



ADVANTAGE OF OZONATION IN THE WASTEWATER DISINFECTION

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ABSTRACT

Ozone has the ability to kill and destroy microorganisms including bacteria, fungi, viruses, yeasts and algae. Ozone is also effective against kits irradiated as Giardia and Cryptosporidium is chlorine without this property. Unlike ordinary disinfectants, such as chlorine, ozone and formaldehyde or harmful to not leave any toxic substances; because these molecules are not stable and after a short break and become stable oxygen molecule. Because the gas is not stable to use it, it must be generated on site. Ozone as an oxidizer is very strong, it has many industrial and domestic purposes. While not seeking to detrimental environmental effects. The aim of this study was to investigate the advantages of ozonation in disinfection of wastewater.

Key words: Ozonation, Disinfection,

INTRODUCTION

Growing cities and increasing population on the one hand and expansion of industries and factories, on the other hand, environmental pollution becomes increasingly more important (1). Existence of wastewater is one of the environmental pollution. Therefore, they must be collected and removed from cities, first they purification and then

returned to the water cycle in nature. Wastewater depending on the origin and properties are divided into three groups (2). Limited water resources usable for different purposes, measures to prevent contamination of water and sewage is inevitable. Industry as one of the main causes of water pollution, both in terms of volume

of waste produced and the type of pollutants that will enter them, has great importance (3). Many industries in their production processes because the materials that enter the water if you are, human health, animals and the environment will be severely compromised (4).

History of water treatment with ozone in Iran

In 1998, due to the increasing pollution of river in Khouzestan province that cause unpleasant taste and odor in the water, it was decided to ozonation in water treatment equipment of number one in Ahvaz city is installed and operated. According to data of the equipment after about 140 days of operation were shut out because of the corrosion shell out as an ozone generator (5). This situation remained the same until changed again in summer 1990, ozone generators, ozone production and injection circuit was put into operation (6). As mentioned above, the main purpose of the use of ozone in the treatment plant, unwanted oxidation compounds by ozone, which improves water quality, especially in terms of taste and smell that has also been associated with decontamination of 100%, of course in the distant past, the ozone system is used in Hamedan but today is not in the operation of the circuit. According to the survey is the

third plant that has used ozone for water purification, wastewater treatment of Baba Sheikh Ali in Isfahan. According to some of the problems that had arisen in the country in relation to ozone, plant managers of the production of ozone bought a small device (with a capacity of 20 grams of ozone per hour) was installed in the pilot after getting desirable results to purchase two units with a capacity of 9 kg per hour is ozone. According to information obtained, the price of these units was 600,000 euro (6). In this regard and in accordance with the policies of water and wastewater companies to replace disinfectants and oxidizing stronger than chlorine, ozone has been used in new treatment plant of Hamedan and all these companies are looking to replace ozone by chlorine, which reflects market for ozone generators in the country (7). Now a number of domestic companies, which are represented by foreign companies, are assembling parts imported ozone generator system (8).

Experiences of some countries in the use of ozone:

1. American

In 1940, the first unit of ozonation to eliminate taste and odor of materials mill was established in the United States. The chlorination is also used

together was always to be in stable distribution system residual disinfectants. Research has shown that the use of ozone, chlorination would be to reduce the production of trihalomethanes less than 1 microgram per liter (15). Due to higher water quality of the water resources available in the United States, most Western countries, the use of ozone has been little attention in the United States, however, with increasing pollution of surface and ground water quality in the 90 new laws to improve the situation, including the approach to the use of ozone in order to improve the quality and reliability of the drinking water (16).The ozonation of wastewater treatment facilities in the country with between years of 90 to 94 from 20 to 60 has increased (17).

2. Canada

The first ozonation plant in Canada in 1956 was the installation. In this country of ozone as a disinfectant and to remove the taste and odor and turbidity control is used, however, to maintain a disinfectant residual values at the same time in the network's chlorination system has

been used. The use of ozone in Canada to remove taste and odors major problems of disinfection is to help seasonal (18-19).

3. France

In 1992, about 700 plant in France using ozonation systems were employed in water treatment plants of all surface water is provided. The main purpose of using ozone to control taste, smell,destruction of phenol, removing organic material and inactivating the virus and destroy the bacteria. In some of the ozone treatment to remove iron and manganese color and is used in most homes has been reported that ozone treatment was increased turbidity removal efficiency (22-20).

