CONTRIBUTION

Dear colleagues, let me introduce our work included in the conference, the title of which is "A**n efficient technology for wastewater treatment and desalination: case study**".

Water pollution and increase of water demand in various parts of the world has led to a shortage of fresh water resources, which makes it necessary to continuously develop effective water management measures. It includes also surface water prevention from pollution. In a number of countries, wastewater usually is discharged into surface water and Armenia is no exception in this respect. Thus, polluted waters become unusable for both drinking and irrigation; as well as service water and in fish industry. Due to the above-mentioned circumstances, today wastewater treatment and reuse have become a vitally topical issue. Solution of this problem will provide a number of advantages for various sectors of the economy. The key problem here is to apply a cost effective wastewater treatment technology which will provide the appropriate quality of treated wastewater.

The paper aims to suggest the cost effective and environment friendly technology for some industrial wastewater treatment. In this regard main methods of wastewater treatment have been studied and cost efficiency of some desalination method in Armenia have been analyzed.

Mechanical treatment is the wastewater treatment oldest method. Disadvantages of this method are both the low degree of purification and the impossibility of removing toxic substances dissolved in water. Chemical method is carried out using special chemical reagents, which convert the contaminants in the water into insoluble sediments. The main disadvantages of this method are both the low level of filtration of the treated wastewater and the high cost of the reagents used. This method is usually used for some industrial wastewater treatment. In the case of physico-chemical methods, wastewater is mixed with a chemical that interacts with pollutants, accelerates the separation of suspended particles, absorbs or dissolves pollutants, and makes harmful chemical substances harmless. It has a number of advantages: cleaning equipment occupies a relatively small area, has a high resistance to the wastewater amount and quality fluctuations, provides a relatively high quality of wastewater treatment. Biological treatment methods are divided into aerobic and anaerobic methods, depending on the conditions of wastewater treatment. Aerobic treatment reduces odor and removes nutrients more efficacy. Main disadvantages of aerobic treatment are energy consumption, utility and maintenance high costs of this process. Anaerobic treatment has a number of advantages over aerobic treatment. The biogas produced during an anaerobic treatment process can be used as a source of renewable energy also produces very low sludge that is de-waterable and fully stabilized for disposal.

New desalination technologies being developed in the world to meet the growing demand for fresh water. Desalination methods presented in tha paper are classified into 3 main groups: chemical: ion exchange, membrane: electrosarmos, reverse osmosis, electrodialysis, and thermal: extrusion, distillation. Ion exchange and electrodialysis are the most reliable among water desalination methods enabling to perform both a partial and deep treatment. Thes methods presently are not in wide use for they are rather costly. Electrosmos and reverse osmosis methods are effective for mineralized water desalination have low cost and high productivity. However, high concentrations of salts are considered a limiting factor for these methods. The cost of water treatment with the mentioned methods increases linearly with the increase of the concentration of salts contained in water. Cost and productivity of water desalination by different methods are presented in slide 5.

The proposed technology developed based on the water treatment and desalination main method - distillation, the principle of which is water evaporation and condensation. Disadvantages of the distillation method are: high energy consumtion, low productivity, evaporating organic compounds at temperatures below 100^{o}C, water hardness, which can cause sediments formation on the heat exchanger surfaces. The main disadvantages of distillation after the implementation of these processes are high energy consumption and low productivity

Various energy-saving technologies have been developed to reduce energy consumption. In order to calculate the amount of energy required for water treatment, thermal calculations have been performed according to well-known thermal engineering formulas. It has been found out that in order to desalinate 1 m^3 of water by using electricity in Armenia, 21.9 thousand AMD that is USD 45.63, is needed, which has a very high cost compared to other methods, therefore this method needs to be improved.

Using the principles of above-mentioned technologies, we have developed a new technology for wastewater treatment, pure water and concentrate production, which is presented slide 6.

Power from *1* solar photovoltaic station is supplied to *2* accumulator, from which taken power heats thermally insulated *8* and *17* chamber. At the same time, power is supplied to 9 spiral closed electric heater. From the *3* sewage container, the wastewater passes through *4* heat exchanger, enters *5* absorbing pipe and is triturated into *8* chamber by *6* pump and *7* pipe. The smallest wastewater particles evaporate immediately, the medium particles, touching the *9* heater, also evaporate, and the larger droplets accumulate at the bottom of the conical chamber. The condensed wastewater is re-triturated in *17* chamber through *14* absorption pipe, *15* pump and *16* pipe. These processes also take place here, after which the wastewater condensate is discharged from *18* pipes into *19* wastewater condensate container. The steam generated in the *8* and *17* chambers passes through *11* pipe through *4* heat exchanger and cools transferring its energy to the passing wastewater, discharged from *12* tubes into *13* container for clean water. The *10* grid located in two chambers serves to prevent water droplets penetrating into the evaporator pipe.

