



## The Effect of Chemical Addition Factors on External Water Purification With Microsoft Excel Application

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### ABSTRACT

This study aims to look at the influence of chemical addition factors such as Alum, Soda ash, and Flocculant in external water treatment in water purification that will be used in processing in palm oil mills does not form scale / sediment on the walls, especially in boilers stations / boilers. This study was conducted in the laboratory using jars with each experiment three times / 3 times with the addition of a predetermined chemical dose and visible turbidity / level of clarity and recorded processing into data. Then the results of the recapitalization of the research data obtained will be processed using the statistical analysis method using the complete random design (RAL) method of 3 factorials and continued with the results of the anova / fingerprint test table and the data processing will use the help of the Microsoft Excel application. From the results of the research obtained using the RAL (Complete Random Design) method 3 factorials the result that the influence of the addition of alum and flocculant chemicals will have a real effect on water purification which means that the  $F_{count} > F_{table}$  value, then  $H_0$  is rejected, alum and flocculants have the function of forming flocs that aim to precipitate dirt so that the water can be purified, it is very dominantly needed, While on the addition of chemical soda ash with the result the decision obtained  $F_{count} 0.186746989 < F_{table} 3.168245967$  So it can be concluded that  $H_0$  is accepted at the real level of  $\alpha$ . which means that the treatment has no real effect on the observed response. This is because soda ash has a function that can only be used as a pH regulator for the water to be purified in the palm oil mill.

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## 1. INTRODUCTION

The water treatment methods that are generally used are related to pollution in water. The pollution that must be considered in most water supplies is pathogenic bacteria, turbidity and floating materials, color, taste and smell, and organic compounds. Traditionally, well bore water and turbid water can be rarefied with alum, (Nasir et al., 2014).

Water is of great benefit to life, to humans, animals, plants, agriculture, industry and to the balance of nature. Various industries also need water for treatment activities such as palm oil mills. (Rahayu et al., 2019). Water used as boiler filler if not treated will detect calcium and magnesium salts contained in water and will settle due to exposure to heat. This precipitate is attached to the walls - the walls of the boiler become crusty. (Irawan et al., 2019), so before the water enters the station in the factory, we must first analyze the minerals contained in it. The main source of water will usually be treated by adding soda ash

chemicals, aluminum sulfate and polymer to the coagulation-flocculation and sedimentation process to obtain water that is in accordance with water quality standards in the factory. (Rahardja, 2019). Sedimentation is one of the processes of separating a mixture of solids and liquids (slurry) into clear liquids and sludge. This process utilizes the force of gravity (Rumbino & Abigael, 2020).

Most alum is undissolved and will precipitate as an  $Al(OH)$  floc, which can confine the colloids and carry them down, so that deposits or collisions between particles can be increased by slow stirring, resulting in solids that can be precipitated. (Suprihatin, Ono Suparno, 2013: 112). The provision of clean water, in addition to its quantity, must also meet applicable standards. Water quality standards are quality standards that are set based on physical, chemical, radioactive and bacteriological properties that indicate the quality requirements of the water. (Nainggolan et al., 2019)

## 2. RESEARCH METHODE

### a. Place and time of research

The place or area that will be used as the location in this research is in the laboratory. This research was conducted from 05 to 07 October 2022.

### b. Research Design

In general, water treatment (groundwater/surface) is carried out by adding certain chemicals (coagulants, pH regulators, and disinfectants) to the water, followed by sedimentation (precipitation) or flotation (flotation) of sludge and filtration (filtration) through sand media. (Kencanawati & Mustakim, 2017). In research, steps are needed to solve the problem so that it is more systematic. The steps are as follows:

- 1) The initial stage of research is to analyze jartes on source water samples in the laboratory. Jar test is a laboratory-scale experiment that serves to determine the optimum dose of coagulants used in the clean water treatment process. If the experiment is carried out appropriately. (Oktaviasari & Mashuri, 2016).
- 2) The next stage is the collection of data, both primary data obtained directly from the results of testing in the laboratory and secondary data obtained from companies related to the water treatment system.
- 3) The results of the data collection that have been obtained will be analyzed using the 3-factorial RAL (Complete Random Design) statistical method.
- 4) The results of the data processing analysis will find answers from the problem formulation of this study

