INNOVATIVE TECHNOLOGIES: ESSENCE AND IMPORTANCE OF GALVANIC PRODUCTION DEVELOPMENT

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Abstract: The paper highlights the main environmental problems of the galvanic industry, since today's traditional galvanic production worldwide occupies the second place in environmental hazards after cars operating. All components that are emitted or discarded become constituents and aggressive parts of the atmosphere and the hydrosphere.

It was investigated that the most dangerous pollutants of the hydrosphere are heavy metal ions contained in industrial effluents of galvanochemical production. The total volume of wastewater in the CIS countries may reach 1 km which carries up to 50 % of the total used metal.

The use of the certified computer program Eol-Plus is proposed, which allows to calculate the contamination field for a point model of a source of harmful substances with a round and rectangular pipe mouth, a linear model, two models of an area source, and make calculations taking into account background concentrations. The program also provides a graphical interpretation of the calculation results presented in the form of dispersion maps with the possibility of changing the scale of the map of dispersion of substances in the atmosphere, the construction of the border of the sanitary-forbidden zone, the choice of the point for determining the concentration scale, obtaining printed copies, the module for generating, scanning and printing the calculation results in the table form documents and the mechanism for creating information files on an external data carrier.

It is proposed an innovative technology for the purification of rain and industrial surface runoff, which involves the complete purification of the first portion of contaminated wastewater with subsequent use for the production needs of the Ternopil State Scientific and Technological Enterprise "Promin".

Keywords: innovations, technologies, ecology, efficiency, galvanic industry, hydrosphere, runoff, morbidity, result.

1. Introduction

The anthropogenic load on the environment, produced by galvanic and pickling plants in Ukraine is counted by hundreds of thousands of tons of harmful substances. Polluting the environment, etching shops cause significant losses to other sectors of the national economy.

The traditional etching technology of 1 m^2 of the metal surface is realized by the removal of working solutions to the wash waters, depending on the degree of complexity of the parts, in amounts from 0.2 to 0.5 liters. That is, during the technological processing of 1 m^2 of metal coating, about 10÷30 g of copper, iron, nickel, etc. enter the wash waters while the maximum permissible concentration of these metals in wash waters is from 0.006 to 0.015 g/dm^3 [1].

In Ukraine despite the large-scale reduction in chemical industrial production (due to the occupied Luhansk and Donetsk regions), small, cooperative and private enterprises and limited liability companies are created in large quantities, which are engaged in metal processing and use galvanic technology. Such enterprises increase the risk of pollution of the atmosphere by emissions and discharges of pollutants. Today there are about 4000 such enterprises on the territory of Ukraine.

Significant damage to society causes nitrogen oxides which are moderately harmful gases. They have a general toxic and irritating effect. They are associated with diseases such as catarrh of the upper respiratory tract, emphysema, angina, pharyngitis, pneumonia, bronchitis, tuberculosis. The number of cancer diseases is increasing, especially in the cities of Ukraine, where industrial enterprises are located in residential areas [2].

In this regard, research is of the topical importance that onto the finding ways to improve the technological processes of cleaning the environment from the effects of various aggressive substances with the help of the Aiol-Plus computer program and water drains, using an innovative technology for cleaning rain and industrial surface runoffs.

2. Materials and methods

To carry out a full investigation of the galvanic production is a sufficiently long-term process that requires accurate calculations in the working areas of the etching workshops.

In the working areas of etching workshops, the maximum permissible concentrations of NO_x in terms of NO_2 are 5 mg/m^3, and in the surface layer, the daily average maximum allowable concentration is 0.085 mg/m^3 (according to updated data 0.2 mg/m^3).

Therefore, the standardization of the quality of the environment should be carried out with the aim of establishing maximum norms of the impact of anthropogenic activities to guarantee the ecological safety of the population, preservation of the gene pool, and ensure the rational use and restoration of natural resources in conditions of intensive economic activity.

