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Production of Ozone and the Simple Detection using Potassium Iodide Titration Method

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Abstract. Ozone is a molecule consisting of three oxygen atoms (O_3) and a powerful oxidizing agent that can also act as a non-chemical disinfectant. Ozone can be detected using potassium iodide and titrated using sodium thiosulfate to know the concentration. The purpose of this study is to know the output of ozone concentration from the ozone generator. Ozone measurement was done by making KI solutions and the concentration are 0,2; 0,4; 0,6; 0,8; and 1 M then flew by ozone for 2 minutes with flow rate 1 L/min and the color of the solution will change from clear to brown. The brown solution titrated using $Na_2S_2O_3$ 0,4M solution, until the color of the KI solution becomes clear again. In conclusion, potassium iodide (KI) can detect the output of ozone generator which means potassium iodide (KI) concentrations linier with ozone concentration.

Keywords: ozone, simple detection, potassium iodide, titration method

1. Introduction

Ozone is a molecule consisting of three oxygen atoms (O_3) and is a powerful oxidizing agent which can be also acted as a non-chemical disinfectant [6]. Ozone was specified as non-toxic in low concentrations, environmentally friendly, relatively harmless, and almost similar to oxygen. The production of ozone can be made by flowing oxygen into the ozone generator. The initial method for ozone generation is utilization of splash from an electrode that may break up oxygen to convert into three bonds [5]. The high concentration and purity of ozone may be adjusted using controlled flow rate and the pure of oxygen input, therefore for the achievement of good validity of ozone measurement, the pure oxygen is advised to be applied in the system [5].

Ozone can be detected via the utilization of potassium iodide or KI and sodium thiosulphate or $Na_2S_2O_3$ using titration methods. This can be applied since reaction of the system produces the visible color at the final reaction, thus this visible color appearance can be detected with ease and may provide the linear graph as the volume of applied solution. The amount of ozone may be detected by flowing ozone into the KI solution, then analyzed using titration method using sodium thiosulfate [3].

The purpose of this study was to expose the color appearance of titrated sample and concentration of ozone caught by KI with the high volume of KI.

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2. Materials and Methods

2.1. Materials

2.1.1. Chemical materials

KI (0.2 mM) from Roche (Germany), ozone generator, oxygen container from modern health shop in Semarang, Indonesia, aquadest, and sodium thiosulfate were obtained from Center of Research and Services-Diponegoro University, Semarang, Indonesia.

2.2. Methods

2.2.1. KI solution preparation

KI in aquadest solution was prepared from the initial KI at the concentration of 0.2 mM using KI powder. Other concentration was also made to produce KI at concentration of 0.4, 0.6, 0.8, and 1 mM.

2.2.2. $Na_2S_2O_3$ solution preparation

$Na_2S_2O_3$ in aquadest solution was made from the powder at the concentration of 0.4 mM.

2.2.3. Ozone treatment

Ozone treatment was applied using following the method with small modification [4]. Potassium iodide at the concentration of 0.2, 0.4. 0.6, 0.8, and 1 mM were flew by ozone using ozone generator for 2 minutes with the adjusted flow rate at 1 L/min. The color of the solution changed from clear to brick red.

2.2.4.Titration

The brick-red-colored solution then was titrated using 0.4 M $Na_2S_2O_3$ solution until the color of the KI solution turned back to clear.

2.2.5. Titration analysis

Testing was done by calculating the dissolving ozone based at the input oxygen rate. For example 10 L/min (Vair = 10 L min) was applied into KI solution, for example 2 minutes (t = 2 minutes). KI solutions then was exposed to ozone. KI and ozone solutions were then titrated using $Na_2S_2O_3$ solution until the KI solution turned back to colorless. The volume $Na_2S_2O_3$ was then recorded and substituted into the following formula:

$$Ozone\ Concentration\ = \frac{Mr\ O3.V.N}{Vair.e.t}$$

while Mr O_3 is 16.3 = 48, V is $Na_2S_2O_3$ volume, N is $Na_2S_2O_3$ concentration, Vair is air flow rate (oxygen), e is electron mass X 2, t is time (min)

