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Transportable Process Module with Upgraded Ecological and Economic Parameters for Regeneration and Processing of Foul Electrolytes

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A transportable unit with improved ecological and economic parameters which uses progressive technologies for regeneration and processing of electrolyte-containing effluents and solutions is suggested. The solutions to improve environmental effectiveness and reduce the cost of manufacturing processes of neutralization and electrochemical regeneration of spent electrolytes are considered. The mobile unit can be used for treatment of metallurgical, machine-building, automotive and other industries wastewater, as well as for scientific and research purposes.

Keywords: FOUL ELECTROLYTES, TRANSPORTABLE UNIT, NEUTRALIZATION, ELECTROCHEMICAL REGENERATION, ENVIRONMENTAL AND ECONOMIC PARAMETERS

Problem Statement

The problem of formation of significant quantity of production hazardous waste is urgent for industrial centres of Ukraine. Environmental hazard of such waste causes the necessity to find the means to reduce their negative impact on the environment and human health. The foul electrolytes are formed in technological processes of metallurgical, machine building, chemical industry, as well as during batteries operation. Thus, all industrial enterprises face the problem on utilization of this kind of wastes, which are formed both in the technological processes and during the operation of enterprise vehicles.

The Analysis of the Latest Achievements and Publications

The feasibility analysis showed that depending on the specifics of the enterprise and the conditions of waste water and process solutions formation, their chemical composition and quantity several options of their processing are possible. Nevertheless, the most common methods of are neutralization and electrochemical regeneration; and in the context of ecological safety regeneration is the preferable one. Building of stationary treatment facilities for disposal and recycling of waste water needs large economic costs and additional production space. The usage of such transportable units will help to eliminate these disadvantages. They can be transported to the sites of generation of pollutant effluents, which will exclude the necessity in the construction of stationary treating systems. The disadvantages of the known modular units [1, 2] are insufficiently high degree of purification and increased hardness of treated water while using reagent method. It makes impossible to recycle the water and causes its discharge into the sewerage facilities. Among other disadvantages there is impossibility of technological solutions concentration during the regeneration and lack of compulsory monitoring of waste water composition.

Work Objective

The purpose of the work was to reduce cost of the technological process of wastewater treatment containing electrolytes, and to improve environmental and economic parameters of the unit: to increase cleaning efficiency, to ensure the return of treated water and the regenerated solutions into the process.

Investigation

The stated objectives were achieved due to the usage of advanced technologies of regeneration [3]

and processing [4] during the development of transportable unit. It was offered to construct the mobile unit in the form of a movable platform with the casing, in which the production lines of neutralization and regeneration are set, allowing to process waste water in three ways: by neutralization, electrochemical regeneration and combined method (Figure) [5].

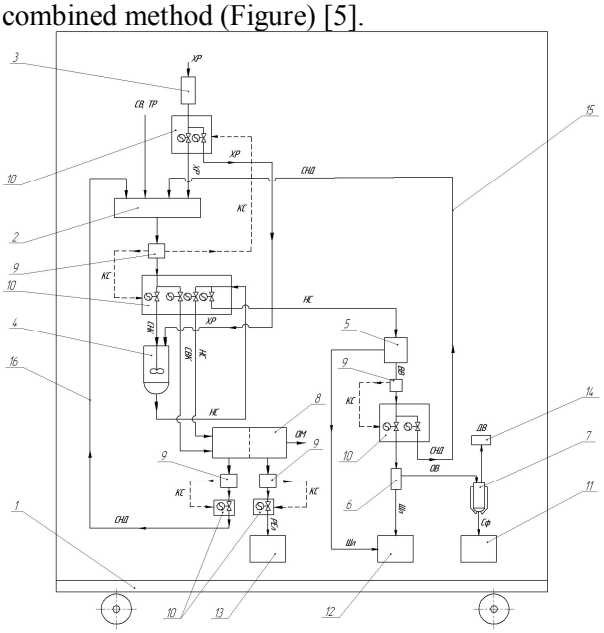

Figure 1. **Complete equipment of processing chamber of transportable unit for waste water and technological solutions treatment:** 1 – motion platform with casing; 2 – facility for discharge equalization; 3 – unit of chemical reagents preparation; 4 – reactor-neutralizer; 5 – holding pond; 6 – micro filter; 7 – evaporator unit; 8 – electrochemical regeneration facility; 9 - discharge control unit; 10 - control unit for waste water and technological solutions discharge; 11 – sulphates collection container; 12 – slurry collection container; 13 – regenerated electrolyte collection container; 14 – polished waste water collection container; 15 and 16 – pipelines for recycling the effluents for polishing; СВ – waste water; ТР – technological solutions; ХР – chemical reagents; НС – neutralized waste water; ВВ – settled sewage; ОВ – clarified water; Шл – slurry; ДВ – polished water; Сф – sulphates; РЕл – regenerated electrolyte for recycling; ОМ – metal oxides for utilization; СНД – effluents for polishing; КС – control signal; СВК – high concentration effluents; СНК – low concentration effluents

Equipment works the following way: the transportable platform with the casing 1 where a set of process equipment is established is moved to a place of formation or accumulation of waste water (CB) and technological solutions (TP). Waste water is subjected to equalization in the waste water equalization facility 2. Control unit 9 of waste water chemical composition, which is designed as a sampling unit and sensors with electronic (microprocessor-based) device of control signal formation, determines its pH and the presence of environmentally harmful components in the solution. If necessary, waste water can be brought to the desired pH by chemical reagents from the unit of chemical reagents preparation 3. Depending on the indicators obtained a decision on the method of further waste water processing is made and the corresponding production line is selected: neutralization, regeneration or combined treatment line. Discharge control is performed by unit 10 (a tank of valves (taps) with electric drive).

