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EFFECTIVENESS OF RICE HUSK ASH WASTE AS ADSORBENT HOUSEHOLD WASTE WATER

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Abstract: This study aims to determine the effectiveness of rice husk ash as an adsorbent to reduce phosphate levels in household wastewater and inexpensively. This research is an experimental laboratory research using the spectrophotometric method. Research data can be obtained through a series of experimental stages, including 1). Preparation of phosphate standard solution curve, 2). Determination of phosphate content before and after passing the adsorbent for the analyzed sample, 3). Determine the effectiveness of adsorbents in reducing phosphate levels in household wastewater. The effectiveness of rice husk ash as an adsorbent can be determined by comparing the phosphate levels before and after household wastewater is passed to the adsorbent. The magnitude of the reduction in phosphate content indicates the amount of phosphate adsorbed on the ash. Based on the experimental results, it is known that phosphate can be measured using a UV VIS Reign 1900 spectrometer at a wavelength of 693 nm. The standard phosphate solution curve was made based on the absorbance measurement of the series of standard phosphate solutions (0, 2, 4, 6, 8, and 10 ppm) used. In this study, the curve of the standard phosphate solution has the line equation: $Y = 0.1723 X + 0.3823$ with a correlation coefficient of 0.8633. In the equation of the line, Y indicates the absorbance value of the sample read on the spectrometer, while X indicates the concentration value of the substance being analyzed. Based on the equation of the curve line of the standard phosphate solution, it is used as a reference in determining the phosphate content of the sample by interpolating the absorbance that is read on the spectrometer owned by the sample and then determining the concentration value. Based on the calculation results, it was found that the ability to rice husk ash as an adsorbent to reduce phosphate levels in household wastewater was, on average, 52.54%. The ability of rice husk ash is still relatively small compared to the ability of rice husk ash as an adsorbent on heavy metals. In addition, phosphorus (P) as a constituent of phosphate has a smaller size (P diameter = 1.00) when compared to silica (diameter = 1.10), which is the largest composition in the ash. The difference in the size of the radius of phosphorus is smaller than that of silica. It is suspected as one of the causes of the phosphate content retained in the rice husk ash as an adsorbent is not too large. However, the percentage value of rice husk ash to reduce phosphate levels is still considered quite good as an adsorbent if the goal is to reduce phosphate levels from household wastewater that is discharged directly into the environment.

Keywords: *Rice Husk Ash, Adsorbent, Phosphate, Household Waste*.

INTRODUCTION

The presence of household waste is one of the biggest contributors to water pollution, reaching 47.62% [1]. Although this figure is quite large, the public's perception of the dangers of household waste being dumped into the river is still relatively low [2]. There is a low level of public understanding of the dangers caused by household waste being dumped into the river. It is thought to be why the handling of household waste is neglected even though the impact that waste disposal can have is very large [3].

If this condition continues to be ignored, the community may also feel the dangers that the presence of household waste will cause. One of the dangers that can be caused by the activity of disposing of the household waste directly into the river is the contamination of river water by chemicals and various harmful bacteria that will spread more widely. Thus, river water can no longer be used as a source of clean water (http://plpbm.pu.go.id/v2/posts accessed 14/2/2021). In addition, household waste disposal directly into the river can cause diseases due to sanitation and allow a decrease in water quality [4-5].

Wastewater can come from households, industrial or other public places containing materials that can endanger human life and living things and interfere with environmental sustainability. Wastewater consists of 99.7% water and 0.3% other materials, such as solids, colloids, and dissolved materials. One of the wastewater groups is household wastewater (Grey water, GW). Gray water is defined as wastewater from household activities originating from water used for washing dishes and water used for bathing and washing clothes. In household wastewater, the pollutant levels are light (light) compared to wastewater originating from industrial activities [6].

In the community's daily activities, detergents very common for washing clothes or cleaning the body (such as shampoo, hand soap, etc.). Detergent is a cleaning agent made from synthetic chemicals with the main component in the form of surfactants. Because it is considered not a hazardous or toxic material, some of the waste using detergents is often dumped into the waters, so it is a potential source of pollution [7].