High disinfection power

Ozone is germicidal properties of high oxidation potential it represents. Research shows that ozone disinfection is achieved by a direct effect on bacteria and bacterial cell wall is analyzed. The mechanism of action in terms of chlorine in the disinfection process is different. Due to the high ozone disinfection compared with chlorine (25 times) and other disinfectants are needed

less time to complete the disinfection process. The study is also the ability of ozone to eliminate viruses than chlorine (27-23).

Ozone as a strong oxidant

Ozone has many uses in the treatment of drinking water, such as taste and odor control, color control and removal of iron and manganese, in addition to disinfection. Clarify the oxidizing power of poor quality water sources such as recycled water is important. Ozone is fully oxidized mineral waste and cause sedimentation and they will be removed. The major importance of ozone is capable of breaking down organic compounds with iron and manganese. Ozone in removing organic compounds producing color, so that the strong and effective as a polishing agent has good drainage and removal of paint numerous applications in drinking water. Ozone is also capable of generating phenolic compounds and other compounds destroy the taste of drinking water. Research has shown that the pesticides malathion and parathion ozone can convert the phosphoric acid compounds are carcinogenic and

hazardous (safe). Recently, the use of ozone to control and remove turbidity and organic matter in EPA regulations guidelines have been presented (25-21).

Water refinery of cooling towers by ozone

Nearly a century of oxygen to form ozone is known for its high potential for water disinfection are known. Cooling towers, water must be treated to prevent the development of microbial mineral layers because these layers can reduce the efficiency of the heat transfer surfaces (12). The use of ozone in water cooling towers which are generalized finding is relatively new. In this section we try to use the experiences of such technology in the real cooling towers have been studied and the results and benefits described (7).

Technology selection

Over the past twenty years, treatment with ozone in a cost-effective technologies in terms of energy has become. In this section we try to clarify the issue of evaluation of results and experiences. In a study of information foreign manufacturers, consumers, trading companies,

research institutes and other parts involved in this technology has been used. In these studies, energy consumption, cost and environmental benefits have been considered (9). In addition, various technologies have entered the market in terms of new or already have your answer practically divided, and some were concerned that their questions have to be practical. The tower was diagnosed as water treatment method using appropriate ozone (9).

Potential of this method

During the last twenty years has led to improvements in systems of commercial ozone generators are small in size so that in addition to being economically effective, reliable system. However, the use of ozone in cooling tower water treatment new job, but because of its advantages, the market is growing. Installation and operation of this system are appropriate and reduced the number of bacteria and thus biofilm formation on heat transfer surfaces decreases (7). Reduce energy consumption, increase operational efficiency and reduce matters relating to maintenance, in addition to cost

savings, has environmental benefits as well as drainage of blow down is also an important issue (8).

Application

There are many reasons that are attracted towards ozone which in this case could be the high cost of chemicals or criticality of the material, he or cost of effluent discharge to the environment or that law is so high that blow down shall discharge sewage. This technology also connected for cooling towers, air-conditioned, as well as the applicable style industrial processes (7). Manufacturers claim that the system in cooling towers of wood and metal can be used with capacities 60-1000 ton. The use of ozone technology four technical criteria must be taken into consideration (9).:

1. Water quality compensation that is added to replace water lost through evaporation and blow down (the hardness and mineral content of the factors involved in the efficiency of the impact of ozone)
2. The heat exchanger operating temperature (if the temperature is

- too high, the ozone disappears immediately before impact.)
3. The rate of corrosion of materials (the amount of their alternative and additional protections against corrosion)
 4. The cooling tower operating environment (debris and excess organic matter increases consumption of ozone disinfection of water).

Studies of "screening" and economic analysis must also be part of the decision-making process. The chiller cooling towers connected to the style used in industrial processes with commercial air conditioning systems are just one of the examples. In our country, a study on the benefits of the use of ozone in cooling towers has been conducted entitled "Evaluation of the performance and level of energy losses cooling towers of Isfahan Refinery ". The economic study was carried out to reduce ozone generation system blow down cooling towers of Isfahan Refinery. Based on the calculations in this study, approximately 780 thousand cubic meters of ozone water production system and about 117 thousand

dollars in operating cost savings will follow the refinery towers. Meanwhile, the economic assessment carried out showed that the payback period will be one year (11).

