process of applying rust-converter is recommended to be supported by adding alcohol or warming the surface itself. The warranty period for the «CONTRRUST» protection applied according to the manufacturer's instructions is no less than the warranty period of the paint coating that will be applied on the surface after treatment with «CONTRRUST» ( including coatings that can withstand temperatures above 300 ° C). In all cases, we recommend using coatings or paint after treatment by «CONTRRUST». "CONTRRUST" modification "B" (powder, which can be prepared under extreme conditions for modification "A") allows elimination of point and gap corrosion in the course of metalwork [9]. The economic

effect of using rust modifier on different objects, structures, and metal structures is currently over UAH 50 million, including:

- Kyiv, str. Solomianskaya 2a, customer is Court of Appeal, designer is CJSC "GIPROtsivilprombud", economic effect is 30,0 million UAH;
- PJSC «PVI-ZIT Oil and Gas» as a contractor for Kutaisi-Abasha (Georgia) gas pipeline is UAH 10.2 million, Lviv Bobrivka is UAH 0.743 million, Brest (Belarus) is UAH 0.739 million;
- Lukoil is Karpatnaftochim Company, economic effect is UAH 6.41 million;
- Kharkiv, Sumy market – contractor of LLC Spetsstroyontazh – Ukraine is UAH 5.8 million and other.

### **CONCLUSIONS**

1. On the basis of basic researches of corrosion mechanisms (including under the protective coating), methods of estimation of a condition and forecasting of corrosion resistance of metal-containing structures and possible terms of their failure and possible ways of prolongation of service life were created and implemented.

2. The newest technology of preparation of the corroded surface with the use of the CONTRRUST rust modifier (hi-tech technology), which currently has no world analogues, is proposed and introduced in the industry.

3. On the basis of the conducted researches the rational technology of surface preparation at drawing various types of paints and varnishes on metal structures of different technological purpose is developed.

4. According to the results of the research, it is established that the application of CONTRRUST and coatings based on bitumen-latex emulsions and other coatings of the developed composition of the surface do not require careful preparation before application (grade D).

5. Designs of coating systems for corrosion protection of oil and gas pipelines, valuable metal equipment, machines and other metal products are proposed.

6. Studies and tests have shown that the proposed coating systems meet the required regulatory requirements to ensure long-term corrosion protection of metal products and can have great prospects, first of all, for the repair of existing facilities.

7. Methods for diagnostics, assessment and monitoring of the condition of metal structures and products developed and implemented at the state level (DSTU). The overall economic impact of the implementation of the work is over UAH 60 million.

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***В.І. Савенко, Л.М. Висоцька, І.С. Нестеренко, Ю.Л. Полозський, В.П. Попков***  
***Унікальні інноваційні екотехнології для захисту від корозії металомісних конструкцій***

*Нині втрати від корозії в промислово розвинених країнах досягають 3-5% національного доходу. Особливо це стосується металургійних і хімічних підприємств, нафто- і газопроводів, плавзасобів та інших, де елементи та конструкції працюють у високоагресивних середовищах 4-5 градусів. Загальний збиток від корозії становить мільярди доларів через надзвичайні ситуації, екологічні катастрофи тощо. За статистикою, відсутність антикорозійного захисту є причиною майже 25 відсотків аварій.*

*В результаті корозії метали перетворюються на різні сполуки - оксиди, гідроксиди або солі, у вигляді яких вони знаходяться в природі. Важко врахувати непрямі втрати від простоїв і зниження продуктивності устаткування, що зазнало корозії, від порушення нормального ходу технологічних процесів, від аварій, спричинених зниженням міцності металоконструкцій. Через корозію втрачається до 10 відсотків виробленого металу.*

*Існують також непрямі втрати, які важко передбачити чи передбачити. Це втрати від простоїв і зниження продуктивності обладнання, яке зазнало корозії, від порушення нормальних технологічних процесів, від аварій, викликаних зниженням міцності металоконструкцій, забруднення навколишнього середовища, страхових виплат і, головне, від смертельних випадків. Дослідження корозії показують, що захист від корозії – це насамперед правильна підготовка поверхні, а потім герметик або фарба. В результаті експериментів і випробувань отримано і запатентовано речовину CONTRRUST – універсальний екоматеріал на основі рослин-модифікатора-перетворювача, який перетворює іржу в хелатні металополімери. Склад, властивості та використання матеріалу, названого та запатентованого як CONTRRUST, були ретельно досліджені та впроваджені.*

***Ключові слова: дослідження, іржа, захисні покриття, ефективні засоби, екологія, хелатні металополімери, композиція, екоматеріал рослинного походження.***

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