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A CASE STUDY OF INDUSTRIAL WASTEWATER TREATMENT FOR THE PETROCHEMICAL INDUSTRY WITH A FULL RECYCLING SYSTEM / IRAQ: A REVIEW ARTICLE

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Abstract
In light of the generalization of public policies to rationalize fresh water consumption in industries internationally, and reduce rates quantities of water discharge from water bodies, with the aim of reducing the negative impact on the environment, and to reduce the annual operational cost, industrial wastewater treatment designs aim with a complete water recycling system based on exploiting the available surplus of industrial wastewater in companies and factories, to achieve a policy of integration between companies, and to maximize the benefit from the capabilities available to it, thus reducing the investment cost required to establish a new socket project water, a lifting station, primary treatment units, and sand filters so that industrial wastewater is reused after treatment in cooling operations in cooling towers, or treatment operations to produce ultra-pure water to produce various types of steam, or used in industrial processes as a theoretical field study by emphasizing the maximization of the role of modern technology to reach the highest productivity with the least amount of liquid waste and reach the lowest possible capacity of evaporation equipment in processors.

Keywords: Water treatment technologies, Sustainable development, Industrial waste

A review Article Problem: Water is one of the most important factors for sustainable development, so there is an urgent need to rationalize the use of what is available water resources, which are suffering from scarcity and scarcity at this particular time, Since most of the Iraqi lands are in arid and semi-arid areas characterized by lack of rainfall, the importance of treating and reusing sewage and industrial wastewater has grown, and encouraging sound, integrated management of the reuse of wastewater after treatment. Technologies and treatment methods have developed rapidly with taking into account the environmental standards of the nature of this water, with the need to follow up on the environmental effects of reusing this water by developing integrated programs for environmental monitoring of pollutants and their effects on the surrounding environment.

A review Article Objective: The design of treatment plants takes place according to the quality and characteristics of the wastewater to be used by the plant by treating it according to the composition of the type of pollutant, so each factory must choose treatment techniques according to parameters that change with the change of the product, and the specifications and quantity of waste water and the ability to reuse it. It is possible that the petrochemical industry may cause environmental pollution by discharging it into the river. It is loaded with many dangerous pollutants

The method Article: The study deals with the different types of pollutants in industrial wastewater generated from different sources production units in the petrochemical industry, methods, methods, levels, and processing techniques traditional and modern ones used, highlighting some successful models and studies, It has been adopted in the treatment of industrial wastewater by applying modern technologies, especially complete water recycling, which has become common recently, with the aim of highlighting the environmental and economic benefits of these treatments in Baghdad /Iraq .

1- INTRODUCTION : Most countries of the world have turned to planning and sound, integrated management of reuse industrial wastewater after being treated efficiently and sufficiently to prevent damage from reusing them, and getting rid of the old method that was followed in the past by getting rid of them drainage on water bodies[1].

The success of water treatment and reuse depends on a set of standards and controls the environment that is related to the nature of this water and the ultimate goal of treating it and reclaiming it , which must be carried out within a framework that ensures the protection of the environment, through the development of programs integrated environmental monitoring of pollutants and their effects on the surrounding environment. The study began by defining the concept of water quality, as every industry requires it, the "specific quality" of water varies from one industry to another, and it is possible that the quality of the water is suitable for one industry, but unsuitable or dangerous for another. For example, it may food industries require water containing concentrations of calcium sulphate, it is necessary to know quality requirements for industrial water in terms of quality and quantity of impurities present in it, and their effects on industrial use, as the permissible limits of these impurities vary according to uses, In addition, the quality of water is affected by its properties, and the proportions and quantities of impurities present in it. Petrochemicals collect huge amounts of water, and most of these complexes have their own water resources, whether from surface water sources, groundwater [2].

