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Analysis of Triclosan Content in Cisadane River Water Using Gc-Ms (Gas Chromatography Mass Spectrometry)

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Abstract

The Ministry of Environment and Forestry states that 75% of river water in Indonesia has been polluted by household and industrial waste. Specifically, triclosan (2,4,4-trichloro-2-hydroxydiphenyl-ether) is an antibacterial that is widely used in various health and household supply products, such as detergents, toothpaste, mouthwash, bath soap, and so on. This study approach employs liquid-liquid extraction on samples, which are subsequently subjected to SIM mode analysis utilizing the Gas Chromatography-Mass Spectrometry (GC-MS) method. River water samples were taken from 3 points, namely village areas, fishing, and industry. The results of this study indicate that the levels of the three Cisadane river water samples are positive for Triclosan with levels less than 0.3%, namely at the fishing point 598x10-9%, industrial point 1076x10-9% and residential point 1584x10-9% with a retention time of 19. 37 minutes.

Keywords: Triclosan; River water; Gas chromatography-mass spectrometry

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INTRODUCTION

Although rivers are essential for human life, many rivers in Indonesia are polluted. As informed by the Ministry of Environment and Forestry, 75% of river water in Indonesia is significantly polluted by household waste and industrial waste.[1] One of the main rivers in Banten and West Java Province is the Cisadane River. Cisadane River is the biggest natural resource of Tangerang City.[2] To manage industrial waste, it must pass through The Wastewater Treatment Plant (WWTP). However, in the field, industry players do not follow environmental regulations. Many people continue to dump waste into the river without being managed. written sanctions, administrative sanctions of government coercion, and out-of-court dispute negotiations are carried out as a way to overcome that. Due to the inability of the Wastewater Management Plant to function, Tangerang City's wastewater treatment system has not been optimized. Household waste, rainwater, and industrial waste are the sources of wastewater in Tangerang City. For household waste, a septic tank system is used and discharged into open drainage, while the rainwater disposal system follows the natural flow of the city.[3] Pollution of this water source endangers the environment. PDAM Tangerang City gets its clean water from the Cisadane River, which serves the entire city of Tangerang.[4] The use of chemicals is always increasing along with the growth of various types of industries. As a result, the

risk of chemical poisoning and exposure increases.[5]

Figure 1. Cisadane River
Source: Individual Reference

Household Health Supplies (HHS) is a type of product that uses a lot of chemicals, so it can pose a risk of exposure and poisoning for its users, especially if they do not follow the rules for safe use and waste disposal.[6]Triclosan is a phenolic or aromatic organic substance. Triclosan is one of the most widely used antibacterial drugs because it can block many gram-positive and gram-negative bacteria from multiplying.[7] Triclosan is a commonly used antibacterial active ingredient in various types of toothpaste, body wash, and hand soap.[8] At low concentrations, triclosan can stop and kill bacterial growth very well.[9] The maximum level of triclosan in products is 0.3%, namely in toothpaste, hand soap, body wash, liquid soap, deodorant (non-spray), face powder and blemish concealers, nail preparations for cleaning nails before application of artificial nail systems, shampoo, conditioner, facial cleanser[10], and the maximum level is 0.2% in mouthwash.[11] Triclosan will harm health in the long run and make bacteria immune, triclosan can interface with the normal process of hormone work by becoming a thyroid poison.[12] Triclosan has chlorophenol properties, which make triclosan a cause of cancer in the human body. Chlorophenol is stored in fat if it enters the body[13].

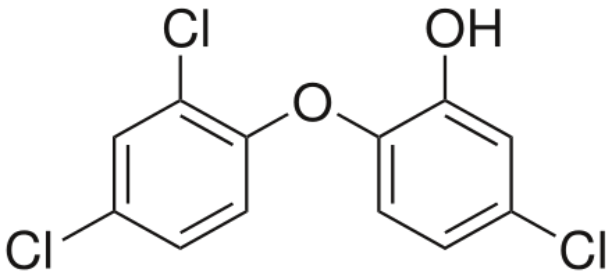

Figure 2. Triclosan Structure
Source: Cosmetic Ingridient Review (2010)[14]

It is known that if the hazardous materials contained in Cisadane River water can harm the community, especially the community around the Cisadane River. Gas Chromatography Mass Spectrometry (GC-MS) is a gas chromatography technique used in conjunction with mass spectrometry.[15] Gas chromatography is used to find compounds that are volatile under high vacuum conditions and low pressure when heated.[16] Mass spectrometry determines molecular weights, and molecular formulas, and produces charged molecules.[17] Therefore, it was analyzed entitled Analysis of Triclosan Content in Cisadane River Water Using GC-MS.

METHOD

Tools

Glassware tools, separatory funnel, Gas Chromatography type Thermo Scientific TRACE 1310 interfaced with Mass Spectrometry Thermo Scientific ISQ 7000 with TG-1MS capillary column (30 m × 0.25 mm × 0.25 µm).

Materials

The specimen used in this study is Cisadane River water located in Tangerang City, Banten. The chemicals used in this study are chemicals in an analytical degree of pharmaceutical grades. Consisting of triclosan compounds (Sigma Aldrich) as a comparison standard, NaOH, distilled water, n-hexane, methanol, sodium sulfate (Na_2SO_4), and Hydrogen Chloride (HCl).