Thus, the proposed wastewater treatment process runs through three scheme includes 3 main units. The first one is the solar photovoltaic elements unit, which is used to generate comparatively cheap energy, the second is the dusting chamber, which allows water to evaporate at temperatures up to 100^{o}C and at the same time increases the productivity of the equipment. The third one is the heat exchanger unit, which allows the energy spent on evaporation to be transferred to the new stream of wastewater to be treated. To substantiate the efficiency of the proposed technological solution, we performed a thermal design. For instance, the task is to calculate the required capacity for 50 l/h wastewater treatment. Thus, in one hour it is necessary to evaporate 50 kg of water, which will require 50×0.75 = 37.5 kW of power, where 0.75 or 75% is the efficiency ratio. Since most of the heat energy expended is returned by the heat exchanger, energy can only be expended on heat losses. We admitted that in the case of good thermal insulation, these losses are 25%. In this case, the required energy will be about 10 kW. Thus, for 1 m^3 wastewater treatment 200 kWh of electricity will be required. If this energy is provided from the network at a price of USD 0.06 per 1 kWh, the wastewater treatment cost will be USD 12.37, which is 3.7 times cheaper than traditional wastewater treatment. Taking into account that the cost of solar energy is USD 0.004, then for 1 m^3 wastewater treatment USD 0.83 will be required, which is 55 times cheaper than the traditional method of wastewater distillation.

As a case study, economically efficient and environmentally safe new technology for brandy and wine factory wastewater treatment is suggested, pure water and distillery dreg concentrate production, which will be used in agriculture to improve soil properties and increase fertility. Wine and brandy wastewater management is of interest in various wine regions of the world, including the United States, Australia, France. Although wine production does not have a reputation for polluting industry, these effluents contain large amounts of organic matter, low pH, and variable levels of salinity, which is indicating that these effluents can be environmentally harmful. Treatment ad utilization of this wastewater also incurs significant costs for manufacturers. Thus, the creation of effective and low-cost methods of wastewater treatment is a topical issue.

The use of distillery dreg as a fertilizer for perennials - grapes and apricot orchards with the norm of 700 t/ha allows to improve the chemical, physical and nutritional regimes of the soil and increase the yield. However, the cost of transportation is a significant obstacle for distillery dreg usage, as it contains a significant amount of water, approximately 90% and transportation is not economically beneficial. For instance, for the reclamation of one hectare of saline-alkaline soil, 800 rounds of tank cars of 25 tons capacity are required, with an average distance of 30 km. In case of distillery dreg usage as fertilizer, it will be necessary to drive 28 cars of the same capacity. Among all brandy and wine companies in Armenia, only Yerevan Brandy and Wine Factory, which production is the highest in terms of quantity and quality, is transported the distillery dreg to avoid environmental problems, but in order to reduce huge costs, it is currently given to lands up to 10-15 km away. The cost of one 15- kilometer rounds with 25 tons of tank car of 25-ton capacity is 15 thousand AMD, that is USD 31.25. For the transportation of 28.3 thousand m^3 of distillery dreg produced annually, it is required 1120 rounds for which USD 35 thousand will be needed. In case of distillery dreg condensation by 5 times with the proposed technological solution, those expenses will make USD 7000 or USD 27916 will be saved annually. At the same time, with the nutrients containing in 28.3 thousand m^3 of distillery dreg, 404 hectares of land can be fertilized, the value of fertilizers is USD 312.5 per ha, or USD 126250 will be received as profit annually. Expenditures for distillery dreg condensation will be USD 23580. The annual profit will make approximately USD 131000 and at the same time, the ecological balance of the environment will be maintained.

Thus, we could conclude, that this paper presents a new technology for wastewater treatment, obtaining clean water and concentrate, which is of environmental and agricultural importance. It will allow entrepreneurs of a number of spheres to treat industrial wastewater without economic damage. The units used in the proposed technology, unlike other similar technologies, allow not only to increase the productivity of the equipment, but also to return the energy expended through the heat exchanger. The effectiveness of the proposed technology is demonstrated by the example of the Yerevan Brandy and Wine Factory. With the use of this technology, the factory complying with all environmental standards can implement industrial wastewater treatment by obtaining distillery dreg concentrate, the sale of which will provide additional income.

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