Petrochemical plants use huge amounts of steam in their various production units, such as ethylene cracking units and naphthalene steam cracking to produce ethylene, or to produce hydrogen using the steam reforming method. A number of petrochemical complexes treat, purify, and reuse part or all of the wastewater in their factories, the concept of water balance for the cooling tower includes all water inputs and outputs associated with the operation of the system, this includes water output "outlet", controlling water loss factors such as evaporation, wastage, and drift water droplets coming out, pump leaks, or any uncontrolled sources and causes of water lose control, such as overflow, all causes of water shortage or loss are compensated for by feed water supply "compensation" there are several traditional methods of water treatment drainage and methods of reusing treated water, such as physical treatment methods or mechanical, chemical treatment methods, and biological treatment methods, as there are many methods and levels of industrial wastewater treatment according to the required treatment, and according to specifications of wastewater entering the station and emerging from it, and according to the amount of wastewater required treated, but in general, the levels of industrial wastewater treatment may be preliminary or preliminary treatment, primary, secondary, or tertiary or advanced pretreatment depends on the sedimentation of solids in primary sedimentation ponds[3]. These basins are usually wide enough to accommodate light solids, fats and oils by floating on the surface of the water, so that it is easy to scrape off and remove. This is done through reservation at refineries, separation of oily materials, grease, and suspended materials that can settle. Treatment methods included according [1,4]

Primary are both screening or methods of stabilizing the flow rate and flow of water industrial drainage "Flow Equalization", and various oil separation methods, such as the CPI oil separation unit, and sedimentation and decantation methods clarification", in addition to a simplified explanation of the different deposition methods, included deposition by coagulation and Flocculation, and definition of flotation methods flotation, dissolved air/dissolved gas flotation method (DAF/DGF), the method of induced air flotation, IAF, and gas flotation GF .

Secondary processing it is called biological treatment, and it comes after the completion of the initial and primary treatment stages an important and integral part of industrial wastewater treatment plants, where more than can be removed 90% of organic materials present in wastewater through biological treatment processes as dissolved organic matter, which evaporates from the initial treatment stage, is removed. The study explained a biological treatment is a process carried out by groups of bodies and microorganisms that consume organic materials as food and convert them into nuclei the final metabolism of carbon dioxide, water, and energy is necessary for the growth of bacteria and its reproduction, biological treatment processes are divided into four main groups, processes aerobic, and anoxic nitrification processes - ammonia oxidation processes in the presence of hypoxia, anaerobic processes, aerobic processes and anoxic nitrification traditional biological treatment methods known as sludge methods were highlighted anabolic steroid, which is considered one of the most widely used methods at the present time due to its high efficiency in treatment, this name is given because part of the settled

sludge is returned to the sedimentation basins the secondary tank is continuously aerated, and this helps in accelerating the biological process efficiency increases due to the increase in biomass density in the aeration basin, thus increasing the rate oxidation, the breakdown of organic materials into their basic components. Treated water enters ponds aeration after passing through the primary sedimentation basins[4,5].
There has been a need for more advanced biological methods to improve specifications and quality effluents in terms of their biological oxygen demand (BOD) content Nitrogen and phosphorus, with the aim of meeting increasingly stringent environmental requirements for permitting distributing treated water to public drains, or reusing it for other uses industrial and other uses to ensure that the required stringent environmental standards are met, some modifications have been made various features have been added to the basic design of activated sludge treatment plants traditional, some modifications were included in the designs of co-processing units and sinks sedimentation, and other facilities. These methods have evolved to include the graded activated sludge method tapered Aeration, the activated sludge method is extended (extended - prolonged) aeration "Aeration Extended" method, "Oxidation Ditches" method, and methods stabilization, to include more advanced and modified methods in bioreactor designs such as sequencing Batch Reactors (SBR), Moving-Bed Processing System, and Membrane Reactors as for tertiary treatment anumber of physical and chemical separation methods are included. Tertiary treatment is used after operations biological treatment at the secondary stage, with the aim of meeting the requirements of integrated treatment operations to reach the levels and quality of water required in terms of environmental requirements for reuse at this stage, pollutants are removed from the wastewater that have not been removed or disposed of completely in the secondary processing stage, to reach acceptable limits of material content total solids, biochemical oxygen demand content (TSS, BOD), and nutrient removal nitrogen, phosphorus, and removal of volatile organic compounds and metals[4.6].