Sampling

Cisadane river water samples were collected at 3 points. River water samples were collected in 1000 mL glass bottles. The samples were then stored at 4oC for immediate analysis.[18] Preparation of triclosan standard by accurately weighing 5 mg of Triclosan standard and transferring into a 25 mL volumetric flask then dissolving with methanol to increase solubility.

Preparation of river water sample

A 1000 mL river water sample was put into a 2L separatory funnel along with 10 g NaOH. Then the solution was washed with 50 mL of n-hexane and Na^2SO^4 with 10 minutes of shaking, the water phase was then extracted two times. After which the phases were allowed to separate. The aqueous phase was transferred into a separatory funnel, after which the pH was adjusted to 2 with concentrated acid (HCl). The results were condensed to 1 mL using a rotary evaporator at 50°C for cleaning.[18] GC-MS condition is 1 mL sample was injected in split mode into a Thermo Scientific TRACE 1310 GC connected to a Thermo Scientific ISQ 7000 MS. The stationary phase was a TG-1MS column (30 m × 0.25 mm × 0.25 um) Temp -60 to 330/350°C. The column temperature was programmed with an initial temperature at 60°C and held for 2 min, then increased to 290°C in 10°C increments per minute, and at 290°C held for 6 min. The injector temperature was set at 250°C. The carrier gas was ultra-high purity helium gas at a flow rate of 1 mL per minute.

RESULTS AND DISCUSSION

Triclosan Standardized Test

In the measurement of the triclosan standard solution at different concentrations, it was discovered that the area value increased with the standard solution concentration.

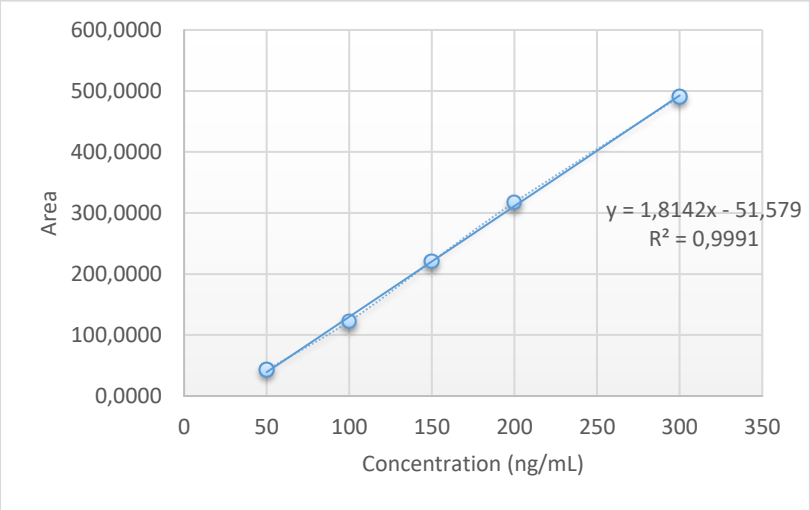

Figure 3. Triclosan Calibration Curve

The linear equation y = bx + a is y = 1.8142x - 51.579 with a correlation coefficient (r) of 0.9995. The correlation coefficient value close to +1 indicates a strong positive correlation between variables while based on the coefficient of determination (R2) value of 0.9991 which indicates that variable X (standard solution concentration) affects variable Y (area) by 99.91% and value obtained has met the requirements19. For grades, linearity is ≥ 0.9810.

Cisadane River Water Testing

This test uses three points, namely, fishing, residential, and industrial points analyzed using Gas Chromatography Mass Spectrometry Thermo Scientific, combining these two tools can produce more accurate data in the identification of compounds equipped with molecular structures[20]. which is tested three times (triple) resulting in data such as tables:

Table 1. Levels Triclosan

Sample	$\overline{X}$ AUC	$\overline{X}$ *Concentration*	Content (ng/mL) X±SD
Fishing	56.9268	59.80913	5.98091
Residential	235.9431	158.4842	15.84842
Industry	143.7955	107.6918	10.76917

From the data, it can be compared that of the 3 samples, the lowest level was found at the fishing point with an average level of 5.98091 ng/mL or 5980x10-9% because around the fishing point, no significant community activities were found so the levels found were not too high. The middle level is the industrial point with an average level of 10.76917 ng/mL or 1076x10-9% due to the collection point being far from residential areas but the river water at this point has been polluted by oil waste in

March 2022, and until now the river is still dark in color and emits an unpleasant odor. Furthermore, the highest level is found at the village point with a level of 15.84842 ng/mL or 1584x10-9% where in the morning the local residents routinely wash clothes along the river so that triclosan levels are high.

CONCLUSION

Based on the results of the research that has been carried out, the following conclusions can be drawn: There is triclosan content in cisadane river water fishing points, residential points, and industrial points. Triclosan levels obtained from fishing points are 5.98091 ng/mL or 5980x10-9%, residential points are 15.84842 ng/mL or 1584x10-9% and industrial points are 10.76917 ng/mL or 1076x10-9% and are classified as safe because they are less than 0.3%.

CONFLICT OF INTEREST

Authors declare that there is no potential conflict of interest with the research, authorship, and/or article publication.

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