Static Mixer Apparatus for blending Ozone with water in the Process Pipeline

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Abstract. The article describes the procedures and results of directly mixing ozone with treated water in the process pipeline. The issue of disinfecting drinking water is significant because water is a vital resource for economic activity. Modern researchers are developing innovative disinfection technologies, such as mixing ozone-air with treated water in the process pipeline. The formation and quality of water in a reservoir were investigated, as well as the effect of ozone on the physicochemical parameters of water taken from the reservoir. The study presented a prototype disinfectant system and confirmed the findings of other researchers that swirling water flow is the most efficient way to mix 99% of ozone released into the pipeline. The study determined a treatment mode that provides the maximum disinfection efficiency while using the least amount of ozone.

1 Introduction

In recent years, there has been research on the use of static mixers to disperse ozone-air mixtures directly in the process pipeline. Static mixers are compact devices that can mix gases and liquids very effectively. They work by creating a swirling motion in the liquid, which helps to dissolve the ozone. The use of static mixers is the most economical and promising way to achieve high levels of ozone utilization. This is because static mixers can achieve 95-99% ozone utilization, which is much higher than other methods of mixing ozone with water [1-3].

1.1 Existing Methods

Traditionally, drinking water is purified and disinfected using coagulation and chlorination at the initial and final stages of treatment. However, wastewater from cities and industrial plants has led to significant changes in the quality of water in water sources. Studies have shown that the water treatment facilities are unable to effectively remove various contaminants like surfactants, oil products, phenols, ions, heavy metals, etc., which are

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 https://doi.org/10.1051/e3sconf/202344906014

present in the water [4]. Furthermore, the use of chlorine for treating water from surface sources leads to the creation of harmful and cancer-causing substances like volatile halogen-containing compounds (VHCs) and trihalomethanes (THMs) [5].
For these reasons in our study, we decided to focus on the same swirling motion method that is created by static mixers. This process is widely known as the process of Ozonation [4].

2 Method, Design and Experimental results

This article discusses the design of the apparatus for mixing liquid and gas. The principle of operation of the apparatus is based on the creation of swirling liquid flow in order to mix water and gas media during the treatment of natural waters with ozone.

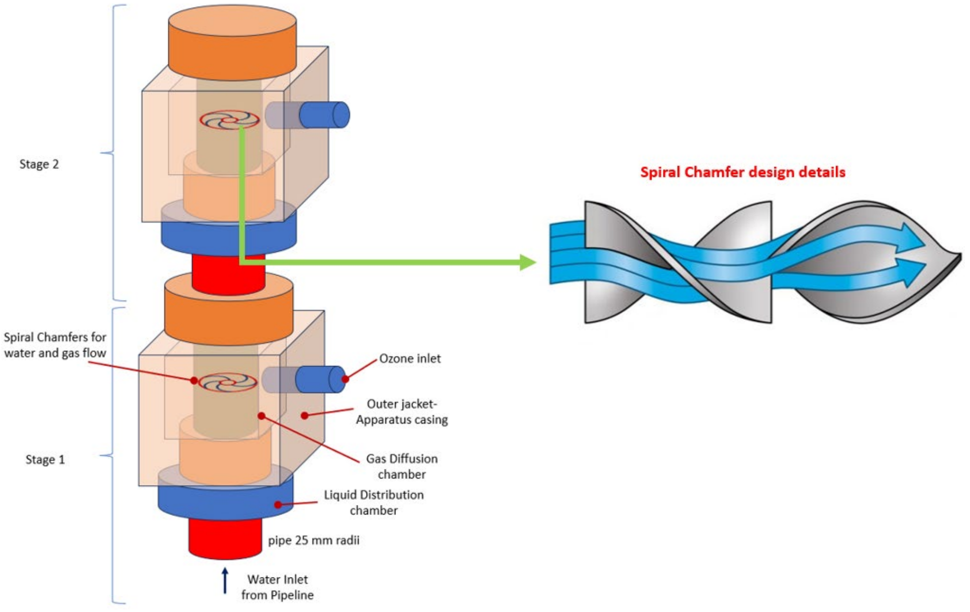

Fig. 1. Apparatus used for ozonization in this study contains two stage process of mixing the Ozone into the water through the supply pipe.

