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ANALYSIS OF COAGULANT NEEDS AND OPERATIONAL COSTS IN THE WATER PURIFICATION PROCESS ON CLARIFIER (Z-9451) IN THE UTILITY UNIT OF PT PERTA ARUN GAS LABORATORY SCALE USING THE JAR TEST METHOD

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ABSTRACT

This study discusses the analysis of coagulant needs and operational costs in the water purification process on the clarifier (Z-9451) in the utility unit of PT Perta Arun Gas on a laboratory scale using the jar test method. This research is expected to provide benefits in improving the efficiency of chemical use, producing water quality that meets standards and estimating operational costs. This study aims to test the effectiveness of coagulants using jartest on clarifier inlet water samples at PT Perta Arun Gas. The parameters tested include pH, turbidity, and conductivity. Experiments were carried out with variations in the doses of coagulants and polymers. The results of the experiment will be used to determine the optimal dose of coagulant for raw water treatment. The best efficiency In the first week of November 7, 2023, the results of the analysis of the clarifier feed raw water (Z-9451) were obtained, namely a decrease in turbidity of 98.74%. In the second week of November 14, 2023, the decrease in turbidity was 98.42%, in the third week of November 21, 2023, the decrease in turbidity was 98.33%, and in the last week of November 28, 2023, the decrease in turbidity was 98.50%. The results showed the best efficiency in the first week with a concentration of aluminum sulfate of 24 ppm and polymer 0.20 ppm. The use of this concentration is able to produce good water quality and save the company's operational costs. However, weather conditions can affect the quality of raw water, so further research is needed to obtain the optimal conditions for the addition of aluminum sulfate and polymer. It is recommended to conduct a weekly Jartes analysis in order to provide recommendations on the use of aluminum sulfate and polymers as coagulants in utility units.

Keywords : Aluminium Sulfat, Clarifier , Jartest, Koagulan, Polymer, Turbidity

INTRODUCTION

In a gas processing industry such as PT Perta Arun Gas, supporting facilities are needed which are commonly referred to as utility facilities. In a process in an industry or factory, utility facilities are very important in the production process to play a role in meeting the supporting needs of the production process that are needed so that they can run smoothly according to the standards that have been set. One of the main needs in the production process in the industry is that the quality of water is according to the required process standards. The availability of water that meets the quality standards for processes in the industry is a product of the utility unit, so the utility department is the most important part of the sustainability of the production process in the industry.

Water is one of the means of supporting processes in an industry or factory. In industry, the water used comes from the results of water treatment in the utility department. So that one of the functions of The utility department is to treat the right water according to SNI standards and the Indonesian Minister of Health for industry. Raw water or raw water to be treated comes from seawater, river water, groundwater and fresh water. The raw water is usually still dirty and not suitable for use and is then treated through a series of water treatment processes according to factory standards to produce water that is suitable for the needs of the process in the factory and suitable for human sanitation needs in and around the factory.

The Water treatment unit is part of the water system that functions as a unit that treats raw water into clean water used for purposes in factories, offices and housing. The water used in unit-94B is fresh water, namely surface water (river water). The main purpose of All of these water purification processes are to remove or reduce the level of impurities

in the water so that the water is suitable for use. Impurity substances in water can be grouped into three groups, namely, Suspended solids, Dissolved solids and Dissolved gas (M. Tomtommy, et al. 2021)

This water treatment unit is designed to produce clean water by treating raw water from the raw water reservoir where raw water is pumped from the raw water reservoir into the clarifier so that the suspended solids in the water are deposited by injecting chemical substances. The commonly used chemical substances are aluminum sulfate, polymers and chlorine.

After the injection of chemical substances into the clarifier, the stirring process is carried out with a device called an agitator. Agitator

Make the chemical substances that have been injected into the clarifier mix perfectly with water so that the mud that is carried in the water

rivers that have a low density,

It turns into flocs and then settles on the base of the clarifier. So that the sediment is discharged into the environment continuously to cause the accumulation of sediment in the surrounding environment, by knowing the amount of chemical use, it is hoped that the use of minimal chemicals with maximum processes and water quality meets standards and produces fewer sediments.

Regarding the problems that have been going on so far, there is uncertainty in regulating the need for chemicals in the clarifier unit. Therefore, further research is needed, especially calculations to determine the amount of chemical needs needed, this is necessary in order to achieve water quality in accordance with standards and to be able to estimate the operational costs of using chemicals.