### c. Research Methodology

This research was conducted using descriptive and analytical methods, namely methods that describe the situation that occurred in the field and existing data, then processed, analyzed and further processed using statistical methods using the complete random design (RAL) method and continued with the results of the anova test table / fingerprint to see the influence of adding chemicals to external water purification. The data obtained from the experimental results will certainly be analyzed to find out the results. To analyze data from a complete random design, a variety will be carried out based on the tabulation of the data obtained and with the following steps:

- 1) Looks for Free Degree (DB) values
  - 2) Finding the Sum of Squares (JK)
  - 3) Finding the Middle Square (KT)
  - 4) Looks up F count and F probability table (0.05)
  - 5) Summing up the results of the analysis
    - If obtained If  $F$  calculates  $< F$  table ( $\alpha=5\%$ ) means that the treatment has no noticeable effect on the observed response, meaning that  $H_0$  is received at a real level ( $\alpha$ ) of 5 %.
    - If  $F$  calculates  $> F$  table ( $\alpha=5\%$ ) means that the treatment exerts a noticeable influence on the observed response, meaning that  $H_0$  is received at a real level ( $\alpha$ ) of 5 %.
- (Bambang Admadi, et al., 2011:12)

## 3. RESULT AND ANALYSIS

### Data Collection and Processing

Results addition of each of the chemical ingredients / standard solutions from the results of the study on the jartes dose table. From the results of water purification testing using the jartes method, each test is seen the level of water clarity using the turbidity tool and the results are recorded in the observation data table.

Table 3.1. Results of Recapitulation of Observational Data

Combination Treatment			<i>Water turbidity</i> results			Total
			Deuteronomy			
T	S	F	I	II	III	
T (2ml)	S ( 1ml)	F (1 ml)	4.53	4.5	4.52	13.55
		F (1.5 ml)	4.28	4.26	4.28	12.82
		F (2 ml)	4.09	4.07	4.08	12.24
T (2ml)	S (1.5 ml)	F (1 ml)	4.51	4.54	4.52	13.57
		F (1.5 ml)	4.25	4.24	4.22	12.71
		F (2 ml)	4.07	4.05	4.08	12.2
T (2ml)	S (2 ml)	F (1 ml)	4.54	4.5	4.53	13.57
		F (1.5 ml)	4.2	4.22	4.21	12.63
		F (2 ml)	4.08	4.09	4.07	12.24
T (2.5 ml)	S ( 1ml)	F (1 ml)	3.53	3.5	3.52	10.55
		F (1.5 ml)	3.32	3.34	3.33	9.99
		F (2 ml)	3.08	3.08	3.07	9.23
T (2.5 ml)	S (1.5 ml)	F (1 ml)	3.51	3.53	3.5	10.54
		F (1.5 ml)	3.35	3.3	3.34	9.99
		F (2 ml)	3.1	3.13	3.1	9.33
T (2.5 ml)	S (2 ml)	F (1 ml)	3.5	3.52	3.51	10.53
		F (1.5 ml)	3.31	3.33	3.3	9.94
		F (2 ml)	3.12	3.1	3.11	9.33
T (3 ml)	S ( 1ml)	F (1 ml)	3.44	3.42	3.45	10.31
		F (1.5 ml)	3.2	3.21	3.23	9.64
		F (2 ml)	3.04	3.01	3.03	9.08
T (3 ml)	S (1.5 ml)	F (1 ml)	3.41	3.39	3.4	10.2
		F (1.5 ml)	3.24	3.26	3.23	9.73
		F (2 ml)	3.06	3.04	3.05	9.15
T (3 ml)	S (2 ml)	F (1 ml)	3.47	3.45	3.48	10.4
		F (1.5 ml)	3.26	3.24	3.25	9.75
		F (2 ml)	3.03	3.01	3.04	9.08
Grand Total						292.3