Since the negative impact of air pollutants on living organisms does not directly depend on the volume of emissions into the atmosphere, but on the concentrations formed in the surface layer of air that people breathe, we suggest calculating the NO_x concentrations of the proposed solution formulations using a certified computer program Eol-Plus.

Using this program one can calculate the concentrations of dispersion of nitrogen oxides in atmospheric air which are formed as a result of scattering during the etching of the surface of ferrous metals using the Eol-Plus software.

The assessment of the impact of pollutant emissions in the air at the border of the sanitary protection zone is carried out in accordance with the requirements of the All-Union normative documents-86, taking into account the consequences of calculation of atmospheric air pollution level and using the Eol-Plus software.

The program “EOL”, developed by the Design Bureau of System Programming “TOPAZ”, is designed to calculate the level of atmospheric pollution in order to assess the impact of harmful industrial emissions of the projected enterprises, those that operate and those that are being reconstructed on the pollution of the surface layer of the atmosphere.

The calculation modules of the software implement “Calculating method of concentrations in atmospheric air of harmful substances contained in the emissions of the enterprise” in accordance with the All-Union normative document-86 “.

The program also provides a graphical interpretation of the calculation results presented in the form of dispersion maps with the possibility of changing the scale of the map of dispersion of substances in the atmosphere, the construction of the border of the sanitary-forbidden zone, the choice of the point for determining the concentration scale, obtaining printed copies.

The normative size of the border of the sanitary protection zone is determined from the extreme sources of emissions of the industrial site of the enterprise in accordance with the re-

quirements of the normative literature "State Sanitary Rules of Planning and Building of Settlements" approved by order of the Ministry of Health of Ukraine, N 173 dated 19 July, 1996.

We analyze the possible reduction in formation of the above-mentioned water pollutants by applying the proposed technologies of etching the surface of ferrous metals based on the example of information on the formation of pollutants in the production of the Ternopil State Scientific and Technological Enterprise "Promin", where the etching equipment is functioning.

3. Conclusions

Wash waters and waste solutions of enterprises form waste waters which contain all the components that make up the pickling bath. Etching of the surface of ferrous metals is usually carried out in solutions of hydrochloric, sulfuric, nitric and phosphoric acids or their mixtures. Such a process provides the formation of emissions of nitrogen (IV) oxide, nitrogen (II) oxide, sulfur (IV) oxide etc [3, 4]. Emissions of the above-mentioned pollutants into the atmospheric air from stationary sources of pollution, in particular galvanic and etching workshops are given in **Table 1**.

Table 1
Emissions of particular pollutants into the air from stationary sources of pollution

Name of Pollutant	2010	2011	2012	2013	2014	2015	2016
Thousand. tons							
Nitrogen (IV) oxide	310,5	333,0	332,5	333,3	288,1	233,8	240,2
Nitrogen (II) oxide	6,8	21,7	12,5	13,4	10,7	8,7	9,6
Sulfur (IV) oxide	1206,3	1333,1	1399,2	1381,8	1133,3	830,3	1076,4

Nitrogen oxides are moderately harmful gases. They have a general toxic and irritating effect. They are associated with diseases such as catarrh of the upper respiratory tract, emphysema, angina, pharyngitis, pneumonia, bronchitis, tuberculosis [5]. The number of cancer diseases is increasing, especially in the cities of Ukraine, where industrial enterprises are located in residential areas **Table 2, Fig. 1, 2.**

Table 2
Malignant tumors morbidity

Year	Number of patients diagnosed for the first time in their lives per 100 thousand population	Number of patients registered in medical institutions at the end of the year per 100 thousand population
2010	342	2168
2011	349	2234
2012	358	2319
2013	361	2409
2014	314	2231
2015	314	2258
2016	316	2323

Ternopil State Scientific and Technological Enterprise "Promin" refers to the enterprises of the electronic profile. Such plants are usually equipped with a complex system of water preparation (for example, soft water production), stations for cleaning industrial effluents from heavy metals (Fe, Cu, Zn, their alloys, etc.) and neutralizing the runoffs of etching production. It is clear that the sewage system of such enterprises should be multifunctional and must provide separate reception and local cleaning of sewage flows with different quality [6].