Fig 1 shows a two-stage ozonization apparatus. The first stage is the ozone inlet, which is in the middle of the apparatus. The second stage is the liquid distribution chamber, is connected to a pipeline that supplies water to the apparatus. The ozone inlet is where the ozone gas enters the apparatus. The gas diffusion chamber is where the ozone gas is mixed with water. The liquid distribution chamber is where the ozone-infused water is distributed to the desired location. The two-stage ozonization process is used to achieve higher levels of ozone utilization for purification.

The water is allowed to enter the apparatus The ozone gas is let into to the diffusion chamber the spiral fins of the chamfers force the water and ozone layer to undergo spiral motion that creates the swirling action [5-12].

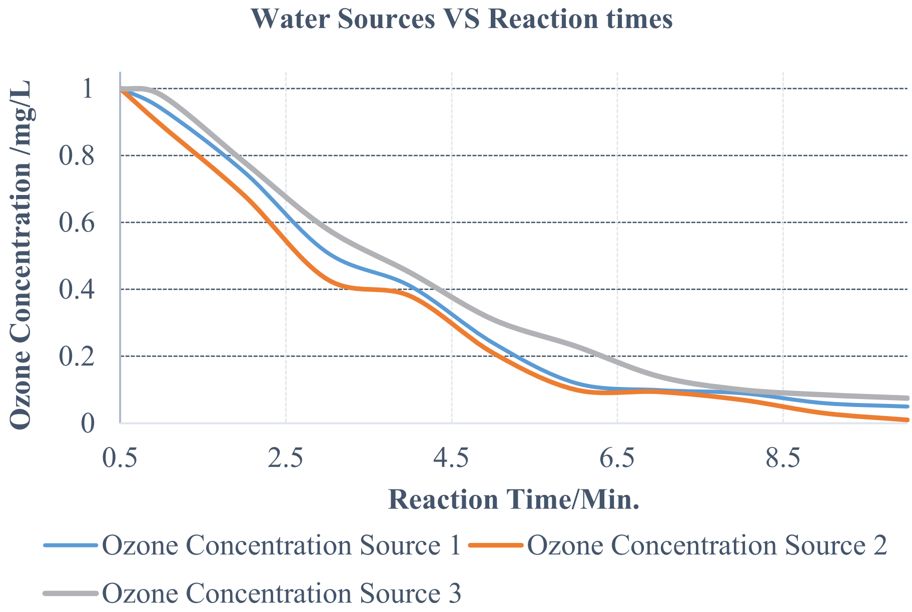

Fig. 2. Ozone Reaction times with water from various sources that was tested on the apparatus.

Fig.2 Dissolved organic carbon (DOC) 2.9 mg/L, carbonate alkalinity 3.2 mM at PH levels of 8 at 16 degree centigrade. The plot shows that the Ozone has a very similar stability levels across all three sources of water. The water is alkaline in nature. It was found that the DOC levels were similar in all three sources of water as they were tested by injecting them into the apparatus described in Figure 1, from three different sources- reservoir, feeder channel, main course of the river (Amu Darya).

3 Conclusions

1. The results from the study emphasize that using static mixers is the most cost-effective and promising approach for achieving high ozone utilization rates in water treatment. With the ability to attain ozone utilization levels of 95-99%, static mixers outperform other ozone-water mixing methods, making them an efficient and reliable choice for water treatment processes.
2. The research findings from the static mixer experimentation provide valuable insights into the water's characteristics and ozone stability levels[5]. The water samples from various sources (reservoir, feeder channel, and main course of the river - Amu Darya) exhibited similar ozone stability, indicating that the static mixer's performance is not significantly influenced by the initial water quality. This robustness allows for consistent and effective ozone-water treatment across different water sources.
3. The recorded parameters of Dissolved Organic Carbon (DOC) at 2.9 mg/L, carbonate alkalinity at 3.2 mM, pH levels of 8, and a temperature of 16 degrees Celsius provide essential baseline information for further water treatment studies. Understanding these key parameters and their interactions with the static mixer's ozone blending process can help optimize and tailor water treatment strategies, ultimately leading to improved efficiency and environmental impact.

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