Table 3. 2 Chemical Ingredients for each addition to the Jartes analysis process

T factor 1%		Total Combinations = 27
Alum 1	T (2 ml)	
Alum 2	T (2.5 ml)	
Alum 3	T (3 ml)	
Factor S 1%		Repetition = I, II, III
Soda Ash 1	S (1 ml)	
Soda Ash 2	S (1.5 ml)	

Soda Ash 3	S (2 ml)	
<b>Factor F 0.02%</b>		
Floc 1	F (1 ml)	
Floc 2	F (1.5 ml)	<b>Total Units = 81</b>
Floc 3	F (2 ml)	

Based on clean water treatment techniques, one way to reduce turbidity is by using alum. Alum as a coagulant material is better known to the public because it has high economic value, is easy to get and easy to store. (Amalia & IW, 2017), this study uses chemical alum, soda ash, and floculant. The results of the recapitalization of the research data obtained will be processed using the statistical analysis method using the complete random design (RAL) method and continued with the results of the anova / fingerprint test table. There are 2 sources of diversity among the observational data obtained in the Anova test, namely: diversity of treatment and error of the experiment. Both are used to indicate whether the difference in observations between treatments is real or by chance alone. The difference in treatment is said to be noticeable when the diversity of treatments is large enough compared to the error of the experiment. (Made susilawati, 2015:11-13), in this study to see every influence of factors whether they have a real effect or not a real effect on each factor where the formulation of the hypothesis consists of:

**Conjecture hypothesis / Null hypothesis (Ho)**

- All **treatments independently** have no real impact on water purification.
- All **treatments in 3 combinations of 2 factors** have no noticeable effect on water purification
- All **treatments in 1 combination of 3 factors** have no effect ta on water purification

**Independent testing of the First alternative Hypothesis (H1)**

3 independent factors, namely: Alum (T), Soda ash (S), and Floc (F)

**Second Alternative Hypothesis Testing (H2) 3 combinations of 2 factors**

3 combinations of 2 factors, namely:

- Alum with soda ash (T,S),
- Alum with Floc (T,F), and
- soda ash with floc (S,F)

**Third alternative Hypothesis Testing (H3) 1 combination 3 factors**

1 combination of 3 factors namely: Alum, soda ash, Floc (T, S, F)

To get the results of the study, the author has made a table of auxiliary factors in helping to get the results of the Anova test / list of fingerprints, here is the table that has been created:

**Table 3.3 Factor Auxiliary Table (T)**

Factor Auxiliary Table (T)	Total
T (2 ml)	115.53
T (2.5 ml)	89.43
T (3 ml)	87.34
<b>Total</b>	<b>292.3</b>

**Table 3.4 Factor Auxiliary Table (S)**

Factor Auxiliary Table (S)	Total
S (1 ml)	97.41
S (1.5 ml)	97.42
S (2 ml)	97.47
<b>Total</b>	<b>292.3</b>

**Table 3.5 Factor Auxiliary Table (F)**

**Table 3.6 Factor Auxiliary Table (TS)**

TS Auxiliary Table	Total
T1S1	38.61
T1S2	38.48
T1S3	38.44
T2S1	29.77
T2S2	29.86
T2S3	29.8
T3S1	29.03
T3S2	29.08
T3S3	29.23
<b>Total</b>	<b>292.3</b>

Table 3.7 Factor Auxiliary Table (TF)

TF Auxiliary Table	Total
T1F1	40.69
T1F2	38.16
T1F3	36.68
T2F1	31.62
T2F2	29.92
T2F3	27.89
T3F1	30.91
T3F2	29.12
T3F3	27.31
<b>Total</b>	<b>292.3</b>

Factor Auxiliary Table (F)	Total
F (1 ml)	103.22
F (1.5 ml)	97.2
F (2 ml)	91.88
<b>Total</b>	<b>292.3</b>