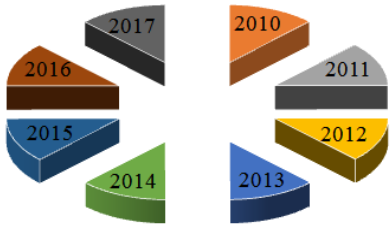

Fig. 1. Number of patients diagnosed for the first time in their lives per 100 thousand population

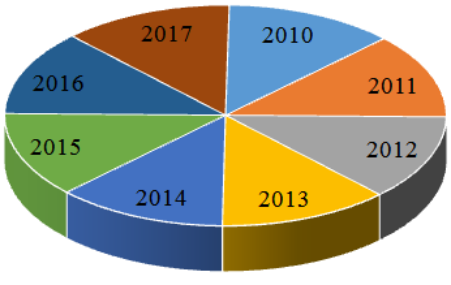

Fig. 2. Number of patients registered in medical institutions at the end of the year per 100 thousand population

To solve the problem of a separate reception of sewage waters of the enterprise and their subsequent processing to the normative values, the following sewage systems operate at the plant: household, industrial, rainy. The scheme for cleaning surface runoff at these facilities is as follows.

Rainwater flows through the system into the rainwater drain and in the gravity mode moves to the rain water storage tank with a volume of 161 m^3. Then, using the GNOME 10-15 pump the first portions of rainwater are poured into the storage of industrial effluents contaminated with petroleum products, paints, etc. The volume of this reservoir is 54 m^3.

In addition to rainwater drains, this reservoir provides the flow of industrial waste from the etching workshops of printed circuit boards, from car washing, etc.

The estimated costs of sewage inflow by type are: rainwater drains – 10 m^3/h; waste water from cars washing – 5 m^3/h; production runoff – 9 m^3/h; total: 24 m^3/h, which are more effective than in previous years [7].

From the drive, this wastewater is sent for cleaning. The scheme of their purification consists of the successive passage of the following purifying facilities:

1. Horizontal clarifier of the first degree of purification with a cassette polyurethane filter;
2. Electrolyzer – 5 m^3/h – 2 items;
3. Sediment II of the purification degree with a cassette polyurethane filter;
4. Mechanical filter with quartz filter loading;
5. Mechanical filter with activated carbon;
6. The accumulator of the clarified water in volume of 67.5 m^3.

From the clarified water tank purified liquids are sent for reuse for the production needs of the enterprise.

Thus, the declared purification technology provides the complete purification of the first portion of contaminated rainwater and its subsequent use for production needs.

4. Discussion

The aspects of this problem of other scientists in this field were analyzed. In particular, scientists Ramesh S., S. Rajeswari, S. Maruthamuthu found that etching of carbonaceous steels in dilute solutions of nitric acid is carried out with the participation of inhibitors containing phosphate ions, and according to S. V. Prikhodko, I. M. Kurmakova, A. M. Demchenko it is better to use inhibitors of triazoloazepine derivatives. The above mentioned technologies provide a reduction in the rate of dissolution of metal surfaces. However, most of these substances are environmentally hazardous, do not have a universal effect when the pH of the environment is changing, some of them are expensive and scarce [8, 9].

The implementation of proposed technologies is both environmentally and economically reasonable. The effectiveness of the proposed technology we tested at the industrial plant LLC at the Chernivtsi Machine-Building Plant. Experimental-industrial tests carried out by LLC "Chernivtsi Machine-Building Plant" showed high ecological and economic efficiency of the solutions of proposed constituents; the specific emissions of pollutants are reduced: nitrogen oxides from 213.7 to 20.4 kg; waste solutions from 40800 to 9780 dm^3. The implementation of solutions of the recommended composition reduces the expenses for acquiring chemical reagents for cleaning the surface of carbon steel parts and improves the ecological situation of the working area and the environment [10].

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