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The use of detergents for daily needs will, of course, impact increasing the amount of detergent that will be dumped directly into the river. The presence of detergents in household wastewater can trigger an increase in phosphate levels due to the combination of polyphosphates and surfactants [8]. Excessive phosphate in water bodies causes eutrophication [9]. Eutrophic conditions allow algae and aquatic plants to grow rapidly. This situation causes water quality to decline due to the low concentration of dissolved oxygen, even to zero, resulting in the death of aquatic creatures [10].

The presence of excess phosphate compounds can cause damage to aquatic ecosystems due to the occurrence of eutrophication. It is a state of the aquatic environment in a state of excessive nutrition that allows for the rapid growth of algae (blooming), blocks the entry of sunlight into the aquatic environment, and reduces oxygen conditions in the aquatic environment. The water excess phosphate compounds in the aquatic environment originating from household wastewater must be minimized to prevent environmental damage.

In addition, the presence of Surface Active Agents (Surfactants) in detergents that lift dirt has properties that are resistant to decomposition by microorganisms, so the presence of surfactants or additives in detergents will also support environmental damage. In addition to surfactants, phosphates are found in detergents used as fillers. The presence of phosphate in detergents is used to prevent the re-adhering of dirt on washed clothes [11].

The Regulation of the Minister of the Environment No. 51 of 1995 concerning the quality standard of liquid waste for industrial activities stipulates that the phosphate level should not be more than 3 ppm. Therefore, to avoid greater environmental damage due to household wastewater, the household wastewater should be treated to reduce its phosphate levels before being discharged into the river. The wastewater treatment systems can be used in wastewater filtration using various materials, such as gravel, charcoal, zeolite, and sand [12]. The system is considered quite effective because the inorganic materials used, on average, can reduce the levels of pollutants in wastewater, either through the filtration process or the absorption process [13].

The material we often encounter around the living environment that can be used as an adsorbent is rice husk ash [14]. Rice husk ash is one of the combustion wastes or ash from plants which usually comes from rice husks, the rest of the brick industry burning, and so on. Rice husk ash has a chemical composition of 53.09% SiO_2, 24.80% Al_2O_3, and 8.01% Fe_2O_3 [15]. The ability of rice husk ash as an adsorbent has been widely studied, for example, reducing levels of congo red, removal of HCN in Gadung tubers, Cr^{+6} ions, adsorbent Cd ions and Cr ions, decreased industrial wastewater dyestuffs, Pb metal, decreased NaCl levels [16-21].

Based on the experimental results information disclosed above, the opportunity for the use of rice husk ash as an adsorbent to reduce phosphate levels in household wastewater is very large. However, only a few have reported it, so it will be possible to implement it. Of course, the results of this study can be used as a reference to reduce phosphate levels in household wastewater before being discharged into the river.

This study aims to provide information and scientific recommendations based on experimental results on treating household wastewater in a simple, low-cost manner by utilizing a scrice husk ash adsorbent using the spectrophotometric method. This method is relatively easy to do and does not require a long time with a fairly high level of accuracy. In addition, this study also aims to determine the effectiveness of rice husk ash as an adsorbent to reduce phosphate levels in household wastewater simply and inexpensively.

RESEARCH METHODS

Data collection was carried out through a series of experiments which were divided into several stages, among others, 1). Preparation of standard solution curves of phosphate at various concentrations, 2). Determination of phosphate content before and after passing the adsorbent for the analyzed sample, 3). Determine the adsorbent's effectiveness in reducing phosphate levels in household wastewater.

1. Preparation of Reagent Solution.
   The reagent solution is a mixture of solutions consisting of 5N H_2SO_4 solution, potassium antimonyl tartrate solution ($K(SbO)C_4H_4O_6.½H_2O$), ammonium molybdate solution ($(NH_4)_6Mo_7O_{24}.4H_2O$), and 0.1 M ascorbic acid solution ($C_6H_8O_6$) [22].
   How to make a reagent solution is to mix successively 50 mL of H_2S0_4 5N. 5 mL of potassium antimonyl tartrate solution, 15 mL of ammonium molybdate solution, and 30 rnL of ascorbic acid solution.

2. Preparation of Phosphate Working Solution from Standard Solution The working solution in question is the manufacture of a phosphate working solution with various phosphate concentrations (0, 2, 4, 6, 8, and 10 ppm) from a standard solution of 10 ppm phosphate.