Table 3.8 Factor Auxiliary Table (SF)

SF Auxiliary Table	Total
S1F1	34.41
S1F2	32.45
S1F3	30.55
S2F1	34.31
S2F2	32.43
S2F3	30.68
S3F1	34.5
S3F2	32.32
S3F3	30.65
<b>Total</b>	<b>292.3</b>

### Data Analysis Procedure

To analyze the data from a complete random design will be made test results in the form of a fingerprint table / Anova, In this study the author used the help of Microsoft Excel in calculating the data that has been obtained, As for the formula we will use as follows:

Table 3.9. How to analyze data

The Analyzed	How to Analyze
DB (T)	Number of treatments T - 1 $\Rightarrow$ 3-1 = 2
DB (S)	The number of treatments S - 1 $\Rightarrow$ 3-1 = 2
DB (F)	Number of treatments F - 1 $\Rightarrow$ 3-1 = 2
DB T x S	DB T x DB S $\Rightarrow$ 2 x 2 = 4
DB T x F	DB T x DB F $\Rightarrow$ 2 x 2 = 4
DB S x F	DB S x DB F $\Rightarrow$ 2 x 2 = 4
DB T x S x F	DB T x DB S x DB F $\Rightarrow$ 2 x 2 x 2 = 8
DB Error	Total DB - Other DBs = 80 - (2+2+2+4+4+4+8) = 80-26 = 54
DB Total	Sum of 3 factors x subduction = (3 x 3 x 3 x 3) - 1 = 81 - 1 = 80

Advanced table. 3.9

FK	= $292.3^2 / 81$ Total units = <b>1054.806049</b> (see table 3.1)
JK T	= $\text{SUMSQ}(115.53^2 + 89.43^2 + 87.34^2) / 27 - \text{FK}$ = <b>18.27474321</b> (see table 3.3)
JK S	= $\text{SUMSQ}(97.41^2 + 97.42^2 + 97.47^2) / 27 - \text{FK}$ = <b>7.6543200000</b> (see table 3.4)
JK F	= $\text{SUMSQ}(103.22^2 + 97.2^2 + 91.88^2) / 27 - \text{FK}$ = <b>2.384424691</b> (see table 3.5)

JK T x S	=SUMSQ (38.61 <sup>2</sup> + .....+29.23 <sup>2</sup> ) / 9 - (FK) - (JK T) - (JK S) = <b>0.004553086</b> (see table 3.6)
JK T x F	=SUMSQ (40.69 <sup>2</sup> + .....+27.31 <sup>2</sup> ) / 9 - (FK) - (JK T) - (JK F) = <b>0.024293827</b> (see table 3.7)
JK S x F	=SUMSQ (34.41 <sup>2</sup> + .....+30.65 <sup>2</sup> ) / 9 - (FK) - (JK T) - (JK F) = <b>0.004049383</b> (see table 3.8)
JK T x S x F	=SUMSQ (13.55 <sup>2</sup> +.....+9.08 <sup>2</sup> )/3 - FK - JK T - JK S - JK F - JK TS - JK TF - JK SF = <b>0.01074321</b> (see table 3.1)
JK Error	Total JK - Other JK = <b>0.011066667</b>
JK Total	=SUMSQ(4.53 <sup>2</sup> + 4.28 <sup>2</sup> + .....+3.25 <sup>2</sup> + 3.04 <sup>2</sup> ) - FK = <b>20.71395062</b>
KT (T)	JK T / DB T = 18.27474321 / 2 = <b>9.137371605</b>
KT(S)	JK S / DB S = 7.6543200000 / 2 = <b>3.8271600000</b>
KT (F)	JK F / DB F = 2.384424691 / 2 = <b>1.192212346</b>
KT T x S	JK T x S / DB T x S = 0.004553086 / 4 = <b>0.001138272</b>
KT T x F	JK T x F / DB T x F = 0.024293827 / 4 = <b>0.006073457</b>
KT S x F	JK S x F / DB S x F = 0.004049383 / 4 = <b>0.001012346</b>
KT T x S x F	JK T x S x F / DB T x S x F = 0.01074321 / 8 = <b>0.001342901</b>
KT Error	JK Error / DB Error = 0.011066667 / 54 = <b>0.000204938</b>
F Hit (T)	KT T / KT Error = 9.137371605 / 0.000204938 = <b>44.585.96988</b>
F Hit(S)	KT S / KT Error = 3.8271600000 / 0.000204938 = <b>0.186746989</b>
F Hit (F)	KT F / KT Error = 1.192212346 / 0.000204938 = <b>5.817421687</b>
F Hit T x S	KT T x S / KT Error = 0.001138272 / 0.000204938 = <b>5.554216866</b>
F Hit T x F	KT T x F / KT Error = 0.006073457 / 0.000204938 = <b>29.63554217</b>
F Hit S x F	KT S x F / KT Error = 0.001012346 / 0.000204938 = <b>4.939759036</b>
F Calculate T x S x F	KT T x S x F / KT Error = 0.001342901 / 0.000204938 = <b>6.552710844</b>
F table	= FINV(0,05,DB you want to view,DB error)

