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# Sustainable Development of a Water Cleaning System from a Coating Section

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**Abstract.** The problems related to the protection of the environment by acuity in particular as a result of the local pollution of the environment factors by the industry and agriculture or by the population centers, as well as of a trans boundary pollution, which have led to the disturbance of ecosystems and the worse the living conditions of the people. The use of chemical substances in more and more in the technological processes advertise special measures concerning the protection of the environment. A major problem is the purification of industrial waste water.

**Keywords**: coating industry; industrial water cleaning

## 1. Introduction

In the framework of this work shall be submitted to a solution of the cyanides waste water treatment plant from galvanic industry (section accessories).

The removal of the pollutants existing results in the effluent purification stations mechanical-biological waste water implies the use of the effects of the processes of the electrolysis to resolve the issues related to the addressed.

A series of conditions covered locally in Romania by the technical rules of protection of waters (NTPA001 and NTPA002), and on the European plan for the Member States by the Directives KEPCO no. 271/91, no. 676/91 are designed to fit within the limits acceptable level of pollutants in the effluent.

NTPA- 001 refers to the waste waters of any kind, namely to waste water, waste, waste water industrial, sentenced to life imprisonments, or lump, tipped by systems arranged the fire from the technological processes its own, as well as the sewage joint venture, which have or have not been cleaned. The values laid down in these norms are maximum values are admissible.

NTPA-002 concerns the quality of waste water, from both social activities or economic in nature, which is to be the exhaust in the networks of the sewerage of localities and those directly in the treatment plants.

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The establishment of technological process of the origin and the quality characteristics of the waste water requires knowledge of the industrial process for a judicious design of the purification stations. Therefore it is necessary to know the origin of the flow into the main and their main characteristics to define how the waste water treatment plant. The reduction of waste water requires the use of new technologies.

The main harmful substances of industrial waste water are organic substances, the substances in the suspension, toxic substances and heavy metals, cyanide synthetic detergents etc. the recovery of valuable substances in the waste waters is aimed at their recovery and reduction of harmful substances discharged. (Ianculescu, 2002)

As a result of this chemical analysis has chosen to preserve the existing process by neutralization and in order to continue to apply an electrolytic oxidation followed by a process of adsorption on activated charcoal and a final filter in a granular filter with sand.

## 2. Waste Water Neutralization

For neutralization of polluted water from a metal plating section we use the equipment from figure no.1. An acceptable pH for clean water is between 6.5 and 8.

**2.1. We must to make the next steps:** adjust the pH of the solution between 7÷8. If the pH is 7 add sodium hydroxide. If the pH>8 add The hydrochloric acid: Add 4 l solution of calcium chloride inside of cleaning tank and then add 3 liters ferric chlorite at 1000 liters ground. Shake for 15 minutes; add 2.5 l electrolyte/1000 l solution from the tank; mix 3÷5 minutes after; agitation is expected÷2 3 hours for decantation of sludge.

**2.2. For the waste water in B basin (with metallic ions)**

Add the sulphuric acid to pH = 0÷2; add quantity of ground sodium, for reducing hexavalent chrome from tetravalent chrome, to the point of change of color from red to blue-green.

Add all the time the ground metabisulphite. The solution is obtained by dissolving 10 Kg quantity of sodium in 100 l of hot water.

After a primary settling the waters of the tanks B1 and B2 are entered in the B3 and then takes place the final decantation and then filtering (fig. no. 1)

The waste water resulting from washing the parts covered galvanic or from treated electro-chemical, contain toxic substances that are not bio- degradability's. Often hexavalent chromium, cyanide etc. require cleaning them before discharge to the natural circuit. Remove combinations hexavalent chromium shall be carried out by chemical reduction or electro-chemical ion at tetravalent chrome, less toxic and whose combinations are mostly insoluble. (Ionescu & Racoviţeanu, 2003)