3. Preparation of phosphate standard solution curve
   To obtain a standard phosphate solution curve, the following steps can be performed :
   a. Optimize the UV Vis spectrophotometer (Reign UV 1900) according to the instructions for the tool for testing phosphate levels
   b. Pipette 10 mL of the working solution and put each into the Erlenmeyer

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c. Add 1 drop of phenolphthalein indicator. If a pink color is formed, add dropwise 5N H_2SO_4 until the color disappears.
d. Add 1.6 mL of the mixed solution (reagent) and homogenize, then let stand for 10 to 30 minutes.
e. Take as much as 5 mL of the sample solution mixture that has been added to the reagent. Then put it in a cuvette on a spectrophotometer, read and record the absorption at a wavelength of 693 nm.
f. Create a calibration curve from the above data or determine the equation of a straight line.

4. Analysis of the sample solution (before and after the solution is passed the scrice husk ash adsorbent)
For the analysis of the sample solution (before and after the solution is passed the scrice husk ash adsorbent), the following steps are carried out :
a. Pipette 10 mL samples of the test solution and put each into the Erlenmeyer
b. Add 1 drop of phenolphthalein indicator. If a pink color is formed, add dropwise 5N H_2SO_4 until the color disappears
c. Add 1.6 mL of the mixed solution (reagent) and homogenize, then let stand for 10 to 30 minutes
d. Take as much as 5 mL of the sample solution mixture that has been added to the reagent, then put it in a cuvette on a spectrophotometer, read and record the absorption at a wavelength of 693 nm.

RESULTS AND DISCUSSION

Based on the data from the experimental activities carried out, it can be explained as follows:

Phosphate maximum absorption wavelength

The optimization of the maximum absorption wavelength of phosphate in this study was not carried out. It is because, based on the reference, it is known that the maximum absorption wavelength of phosphate is 693 nm [22]. Thus in this study, the wavelength of the UV Vis spectrometer used for measuring phosphate levels was at a wavelength of 693 nm, which is the maximum absorption wavelength of phosphate.

Phosphate standard solution curve

The curve of the standard phosphate solution can be made based on the experimental data that has been carried out.

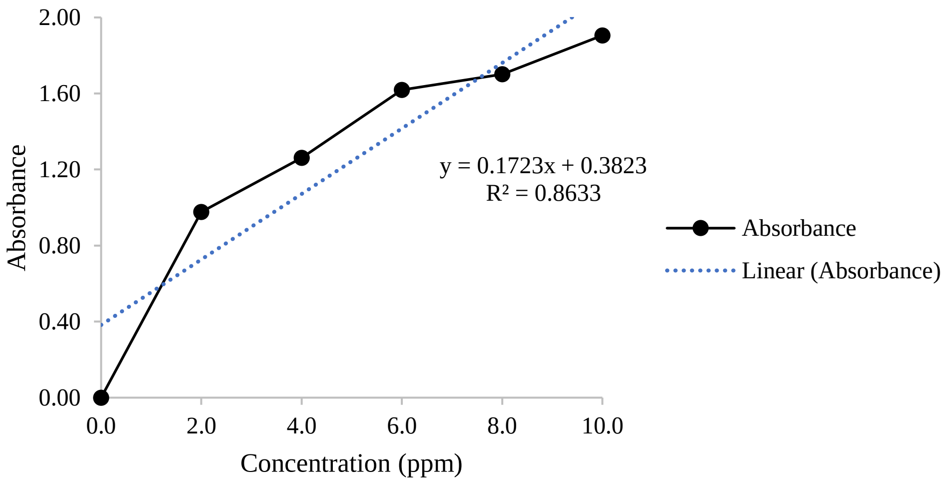

Figure 1. The curve of the standard phosphate solution

Based on the standard phosphate solution curve that has been made, the equation of the line is Y = 0.1723 X + 0.3823 with a correlation coefficient of 0.8633. In the equation of the line, Y is the absorbance value read on the spectrometer, while X indicates the concentration value of the substance being analyzed. Thus the line equation obtained in the curve of the standard phosphate solution will be used to determine the concentration of phosphate in the household wastewater sample before and after the ash is passed as an adsorbent.