### Anova Test Results (Analysis of Variance)

From the results of the test data using the formulation above with the help of the Microsoft Excel application, the results of the fingerprint table / Analysis of Variance are obtained as follows:

**Table.3.10 Diversity Fingerprint Test Results /Anova**

SK (diversity fingerprint)	DB (free degree)	JK (sum of squares)	KT (middle square)	F count	F tab ( 0.05)	Ket
T	2	18.27474321	9.137371605	44.586	3.168246	N
S	2	7.6543200000	3.8271600000	0.18675	3.168246	MR
F	2	2.384424691	1.192212346	5.81742	3.168246	N
TS	4	0.004553086	0.001138272	5.55422	2.542918	N
TF	4	0.024293827	0.006073457	29.6355	2.542918	N
SF	4	0.004049383	0.001012346	4.93976	2.542918	N

TSF	8	0.01074321	0.001342901	6.55271	2.115223	N
Error	54	0.011066667	0.000204938			-
Total	80	20.71395062	0.258924383			-

Description =

N : (Real effect)

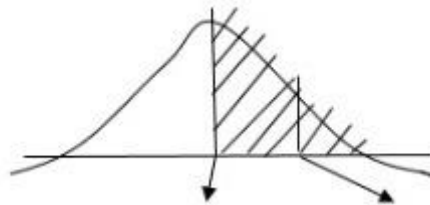
TN: (No real effect)

From the results of the diversity fingerprint test table / Anova, we can see and make a description of the results, namely:

**Independent testing of the first alternative hypothesis (H1)**

1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Alum (T) on water purification is:

- Ho : treatment has no real effect on alum independently
- H1 : the treatment exerts a noticeable effect on the observed self-giving.
- Significant rate :  $5\% = \alpha = 0.05$
- Critical regions : Ho is rejected if  $F_{count} > F_{table} (\alpha=0.05)$  and Ho is accepted if  $F_{count} < F_{table} (\alpha=0.05)$

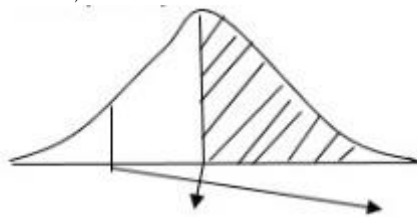


- F table 3.168245967 F Hits 44.585.96988

- Result of the decision :  $F_{count} 44.585.96988 > F_{table} 3.168245967$  So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable influence on the observed response.

2) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Soda ash (S) on water purification is:

- Ho : treatment has no real effect on soda ash independently
- H1 : the treatment exerts a noticeable effect on the soda ash independently observed.
- Significant rate :  $5\% = \alpha = 0.05$
- Critical regions : Ho is rejected if  $F_{count} > F_{table} (\alpha=0.05)$  and Ho is accepted if  $F_{count} < F_{table} (\alpha=0.05)$



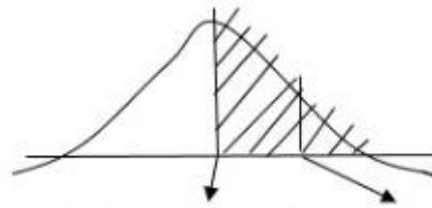
- F table 3.168245967

F Hits 0.186746989

- Result of the decision :  $F_{count} 0.186746989 < F_{table} 3.168245967$  So it can be concluded that  $H_0$  is accepted at the real level  $\alpha$ . which means that the treatment has no real effect on the observed response

3) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals independently on Flocculand (F) on water purification is:

- Ho : treatment has no real effect on alum independently
- H1 : p behavior exerts a noticeable effect on the observed self-administered alum.
- Significant rate :  $5\% = \alpha = 0.05$
- Critical regions : Ho is rejected if  $F_{count} > F_{table} (\alpha=0.05)$  and Ho is accepted if  $F_{count} < F_{table} (\alpha=0.05)$



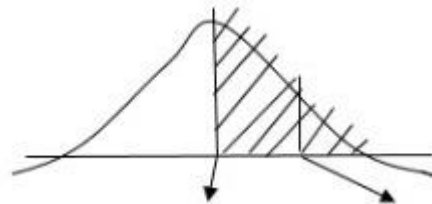
F table 3.168245967

F Hits 5.817.421687

- Result of the decision :  $F_{\text{count}} 5.817.421687 > F_{\text{table}} 3.168245967$  So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable effect influence on the observed response.

### Testing the second alternative hypothesis (H2) in 3 combinations of 2 factors

- 1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification is:
  - $H_0$  : the treatment has no real effect on 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification.
  - $H_2$  : the treatment has a noticeable effect on 3 combinations of 2 factors between Alum and Soda ash (TS) on water purification.
  - Significant rate :  $5\% = \alpha = 0.05$
  - Critical regions :  $H_0$  is rejected if  $F_{\text{count}} > F_{\text{table}} (\alpha=0.05)$  and  $H_0$  is accepted if  $F_{\text{count}} < F_{\text{table}} (\alpha=0.05)$

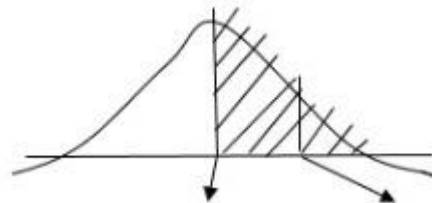


F table 2.542917526

F Hits 5.554216866

- The result of decision  $F_{\text{count}} 5.554216866 > F_{\text{table}} 2.542917526$  So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable influence on the observed response.

- 2) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification is:
  - $H_0$  : treatment has no real effect on 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification.
  - $H_2$ : the treatment has a noticeable effect on 3 combinations of 2 factors between Alum and Flocculland (TF) on water purification.
  - Significant rate :  $5\% = \alpha = 0.05$
  - Critical regions :  $H_0$  is rejected if  $F_{\text{count}} > F_{\text{table}} (\alpha=0.05)$  and  $H_0$  is accepted if  $F_{\text{count}} < F_{\text{table}} (\alpha=0.05)$



F table 2.542917526

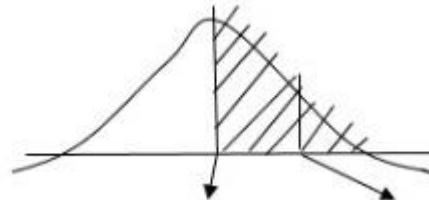
F Hits 29.63554217

- Result of the decision :  $F_{\text{count}} 29.63554217 > F_{\text{table}} 2.542917526$  So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable influence on the observed response.