Tertiary processing processes include physico-chemical separation techniques such as, adsorption Activated Carbon Adsorptio, Membrane Filtration, Ion Exchange, De-chlorination and reverse osmosis, this chapter also sheds light on the modern concept of the drainage system Zero Liquid

"ZLD", also known as the complete recycling system for industrial wastewater, especially with the increasing environmental standards implemented by companies, which stipulate preventing the discharge of pollutants salts, toxic pollutants, nitrates, nitrites, etc., and this technology has now become more widespread all over the world. It can also help companies deal with many challenges such as the high costs of obtaining the necessary water, its scarcity in many cases, and growing interest with zero liquid drainage techniques due to increased environmental awareness and social responsibility towards environmental issues. The investment and operational cost of zero liquid drainage technologies may appear relatively high due to the huge energy consumption (it consumes about 10 - 20 kilowatts) hour/m3, compared to 2-3 kWh/m3 in water desalination techniques), but it may be an economical solution acceptable, especially when the alternative is transporting wastewater over long distances for treatment in external units or stations. The drawback of zero discharge techniques is that there is no fixed standard design for the techniques used in treatment processes for all industries, so that it is constant for all types of wastewater, designs vary from one industry to another according to the specifications and characteristics of wastewater. This is a promise zero Liquid Drain technology is suitable for a wide range of industries, including production projects energy, refining, petrochemical, fertilizer, mining and food production, where available avariety of equipment and technologies suitable for treating various types of wastewater, in the third chapter, the study dealt with case studies of applying the concept of wastewater treatment industrial in the petrochemical industry[7,8].

1-1 Complete recycling of water

In light of general policies to rationalize fresh water consumption in industries, and reduce rates quantities of industrial wastewater discharged into water bodies, with the aim of reducing the negative impact on the environment, and to reduce the annual operational cost with a complete water recycling system, based on exploiting the available surplus of industrial wastewater in factories, to achieve a policy of integration between companies, and to maximize the benefit from the capabilities available to it, thus reducing the investment cost required to establish a new socket project water, a lifting station, and primary treatment units including clarifiers and sand filters so that industrial wastewater is reused after being treated in operations cooling in cooling towers, or treatment processes to produce ultra-pure water for the production of various types steam, or used in industrial processes after removing all the water including "recovery" for reuse again, with the aim of rationalizing the amount of water required, as well meeting environmental requirements, by adding equipment to dispose of waste, as it is a very primitive and expensive method to maximize the role of modern technology to reach the highest productivity with the least amount of liquid waste[9,10].

This is to reach the lowest possible capacity of the evaporation equipment. This is done using the latest treatment methods, which is the zero liquid drainage system "ZLD".

1-2 Water treatment unit in the petrochemical complex

The water treatment unit consists of: according [1,10]

1• Microfiltration unit: The filter unit consists of 6 lines, each line has 80 "filter" containers, and contains an equalization tank to collect water in it, and three vertical pumps that pump water to the filter unit. This unit works to remove obstacles in water and turbidity, the way it is passed through a medium that allows only water to pass through, and does not allow the passage of obstacles.

2 • Partial desalination unit: Partial and complete salt removal unit recovery rates for desalination units using traditional water systems medium salinity "Brackish Water" does not exceed 75% of the value of the feed water entering the water unit, thus there is about 25% of the feed water in the form of liquid waste high salinity levels. The recovery rate is determined by the salinity rate and the safe limit for operation, so that there are no dissolved salts in concentrated form that exceed the solute balance ratio, and thus this leads deposits are formed on the membranes of the final boilers of the desalination units. Therefore, technologies have developed, and the technology of removing salts has become increasingly advanced "Efficiency Reverse Osmosis- HERO", which overcomes the formation of deposits, so it works on removing the causes of scale (precipitation) from the water pumped onto the desalination membranes, by removing water hardness, and thus the recovery rates of the osmotic membrane can be raised to about 97%, which applied to the membrane unit of the complex, where the pH value is raised, which works to remove the causes of biological sedimentation, which was applied in the unit[11,12,13].

As for the unit for removing calcium and magnesium salts from water, "Softener and HRU units consists of four primary containers of water softener, containing cationic resins are used in the ion exchange process to remove calcium and magnesium salts to less than 20 GFM, it also consists of four final containers of water softeners hardness Removal Unit contains cationic resins used in the ion exchange process to remove calcium and magnesium salts to less than 0.5 GFM.