To obtain information on the concentration of phosphate in the sample, it can be done by interpolating the absorbance reading of the sample with a spectrometer on a standard curve.

The concentration of phosphate in the sample before and after passing the scrice husk ash adsorbent

To determine the concentration of the sample solution, the absorbance data will be interpolated into the standard solution curve that has been made. The

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value of the concentration of phosphate contained in the sample can be calculated based on the equation of the line obtained on the curve of the standard solution.

Y = 0.1723x + 0.3823
x = Y – 0.3823/0.1723

Where :
Y = Absorbance read on the spectrometer
X = Sample Concentration (ppm)

Based on the calculation based on the written formula, it can be seen the value of the phosphate concentration in the sample before and after it is passed to the adsorbent of the rice husk ash. The results of the concentration calculations are shown in the table 1 below.

To calculate the effectiveness of the adsorbent of rice husk ash as a filtrate in samples of household wastewater (Bathwater and Laundry Waste) it can be obtained based on the following formula:

$$\% \text{ Effectiveness Adsorbent (EA)} = \frac{\text{KFX - KFY}}{\text{KFX}} \times 100$$

Note :
EA = Adsorbent Effectiveness (%)
KFX = Phosphate Level Before passing the adsorbent
KFY = Phosphate Level After passing the adsorbent

Based on the above formula, the percentage of the effectiveness of the adsorbent for rice husk ash is obtained (table 2):

Table 1. The value of the phosphate concentration

No	Sample	Concentration					
		Before passing through the adsorbent (Rubbing Ash)			After passing through the adsorbent (Rubbing Ash)		
		Y	X (After Dilution)	X (Before Dilution)	Y	X (After Dilution)	X (Before Dilution)
1	Bath Waste	0.805	2.453279	49.06558	0.591	1.211259	24.22519
2	Washing Waste/Loundry Waste	0.847	2.69704	53.9408	0.594	1.228671	24.57342

Table 2. The effectiveness of the adsorbent for rice husk ash

No	Sample	Concentration		
		X (Before passing through the adsorbent Rubbing Ash)	Y (After passing through the adsorbent Rubbing Ash)	% Effectiveness Adsorbent (EA)
1	Bath Waste	49.06558	24.22519	50.63
2	Washing Waste/ Loundry Waste	53.9408	24.57342	54.44
Average Effectiveness Adsorbent (EA)				52,54

Based on the calculation results, it was found that the ability of rice husk ash as an adsorbent in reducing phosphate levels in household wastewater was 52.54%. This result is smaller than when the rice husk ash was used as an adsorbent to reduce the NaCl content, which reached 83.75% [15].

The ability of rice husk ash to reduce phosphate levels by 52.54% also strengthens the conclusions of previous researchers. It stated that the ability of rice husk ash was very effective when used as an adsorbent for heavy metals [23-24], where the absorption of Pb by Activated rice husk ash using HCl can reach 99% with an adsorbent size of 80 mesh.

In addition, when viewed in terms of elemental size, phosphorus (P) as a constituent of phosphate has a smaller size (1.00) compared to 1.10 of silica (Si), which is the element that has the largest composition in rice husk ash. Therefore, because phosphorus is smaller than silica, this is then suspected as one of the causes of the not-too-large amount of phosphate that can be retained in the ash as an adsorbent.

However, the percentage value of rice husk ash reducing phosphate levels by 52.54% is still considered quite good as an adsorbent if the goal is to reduce phosphate levels from household wastewater that is discharged directly into the environment.

CONCLUSION

Based on the experimental results, the conclusions IS Phosphate measurement can be done with a UV Vis spectrometer at a wavelength of 693 nm. The standard phosphate solution curve based on the standard solution series obtained the line equation: Y = 0.1723 X + 0.3823 with a correlation coefficient of 0.8633. (Y indicates the absorbance of the sample read on the spectrometer, while X is the concentration of the sample based on the results of interpolation of the absorbance data obtained on the standard solution curve). The ability of rice husk ash as an adsorbent to reduce phosphate levels that are discharged directly into the environment is quite good, with an average percentage value of 52.54%

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