- 3) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 3 combinations of 2 factors between Soda ash and Flocculand (SF) on water purification is:



- $H_0$  : the treatment has no real effect on a 3-factor combination of soda ash and Flocculant (TF) on water purification.
- $H_2$  : the treatment has a noticeable effect on 3 combinations of 2 factors between soda ash and Flocculant (TF) on water purification.
- Significant rate :  $5\% = \alpha = 0.05$
- Critical regions :  $H_0$  is rejected if  $F_{count} > F_{table} (\alpha=0.05)$  and  $H_0$  is accepted if  $F_{count} < F_{table} (\alpha=0.05)$



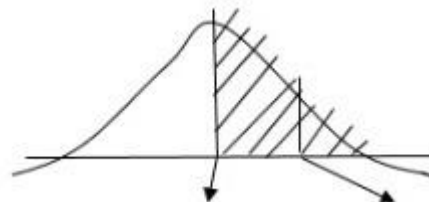
F table 2.542917526

F Hits 4.939759036

- Result of the decision :  $F_{count} 4.939759036 > F_{table} 2.542917526$ , So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable influence on the observed response.

### Third alternative hypothesis testing ( $H_3$ ) by 1 combination of 3 factors

- 1) It is known in the diversity fingerprint table / Anova the sig value for the effect of adding chemicals in 1 combination of 3 factors between Alum, Soda ash and Flocculant (TSF) on water purification is:
  - $H_0$  : treatment has no real effect on 1 combination of 3 factors between Alum, Soda ash and Flocculant (TSF) on water purification.
  - $H_3$  : the treatment has a noticeable effect on a combination of 3 factors between Alum, Soda ash and Flocculant (TSF) on water purification.
  - Significant rate :  $5\% = \alpha = 0.05$
  - Critical regions :  $H_0$  is rejected if  $F_{count} > F_{table} (\alpha=0.05)$  and  $H_0$  is accepted if  $F_{count} < F_{table} (\alpha=0.05)$



F table 2.115223279

F Hits 6.552710844

- Result of the decision :  $F_{count} 6.552710844 > F_{table} 2.115223279$ , So it can be concluded that  $H_0$  is rejected at the real level  $\alpha$ . which means that the treatment exerts a noticeable influence on the observed response.

### b. Analysis and Evaluation

#### Analysis

Analysis of the test results of the addition of chemicals to external water purification independently:

1. From the addition of alum to external water purification there is a significant influence.
2. From the addition of soda ash to external water purification, there is no significant change because soda ash only gets the appropriate pH.
3. From the addition of flocculants to external water purification there is a significant influence.

Analysis of the test results of the addition of chemicals in 3 combinations of 2 factors:

1. From the addition of alum and soda ash to external water purification there is a significant influence.
2. From the addition of alum and flocculants to external water purification there is a significant influence.
3. From the addition of soda ash and flocculants to external water purification there is a significant influence.

Analysis of the test results of adding chemicals in 1 combination of 3 factors:

1. From the addition of alum, soda ash and flocculants to external water purification there is a significant influence.

#### c. Evaluation

Companies should more often analyze jartes on external water to determine the appropriate dose to use because the water from the source has different conditions at all times because weather conditions cannot be conditioned such as the rainy season. Companies also have to control chemical distribution hoses more often because sometimes hoses can occur problems such as being covered by moss. So that the chemical cannot flow optimally, the impact is that the water will not be clear thoroughly.

## 4. CONCLUSION

Based on the results of data processing using the RAL (Complete Random Design) method to see the influence of chemical addition factors on the purification of external water obtained, namely:

- a. The influence of chemical addition factors on external water purification independently: in the addition of alum and flocculants to external water purification there is a significant influence. Meanwhile, the addition of soda ash to external water purification does not have a significant effect, this is because according to its function from the results of interviews with soda ash operators, it is only to get the appropriate pH so that it does not have a real effect independently.
- b. The influence of chemical addition factors in 3 combinations of 2 factors: in the addition of alum with soda ash, alum with flocculants, and soda ash with flocculants on external water purification there is a significant influence
- c. The influence of chemical addition factors in 1 combination of 3 factors: on the simultaneous addition of alum, soda ash and flocculants on external water purification there is a significant influence.

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