RESEARCH METHOD

Material and Equipment

The materials used are water samples on the clarifier inlet (Z-9451), Aluminum Sulfate, and Polymer. The tools used are a set of jartest tools, 1000 ml beaker, 100 ml beaker, 1000 ml measuring cup, 10 ml volume pipette, pH meter,

Erlenmeyer, a set of turbidimeter instruments,

a set of conductiveness tools, a set of pH tools

meter

Trial and Testing Procedures

Parameter Testing

The parameters tested are pH, *Turbidity* and *Conductivity* using test methods according to the Standards that have been established in accordance with ASTM D-1125, Turbidity measurements in accordance with ASTM D-1889 and pH measurements in accordance with ASTM D-1293.

Coagulation-Flocculation Method Using Jartest

As for the steps taken, as follows, 1000 ml each of the *Clarifier inlet sample* was poured into 6 beaker cups and labeled 1-6, the test jar was turned on, each sample was placed into the test device with the paddle position submerged in the sample, alum coagulant was added with doses of 20 mg, 22 mg, 24 mg and 26 mg, 28 mg, 30 mg in beaker cups 1-6, after adding Aluminum sulfate, stir at 100 rpm for 1 minute. Then add *the polymer* with a predetermined dose, lower the stirring speed to 50 rpm and wait for 15 minutes, and let the sample sit for 1 hour so that the floc particles settle.

Parameter Analisa pH

Prepare Beaker Glass 100 ml, put an 80 mL sample of raw water into Beaker Glass 100 ml along with a magnetic stirrer, insert the pH electrode into the water sample to be analyzed, select *the Measure pH method* on the *MetrOhm 867 pH Module*, click *start*, wait for the analysis to complete.

Parameter Analisa Turbidity

Prepare the *cell* bottle for *the HACH Turbidimeter* tool, the sample is stirred first, then put into the *cell* bottle, until the limit mark, and insert the *cell* bottle then press enter, shake the *cell* bottle before analysis to get the actual turbidity value.

Parameter Analisa Conductivity

Prepare 100 ml Beaker Glass, insert an 80 mL sample of raw water into the 100 mL Beaker Glass followed by a magnetic stirrer, insert the conductivity electrode into the analyzed water sample, select *the Measure conductivity method* on the *MetrOhm 867 conductivity Module tool*, click *start*, wait until the analysis is complete.

RESULT AND DISCUSSION

The addition *of aluminum sulfate* and *polymer* as coagulants to the characteristics of the *clarifier feed* water (Z-9451) raw water resulted in several value variations. Based on the results of the research on the use *of aluminum sulfate* and *polymer* using an experimental method using Jartes, the best efficiency in the use of *aluminum sulfate* concentrations in the first week on November 7, 2023 was 24 ppm and *Polymer* was 0.20 ppm. With this concentration, it can be able to reduce water content parameters after water purification treatment and in accordance with the requirements of operational standards set by the company. So that it can provide input on the operational costs of coagulant and polymer needs in the water purification process in the clarifier (Z-9451) The results

The graph obtained based on the results of data processing of the experimental method carried out is as follows:

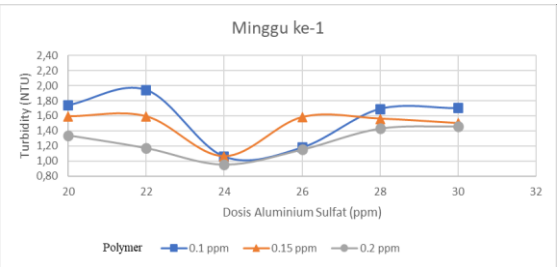

Figure 1. Graph of optimal results of use *aluminum sulfate* and *polymer* Week 1

From the results of Figure 4.1, it can be seen that the graph of the optimum concentration with the experimental method can be clearly seen in the first week of November 7
2023 by 24 ppm and *Polymer* by 0.20
Ppm. In graph 4.1 for *the turbidity* value, it shows that with this concentration value, it is able to reduce *the turbidity* to 0.95
NTU of 75.2 NTU.

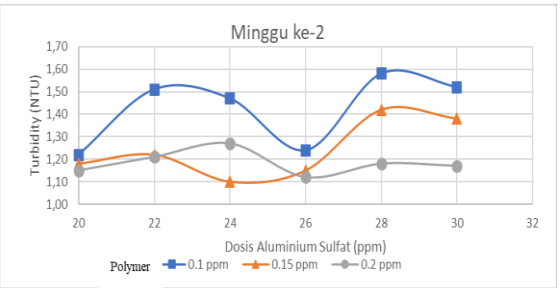

Figure 2. Graph of optimal results of use *aluminum sulfate* and *polymer* Mingg 2nd

Meanwhile, from the results of graph 4.2, it can be seen that the graph of the optimum concentration with the experimental method can be clearly seen in the second week of November 14, 2023 at 24 ppm and *Polymer* at 0.15 ppm. In graph 4.2 for *the turbidity* value, it shows that the concentration value can reduce *the turbidity* to 1.10 NTU from 69.6 NTU.