3• Total salt removal unit: The working idea of the salt removal unit depends entirely on the "Fractional Electro de – ionization Unit on the use of electricity to separate ions and pass them on resin membranes membrane", thus separating the salt occurs, producing completely demineralized water with up to efficiency to about 92%. The unit consists of two lines (the production of one line is 105 m3/hour). This water is stored in tanks made of stainless steel, and this water is pushed to the factories by three pumps, plus a spare pump sludge removal unit in the complex. The purpose of this unit is to remove sludge from water resulting from backwash operations and wastewater resulting from treatment operations, through the injection of some chemicals with the aim of depositing sediments and pollutants, collecting them, and disposing of them, the unit is formed to according [1,12,15]

• **Sedimentation tank**: Water is quenched by injecting some chemicals in order to collect water when the sludge reaches 5%, it is pushed through special pumps to the thickener.

• **Thickener:** It is the one in which the concentration of sludge in the water is raised to about 25%.

• **Centrifugal separation unit:** In the centrifugal unit, water is separated from sludge by centrifugal forces central, and the water is returned back to the chute to get rid of the concentrated sludge in the waste area.

4.Reverse osmosis unit "RO": The unit consists of three degasser towers and four lines, with a production capacity of 220 m3/hour per line of demineralized water partially, this water is used as a feed source for the FEDI Total Demineralization Unit, as well to store water in cisterns for replacing the cooling tower basin water, partially desalted water lines[13,16].

2- Conclusions and Recommendations

New policies, government strategies and public awareness campaigns have contributed community acceptance of the concept of on-site industrial wastewater recycling and recycling, their use, which contributed to finding solutions to the water shortage needed for industry, in addition to applying strict environmental considerations, to preserve the environment, are therefore necessary to be more widespread in currently, the success of water treatment and reuse depends on a set of standards and controls the environment that is related to the nature of this water and the ultimate goal of treating it and reclaiming which must be carried out within a framework that ensures the protection of the environment, and individuals taking into account taking into account economic considerations, and the need to monitor the environmental impacts of reusing this water on the components of the environmental system by developing integrated environmental monitoring programmers, pollutants and their effects on the surrounding environment, as most countries of the world have turned to planning and sound, integrated management for the reuse of wastewater after treating it efficiently and sufficiently to prevent harm from its reuse, and got rid of the old method that was followed in previous times by disposing of it by discharging it into water bodies. Each industry requires a "specific quality" of water that varies from one industry to another. It is necessary to know the quality requirements for industrial water in terms of quality and quantity of impurities present in it, and their effects on industrial use, as the permissible limits of these impurities vary according to uses, in addition to the fact that the quality of water is affected by its properties, proportions and quantities, the impurities present in it, petrochemical industry is a complex and integrated industry that includes many processes industrial and products, in which different types of raw materials (feedstocks) and factors are used catalysts, additives, and chemicals.

The petrochemical industry can cause environmental pollution as a result of waste and discharge industrial wastewater loaded with many dangerous pollutants resulting from the operation of the units different productivity, if not treated in accordance with regulating environmental laws and every industrial facility is required to establish units or plants for treating industrial wastewater , this is in accordance with environmental laws and legislation production factory must choose designs and processing techniques according to specifications that change with the product specifications and quantities of wasted water, and the purpose of its reuse. The petrochemical complexes consume huge amounts of water, and most of these complexes whether from surface water sources, groundwater sources, or both others use municipal drinking water, partially or completely and establish their own units of facilities to secure their energy needs steam, or supplied from external sources, and it usually generates the steam it needs under pressure moderate, as petrochemical plants use huge amounts of steam in their units different productivity, water used in the petrochemical industry is classified according to its final uses, as feed water or cooling, or “Make Up” compensation, or ultra-pure water to feed boilers and produce steam used in heating, evaporation, and drying operations, in addition to using water for extinguishing services, drinking, and other uses. Increasing environmental standards implemented by companies, which prohibit the discharge of salt pollutants toxic pollutants, nitrates, nitrites, etc., have led to the choice of many modern technologies to meet these requirements, the technology has become complete recycling of industrial wastewater, which is also known as effluent drainage zero "ZLD" is more widespread around the world. ZLD technology can help companies deal with many challenges such as high costs of obtaining the necessary water, and its scarcity in many cases. Interest has also increased with zero liquid drainage techniques due to increased environmental awareness and social responsibility towards environmental issues. The study recommends reducing pressure on water resources by use e water more effectively and efficiently and produces the highest quality water and reduce operational expenses at the same time with reducing government expenditures on water management and improving new markets.

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