3. Result and Discussions

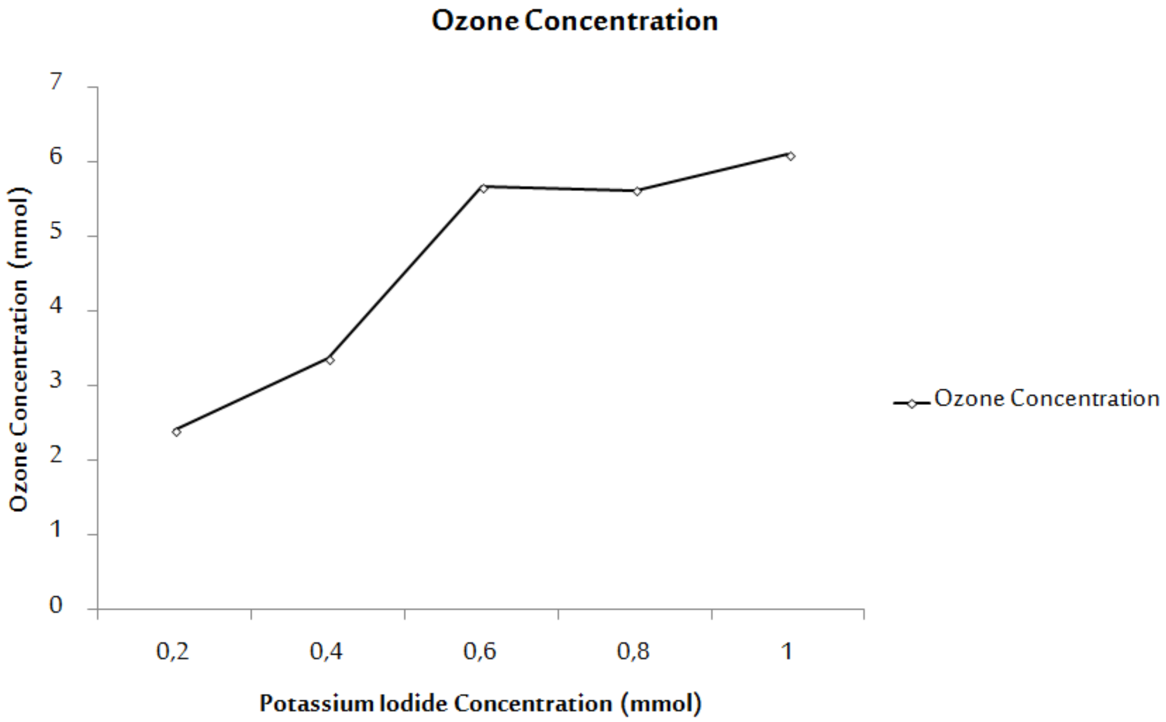

Figure 1. The ozone concentration changes using the KI at the of 0.2, 0.4, 0.6, 0.8, and 1 mM

Determining the product of formed ozone is based on the reaction of I^- with O_3 which produced I_2 by reaction $O_3 + 2I- + H_2O \Leftrightarrow I_2 + 2OH- + O_2$. The equivalent amount of I_2 formed in the KI solution was then titrated with sodium thiosulfate by reaction $I_2 + 2\ Na_2S_2O_3 \Leftrightarrow 2NaI + Na_2S_4O_6$ [1]. The data shows that the concentration of 0.2 mmol potassium iodide could produce ozone at concentration of 2.5 mM while 0.4 mmol potassium iodide generated 3.3 mM ozone. Potassium iodide at concentration of 0.6, 0.8, and 1 mM produced 5.9, 5.8, and 6.2 mM ozone, respectively. This shows that the higher the concentration of potassium iodide (KI), the higher the ozone could be trapped. This is in accordance with the statement that KI binds ozone and more KI concentration the more ozone may be bound [2] .

4. Conclusion

Based on this study, potassium iodide could bind ozone and the more potassium iodide concentration the more ozone might be bound.

5. References

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