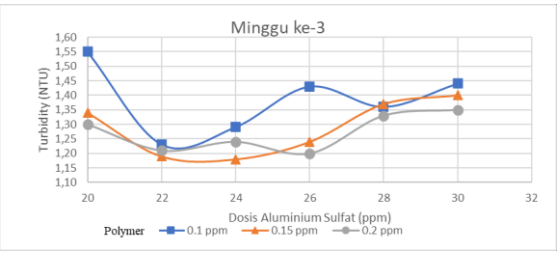

Figure 3. Graph of optimal results of use *aluminum sulfate* and *Mingg* polymer 3rd

The optimum concentration carried out in the experiment in week 3 can be seen in the figure of graph 4.3, which is clearly visible
in the third week on November 21
2023 by 24 ppm and *Polymer* by 0.15 ppm. In graph 4.1 for *the turbidity* value, it shows that with this concentration value, it is able to reduce *the turbidity* to 1.18
NTU of 70.5 NTU.

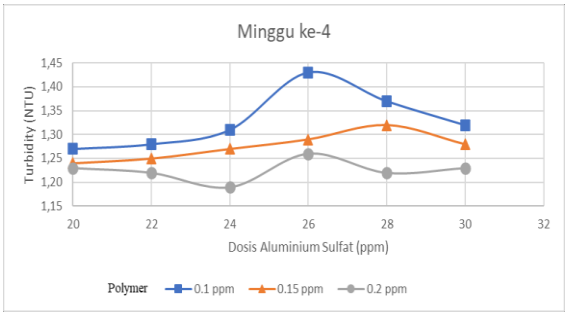

Figure 4. Graph of optimal results of use *aluminum sulfate* and *polymer* Mingg 4th

The optimum concentration carried out in the last experiment in week 4 (four) can be seen in graph image 4.4, that in the fourth week on November 28, 2023 it was 24 ppm and *Polymer* was 0.20 ppm. In graph 4.1 for *the turbidity* value, it shows that with this concentration value, it is able to reduce *the turbidity* to 1.19 NTU from 79.5
NTU.

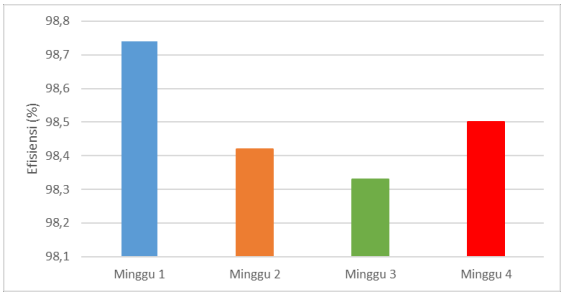

Figure 5. Graph: Efficiency of optimum yield using *aluminum sulfate* and *polymer* Weeks 1 to 4

Based on the water purification process in the Jartes analysis, the use of aluminum sulfate and polymer must be at the right dose so that it can produce the desired water quality and can be used as process water. In the experimental process, the optimum value obtained in the first week was used with the use of coagulants of 24 ppm aluminum sulfate and 0.20 ppm polymer. The use of aluminum sulfate and polymer concentrations can vary according to the condition of the raw water to be treated. Concentrations used for 24 ppm aluminum sulfate and
This 0.20 ppm polymer is proven to be able to produce good water quality based on the parameters carried out.

The cost needed for aluminum sulfate in field operations is Rp
33,750,000 / month but after research is carried out the operational costs needed are 24,187,500 / month with this can save the company by 28.33% and the costs needed for polymers in operations
field of Rp 10,000,000 / month. But
After conducting research, the operational costs needed are 8,064,000 / month which can save the company by
19,36 %.

However, the use of these concentrations is still not optimal because the level of turbidity often changes depending on the weather conditions in the area. Therefore, further research is needed to obtain the optimal condition for the addition of aluminum sulfate and polymer in the water purification unit in the Clarifier unit by conducting a weekly jar test analysis in order to provide recommendations on the use of aluminum sulfate and polymer concentrations as coagulants in the utility unit of PT Perta Arun Gas.

CONCLUSIONS

The best optimum concentration was obtained in the first week with a concentration of Aluminum Sulphate 24 ppm and Polymer 0.20 ppm, the amount of Aluminum Sulphate needed to purify water in the clarifier (Z-9451) with a capacity of 280 m3/h is 6.72 kg/h, the amount of Polymer needed to purify water in the clarifier (Z-9451) with a capacity of 280 m3/h is 0.056 kg/h, the operational cost of Aluminum Sulphate to purify water in the clarifier (Z-9451) with a capacity of 280 m3/hour is Rp
24,187,500/month, and the operational cost of Polymer needs to purify water in the clarifier (Z-9451) with a capacity of 280 m3/hour is Rp
8,064,000/mont
h.

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