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Effect of Collector Reagent Variations in the Flotation Process on the Percentage of Mass Recovery & Metal Recovery

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***Abstrak*:** Indonesia is a country with abundant gold minerals and it is quite economical to mine. Processing gold minerals is very important to increase gold content, one of the methods used is flotation. Reagent knowledge test in gold ore flotation was carried out to obtain certain mass recovery and metal recovery. In this study, the reagents used were 621 (activator), 530X (frother), and several collectors, namely collector type 1, namely 4000, collector type 3, namely X2, and the reagent test used a varied collector on collector 2, namely with reagent 7042; 7042A; 7042W and without using collector 2. Optimal % mass recovery and % metal recovery results using a variation of collector 2 reagent in the form of 7042 which produces a high recovery value of 4.19% in the final concentrate and a high metal recovery of 85.73%

Keywords: Gold, Flotation, Collector, Mass recovery, Metal recovery

1. INTRODUCTION

Gold is a precious metal that has high economic value. The content of gold ore can vary and differ depending on the geological or natural characteristics of the ore mining site. In general, there are several types of gold ore, including native gold, free milling gold ore and refractory gold ore (Siti Aminah, 2022). One of the gold ore processing processes used to increase the grade is flotation.

The gold ore used is sulfide gold ore. The gold contained in this sulfide mineral is refractory so a fine size is required. Examples of sulfide minerals that can contain refractory gold are pyrite (FeS), chalcopyrite (CuFeS2). The process of increasing the grade that is usually used for sulfide minerals is the flotation method, because Sulfide minerals have lower polar properties than oxide minerals. The aerophilic nature of sulfide minerals means that sulfide minerals are easier to float. Sulfide minerals are also easier to wet with collector reagents.

Flotation is a concentration process in mineral processing which aims to separate valuable minerals from impurity minerals by utilizing the physical chemical properties of the mineral surface where in this process selective sticking of the mineral surface occurs with air bubbles in the slurry (Marsden, 1999). In general, there are 3 reagents used in the flotation process method to obtain optimal results, these 3 reagents are modifier, collector

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and frother. This reagent will be used to condition the pulp in the process Flotation, apart from that, also allows valuable minerals to become air-loving (aerophilic) minerals. Addition reagents will facilitate the process of separating valuable minerals from gangue minerals (impurities). Valuable minerals will stick to air bubbles that form pulp on the surface of the flotation cell.

Collector is a reagent to change the surface properties of minerals, and can influence the critical pH used in the flotation process (Ahmad, 2009). Therefore, it is necessary to select a collector that is suitable for the gold ore. Collectors have different specifications to change the surface properties of minerals. where there are collectors for sulfide minerals such as xhantate and collectors used at PT Florrea Solution Indonesia to change minerals with surface properties that don't like air (aerophobic or hydrophilic) into minerals that like air (aerophilic or hydrophobic). The addition and type of reagent used in the floation process is an important part of optimizing the grade increasing process. The gold ore found in a company can be different so it is necessary to check the right reagents for the flotation process being carried out. Therefore, reagent collectors with variations 7042, 7042W, and 7042A and 4000 are used as primary collectors and X2 as secondary collectors from PT Florrea Solution Indonesia. In this research, we want to know what combination of collectors is more suitable for gold ore at Company X, North Sulawesi.

2. RESEARCH METHODS

The research method used in this research is the flotation method, a technique for separating minerals from impurities. The sample used in this research was sulfide gold ore from Company. The flow diagram of the gold ore processing process using flotation can be seen in Figure 1.

The stages start from drying the sample, then blending the sample using the cone and quartering method to mix the sample so that it is homogeneous, splitting using a rotary splitter, grinding time to minimize energy use, determining the dosage of reagents for subsequent use in the flotation process, while the results of the flotation process are filtrated. then dried.

In this study, the reagents used were 621 (activator), 530X (frother), and several collectors, namely collector type 1, namely 4000, collector type 3, namely X2, and collector type 2, namely 7042, 7042W, and 7042A. In the flotation process there are

several parameters that influence flotation, as in Table 1.