Installation of the control units of waste water chemical composition and waste water discharge control after waste water equalizing tank will allow making the best decision on the method of treatment.

If the decision to neutralize is made waste water is directed to the neutralization process line. Waste water and chemical reagents are fed into the reactor-neutralizer 4. As a result of chemical reactions dissolved components transform into insoluble compounds in the form of hydroxides. The obtained suspension enters the holding pond 5, where it is separated into slurry (Шл) and settled sewage (ВВ). Settled sewage from the holding pond is fed to the micro filter 6, where it is post-treated to be purified from suspended particles. Then clarified water (ОВ) enters the evaporator unit 7 with the condenser, where polished water (ДВ) is collected in polished waste water collection container 14, and then can be recycled in the production process. The dry residue, which consists mainly of sulfates (Сф), is collected into the container 11, and then is directed for utilization. Slurry (Шл) from the holding pond 5 and after filter 6 enters slurry collection container 12 and is directed to the further processing.

If the decision about regeneration is made, waste water enters the regeneration process line and undergoes electrochemical regeneration in the unit 8, where by a known method [3, 6, 7] the extraction of metal (ОМ) in the form of nonferrous scrap and recovery of the main components of electrolyte in the original form occurs. Regenerated electrolyte (РЕл) enters regenerated electrolyte collection container. If necessary, it undergoes composition correction and is recycled.

If the decision about combined treatment is made, including reagent and electrochemical methods, waste water treated with reagents flows from the reactor-neutralizer 4 into electrochemical

regeneration facility 8, where it is electrochemically treated.

At the output of each process line the unit of discharge chemical composition control 9 is installed. It sends a signal to the control unit for waste water and technological solutions discharge 10, which allows its returning for polishing in case of a insufficient quality of liquid waste products. In case of insufficient purification of waste water after neutralization, it is returned for polishing into the facility 2 by the pipeline 15. In the case of discrepancy to the regenerated electrolyte, the latter is returned into facility 2 by the pipeline 16.

The processes of neutralization and regeneration can be carried out continuously or discontinuously, depending on the specifics of formation, the quantity and chemical composition of the waste water.

Conclusions

1. The transportable unit for waste water treatment is suggested, in which there are process lines for neutralization and regeneration that allow carrying out treatment of waste water by three methods: the reagent method (neutralization), electrochemical method (regeneration) and combined method (neutralization and regeneration are made gradually).
2. The usage of the suggested transportable unit will allow carrying out rapid utilization and control of electrolytes-polluted waste water; reducing cost of technological process of waste water treatment; improving environmental and economic effectiveness of unit parameters; obtaining economic benefits out of recycling of regenerated electrolytes, valuable components (metals) and water; also it will eliminate the need of creation of expensive stationary treatment systems in industrial enterprises.
3. The suggested transportable unit can be used for wastewater treatment in metallurgical, machine-building, automotive and other industries, as well as for scientific and research purposes.

References

1. V.S. Zhurkov, A.I. Gladkiy, Ye.Ya. Sokol, M.P. Bykov, Yu.A. Khailovich. USSR Patent: AS 899487 USSR, МПК3 C 02 F 1/46, G 05 D 27/00.*

2. K.G. Bogolitsyn, A.M. Ayzenshtadt, M.V. Bogdanov, S.I. Larionov. Russian Federation Patent: No.2162448, МПК7 C 02 F 9/14, 1/00, 1/463, 1/78.*

3. V.P. Bobylev, V.V. Kotlyarov, O.V. Matukhno. Ukraine Patent: No. 90182, МПК7 B01D61/42.*

4. V.P. Bobylev, O.V. Matukhno. Ukraine Patent: No. 85001, МПК8 C02F1/00, C02F1/66, C02F9/00, E03F5/00.*

5. O.V. Matukhno, V.P. Bobylev. Ukraine Patent: No. 65896, МПК7 C02F9/00, C25D21/00.*

6. D.N. Smirnov, V.Ye. Genkin. Ochistka stochnykh vod v protsessakh obrabotki metallov. - M.: Metallurgiya, 1989. – 224 p.*

7. A.I. Serdyuk, T.S. Bashevaya. Resheniye problemy regeneratsyi otrabotannogo akkumulyatornogo elektrolita s tselju umen'sheniya negativnogo vozdejstviia na biosferu // Visnyk KhISP, Issue 1 (6). Series "Ekologiya, tekhnogenna bezpeka i sotsial'nyi progress". – Kharkiv, 2004. – P.148-153.*

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Мобильный технологический модуль с улучшенными эколого-экономическими показателями для регенерации и обезвреживания отработанных электролитов

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Предложена мобильная установка с улучшенными эколого-экономическими показателями, в которой использованы прогрессивные технологии обезвреживания и регенерации сточных вод и технологических растворов, содержащих электролиты. Мобильный комплекс может быть использован для обработки сточных вод металлургической, машиностроительной и других отраслей промышленности, а также для научно-исследовательских целей.