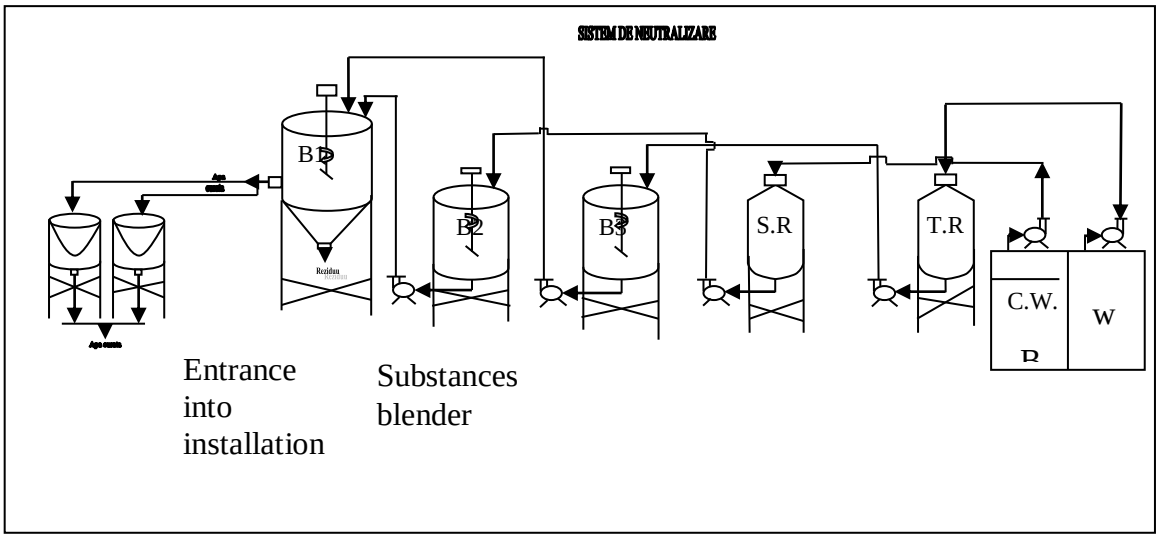


**Figure1. Water cleaning system from a coating section, were: B1, B2, B3- blenders; S.R- secondary reactor; C.W. - clean water; T.R. - tertiary reactor.**

The methods of chemical they have the disadvantages that are effective in an area limited by the pH-acid - and require the catalytic for carrying out the reaction of reduction.

Electrochemical methods eliminate these disadvantages and in addition with the removal of ions containing hexavalent chrome can be removed and other harmful matter.

Electrochemical Treatment consists in the obedience of the contaminated water a electrolyze with water-soluble anode manufacture of alloyed aluminum with 0.01-1 % indium or galiu and of iron or ferrous material (NTPA – 001 & NTPA – 002).

In the case of use sheet punching iron, as a result of the conduct of the electrolysis take place of the following processes: - on the cathode side: a) to reduce chloride ions of hydrogen and therefore alkalinized cathode space; (b) reduction of chloride ions hexavalent chrome at tetravalent chrome, which together with the ions OH-forming an insoluble precipitate chrome hydroxide.

The Ions ferric precipitated in the form of copper hydroxide ferrous rough, which in the presence of dissolved oxygen passes partly in the ferric hydroxide. Product total reaction time is a complex insoluble hidroxidic that incorporates harmful mater, ions in the form of chromium hydroxide.

The presence of the complex of iron makes free chromium substance, which normally require a specific area of pH for the precipitation-full should no longer be sensitive to pH, it can vary within the limits of the very broad (pH=11).

Studies have been carried out on the synthetic waters, containing 200 ppm hexavalent chrome and 20 g/l sodium sulphate necessary to increase the conductivity (SR EN 12566-7:2016); the original solution and the filtrate after the electrolysis of have been the subject of analysis for the determination of hexavalent chrome and tetravalent chrome, after the" iodine metric" determination method and manganese-metrical. Is used a cell of parallelepiped shape made of acrylic display, having a useful 0,3l. Anodes and cathodes with the dimensions 50x30x1 mm (the grilling surface-30cm$^2$), were made of the same material (SR EN 12566-7:2016).

## 3. Experiments

The experiments under have pursued the effectiveness of the cleaning of the polluted waters and specific consumption of energy in depending on the density of the anode (number of anode manufacture) and the time of the electrolysis.

There have been such tests with a number of four anode manufacture to the density of the current and the faster the electrolysis of smeller's found that both the decrease of the density of the anode current less than 0.2 A/dm$^2$, as well as reducing the time of electrolysis below 30 minutes have adverse effects on the effectiveness of treatment (tab.1).

The effectiveness of the cleaning the parameters of the electrolysis of links the point A. anode surface is 1.2 dm$^2$.

