CHAPTER 1

INTRODUCTION

1.1 Background

Rivers are a major source of surface water and offer many benefits to people's lives. However, the quality of river water can change due to life in the river itself and various human activities around it; this is because rivers are open water systems close to human activities (Mardhia & Abdullah, 2018). One of the most common pollutants found is organic compounds, a large group of carbon-containing compounds that excludes carbides, carbonates, and carbon oxides (Qamarul, 2020). The presence of these organic compounds warrants greater attention because they can degrade water quality and disrupt the balance of aquatic ecosystems (Kaneko et al., 2022). Therefore, technology and analysis are needed to quickly and easily detect organic compounds.

Many studies have shown that photocatalysis can increase the efficiency of organic compound removal from water. For example, the study by (Yang et al., 2021) showed that the accumulation of natural organic matter (NOM) on the surface of TiO_2 can reduce photocatalytic activity because the catalyst's active sites are covered, thereby reducing the penetration of ultraviolet light during the photocatalysis process. However, the study only focused on TiO_2 in powder form and used an artificial humic acid solution. Therefore, this study examined only the effectiveness of one material type and has not demonstrated effectiveness in removing organic compounds from natural water. Therefore, this study employs photocatalyst immobilization on a resin, thereby simplifying post-reaction separation and maintaining TiO_2 catalytic activity during pollutant degradation (Sharma & Dahiya, 2022). Thus, the photocatalyst system by Resin Immobilized Photocatalyst (RIP) TiO_2 can combine two main mechanisms: adsorption by resin and photocatalytic degradation by TiO_2, which can work together to increase the efficiency of reducing the accumulation of organic compounds on the material surface (Sharma & Dahiya, 2022).

Furthermore, this study used river water, which better reflects the actual conditions of natural water and contains many organic compounds with more complex compositions. With this type of water, the desorption process is more necessary to maintain the photocatalytic material's performance. Desorption occurs when the analyte contained in a solid is released into solution (Maslukah et al., 2020). As mentioned in the study (Yang et al., 2021), an alkali solution can be used as a desorption agent for regeneration to restore the effectiveness of TiO_2; therefore, this study will use a NaOH solution as the desorption agent in RIP TiO_2. This is also supported by the anatase structure of the TiO_2 catalyst, which is a very stable inorganic oxide, thereby making RIP TiO_2 less soluble in the NaOH desorption solution under ambient conditions (Mbanga et al., 2022).

On the other hand, several local studies have shown that pure water can also function as a desorption solution for saturated materials. However, some studies have reported that deionized water is less effective than chemical solutions such as bases. Although the desorption method using base solutions and pure water has been shown to increase pollutant release, most studies still focus on the percentage of desorption without examining the bonding mechanisms involved and the impact on changes in the adsorbent's structure and functional groups. Based on these limitations, this study was conducted to examine the desorption process using NaOH solution and deionized water on the TiO_2 Resin Immobilized Photocatalyst (RIP) system based on organic compound parameters with the main focus: (1) material characterization to identify changes in the surface functional groups of RIP TiO_2 after regeneration, and (2) the stability of RIP TiO_2 during the photocatalysis process after desorption and its impact on regeneration.

1.2 Formulation of the problem

Based on the background description above, the following is the formulation of the problem in the research:

1. How do contact time and regeneration solution (NaOH and deionized water) affect the amount of organic compounds desorbed from RIP TiO_2?
2. How does repeated use with and without desorption treatment affect the effectiveness of RIP TiO_2 in removing organic compounds?
3. How does regeneration affect the functional groups and morphology of RIP TiO_2?

1.3 Objective of the Study

Based on the background description above, the following are the research objectives:

1. Analyzing the effect of contact time and regeneration solution (NaOH and deionized water) on the amount of organic compounds desorbed from RIP TiO_2
2. Analyzing the differences in the effectiveness of RIP TiO_2 in removing organic compounds during repeated use with and without desorption treatment.
3. Analyzing the effect of regeneration on the functional groups and morphology of RIP TiO_2.

1.4 Benefit

This research has benefits which are written as follows:

1. Researchers gain practical experience while broadening their knowledge of the resin regeneration process, which can serve as a basis for further research.
2. Adding scientific studies on the reuse of immobilized catalysts as catalysts for degrading aromatic organic compounds in river water.
3. To be the basis for developing efficient and sustainable waste processing technology.

1.5 Scope

In this study, the following are the limitations contained in the scope of the study:

1. The sample was river water from the Bonagung River in Rungkut District, Surabaya City.
2. The semiconductor catalyst used is TiO_2, which is immobilized onto anion resin.
3. The desorption solution consisted of 0.1 N NaOH and deionized water.
4. The parameters to be studied are absorbance, pH, temperature, and turbidity values.
5. This research was conducted on a laboratory scale at the Environmental Engineering Research Laboratory, Faculty of Engineering and Science, UPN "Veteran" East Java.