Industrial wastewater treatment with ozone

The reaction of ozone (O_3) in wastewater can be divided into two categories:

Direct reactions of ozone and degradation caused by free radicals. Accordingly, the analysis pure solvents, ozone is as follows (9):

Direct reactions of ozone to the hydroxyl free radical is very selective and slow. The reaction rate hydroxyl radicals (OH^*) are typically a million to a billion times the speed of reaction of ozone. This radical oxidation potential of ozone are much larger and much less selectivity properties. Therefore, it seems that the main active ingredient in the destruction of toxic organic, free radicals are produced when ozone decomposition (14). Advanced oxidation processes (AOP), hydroxyl radical concentration of ozone decomposition to increase to increase the oxidation of organic substances dangerous worse. Some of these advanced processes are combined with ozone to form these radicals increases include: hydrogen peroxide, UV radiation and high

PH. It should be noted that ozonation high PH for the oxidation of ammonia, cyanide and deposition of heavy metals analysis is very effective.

Advantages of ozone disinfection, sterilization and eliminate the microbial load (7):

1. Ozone is a disinfectant effective and far better than chlorine, chlorine dioxide, chloramines and the hydroxyl radical.
2. The relative resistance of microorganisms to ozone approximately as follows: bacteria, viruses, eggs and parasitic cysts.
3. It is observed that after the ozonation, consumption decreased coagulation and filtration speed rises.
4. The micro-organic pollutants in wastewater in the natural organic matter (NOM) can be found, but their concentration is much lower (about $\mu\text{g} / \text{L}0.1$ to $\mu\text{g} / \text{L}100$), which are partially destroyed by ozone and radicals OH.
5. Almost all types, including industrial and domestic wastewater can be used by ozonation treatment. Operating

conditions used in ozonation, it depends on the industry and type of wastewater.

6. According to the summary, followed by the emergence of new types of microorganisms in wastewater, such as eggs and parasitic cyst, revealing a greater variety of pollutant in it. Increasing quality requirements for wastewater, have led designers to consider the ozonation process.

DISCUSSION AND CONCLUSION

Statistics and information show that ozone to kill bacteria and inactivate viruses are effective, also seems to be effective chromophores ozone oxidation, resulting in reduced color. In many cases, ozone reduces the potential for trihalomethane formation. Usually the complete removal of phenol and phenol derivatives of aromatic breakdown occurs when the consumption of phenol 6-4 moles of ozone per Hrmvl In such circumstances, the primary organic carbon remains almost 1.3% of cod removed 80-70 and the concentration of non-aromatic products of decomposition less than 0.5 mg/i.Ozone with organic compounds and substances called ozonide in certain circumstances will produce their effects is not yet known. The amount of bromine that

there is water in bromate ozone becomes affected in the long term can be dangerous in terms of health. Ozone can also be used to reduce the oxygen concentration of toxic substances in wastewater that contain ammonia. In this process ammonia is converted into nitrate. Oxidation of organics, including two direct oxidation with ozone gas and the production of free radicals such as hydroxyl radicals intermediate. Hydroxyl radical production method than direct oxidation by ozone is preferred. Oxidation by hydroxyl radicals can often entire disinfection period of time or by increasing the reaction rate, short and thus extend the whole cleaning contaminants. Ozone spontaneously decomposes into oxygen and hydroxyl radicals form as intermediate products. Ozone in water under alkaline conditions, in contact with UV light or hydrogen peroxide breaks down into hydroxyl radicals. Of these conditions can be used to speed up the formation of hydroxyl radicals in the design to achieve. According to the experiments is well known that the use of ozone in wastewater treatment is surprisingly effective, so that all microorganisms are destroyed and that also causes the metal ions to be deposited in discoloration and loss of smell and taste. Ozonation not produce soluble solids and is not affected by the

system of ammonium ions. With regard to wastewater discharge standards and the results of tests on the treated wastewater by ozonation criteria are acceptable for all proposed uses, including agriculture, industry and urban use artificial recharge of ground water.

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