**Table 1. Efficiency of polluted water treatment**

| The density of the anode current A/dm$^2$ | Time for electrolyses (min) | Efficiently of treatment E,% |
|---|---|---|
| 0,2 | 30 | 100,0 |
| 0,18 | 30 | 92,3 |
| 0,15 | 30 | 83,9 |
| 0,2 | 25 | 83,0 |
| 0,2 | 20 | 64,2 |

Dependent on specific consumption of energy from the density of the current to the anode areas variables: 1- 0.3dm$^2$; 2- 0.6dm$^2$; 3-0,9dm$^2$; 4-1,2dm$^2$.

In accordance with the fitting of the electrodes in parallel, a anode surface of 1,2 dm$^2$ (four anode manufacture) provides an effective way of 100% at a density of current 0.2 A/dm$^2$ and the duration of the treatment of 30 minutes, energy consumption being 0.45 kWh/m$^3$.the precipitate which has formed ,that gathers in him harmful matters in the form of copper hydroxide chromium, has the appearance of powder and is easily filtered.

The Only disadvantage of this procedure consists of the duration of the relatively high treatment which does not allow the achievement of a continuous process.

## 4. Electrolytic Cleaning of Industrial Waste Water

Among the processes at present applied for cleaning waste water, a special place it occupies electrochemical methods, because of the possibilities that offers them recovery or the regeneration of products to be valuable in depending on how is done removing the substances that water polluted, by using electrochemical methods can be classified into three main processes.

Oxidation of electro-chemical of cyanide of waste waters (destruction of cyanide-free and complex), the destruction of cyanides, after the electrolysis, is the result the process of oxidation that adds frequently

small quantities of chlorides in the polluted waters. Chlorine released on anode exercises an oxidizing action on cyanides.

One of the methods of purification of the solutions containing the ferrous and potassium ferry-cyanide propose their treatment in a electrodes anode with graphite and cathode of steel at a density of current by 0,8-30 $A/dm^2$.to intensify the process shall be entered in the solution to 6 g/l calcium chloride for 1 g ferrous- and potassium ferri-cyanide. So 500 ml, containing 1 g/l Ferro cyanide to which have been added 3g calcium chloride have been subjected to the electrolysis at a density anode current of 2.3$A/dm^2$, under a voltage of 5 V, at a temperature of 90°C and pH=3. After 30 minutes of alkali solution was pure, devoid of ions cyanide or $Fe_2$+ and $Fe_3$+ (which have been precipitated as hydroxides).

Degree of purification depends to a great extent on the density of the current. The optimum density of electrical power is 1.9 $A/dm^2$, to which the degree of purification is 99,7 %(concentration of arsenic) (SR EN 12255 – 16:2006).

## 5. Conclusions

Waste waters from the metal plating plant, contain between 1000 and 3000 mg/l metallic ions of various anion exchanger, complexion agents or agents of shine, showing a high degree of toxicity.

The electrolysis of such waters, under certain conditions allows non harmful their often engaged to the recovery of metals.

Metallic ions toxic can be removed by reduction in the process of CRT, when performing and recovery or by embedding in their hydro-precipitated, resulting from the chloral alkali electrolysis with water-soluble anode manufacture (the rule of iron). At the same time with the removal of the metallic ions, shall be carried out and the oxidation of harmful anion, such as cyanides or organic compound existing into the water such toxic metals with chrome, led, zinc, manganese, cadmium and cyanides have been removed from waste water through electrolysis, in the presence of the sodium chloride, using the soluble anode manufacture of iron and cathodes from a insoluble material.

Toxic metals ions have been precipitated that keep and remove by filtration and has been oxidized at charbon dioxide and azot.

For the recovery of metals in the diluted solutions, is carried out by using our proposal, an electrolysis process with a cathode composed of conductive particles of current enclosed in a perforated cylinder rotating, waste water (the electrolyte) is circulated among the cathode ray particles using a pump.

The developments of the industry and in particular of the chemical industry advertise special measures concerning the protection of the environment.

In this context a major problem is the purification of industrial waste water.

The development and implementation of technologies of sewage sludge at a technical level contemporary require addressing modern processes, to ensure the responsible removal as advanced harmful matters at a cost as low.

Using this method of neutralization for polluted waters from a metal plating section we reduce the total production costs with about 37%.

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