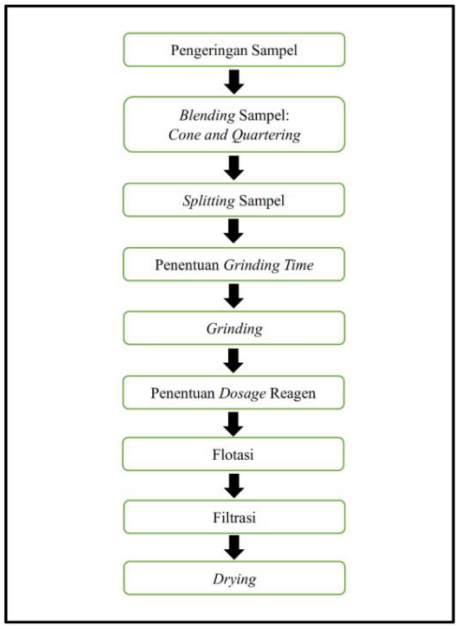

Figure 1. Flotation process flow diagram

Table 1. Parameter Flotasi

Parameter	Keterangan
sample weight	900 gram
particle size	-200 mesh
% *Solid*	29 %
Air flow rate Rou-Scav	5 L / min
Impeller Speed Rou-Scav	1992 rpm
Scrapper Frequency Rou-Scav	25 per menit
Air flow rate cleaner	3 L / min
Impeller Speed Cleaner	1608 rpm
Scrapper Frequency Cleaner	20 per menit
Cell Volume Rougher	3000 cc
Cell Volume Cleaner	1500 cc

1. Sample Preparation

The first step taken before flotation is to dry the sample to reduce the water content in the sample because the water content in the sample, because it can affect the results of weighing the sample and affect the solid percent of the sample.

The dried samples were homogenized using the cone and quartering method. Then a splitting process was carried out to ensure that the sample was homogeneous using a rotary splitter machine.

The grinding process is carried out, but previously grinding time is carried out to minimize the energy used in the grinding process. This process was carried out by adding 41 steel balls weighing 2724 grams, a sample weighing 900 grams, and 1 liter of water until a solid percent of 29% was obtained. Grinding was carried out for 23 minutes according to using a ball mill with the grinding time previously obtained.

The flotation process for sulfide gold ore uses modifier, collector and frother reagents. The dosage of reagents used in each stage is different according to process needs. Reagents in the flotation process are used in the rougher, scavenger, cleaner and re-cleaner processes.

2. Reagent Determination

In the gold ore flotation process, reagents are used in the form of modifier, collector and frother reagents. In this process the reagent used is a reagent product from PT. Florrea Solution Indonesia, namely activator 621, collector 7042, 7042A, 7042W and X2, and frother 530X. The reagents used in this process are used from the rougher, scavenger, cleaner and re-cleaner processes. The dose used in each stage is different according to process needs.

The dose used for activator 621 with a strength of 5% is 100 gpt for stage rougher, 50 gpt for stage scavenger 1 and 25 gpt for stage scavenger 2 and stage scavenger 3. The dose used for collector 3, X2 is used with a strength of 5% of 60 gpt for stage rougher, 20 gpt for stage scavenger 1 and 10 gpt for stage scavenger 2 and stage scavenger 3.

3. Flotation and Dewatering

Flotation involves separating minerals based on their surface properties. This research uses a mechanical flotation machine that can inject oxygen. This flotation process is carried out in 3 stages, namely the rougher-scavanger stage which consists of 4 stages, the cleaner stage which consists of 3 stages and the re-cleaner stage which consists of 2 stages, as in Figure 2.

In this experiment there were 4 series of test work using variations of the 7042 collector, 7042W, dan 7042A.

In this experiment there were 4 series of test work using collector variations 7042, 7042W, and 7042A. The addition of reagents is carried out in stages in the order of activator, collector and frother. The flotation parameters used in this experiment can be

seen in the table. 1.

The concentrate resulting from the flotation process is filtered with a vacuum filter to speed up time and reduce the use of heat energy in the drying process. The filtration process is carried out to reduce the water content in the flotation concentrate.

The drying process aims to remove the water content in the concentrate so that a dry concentrate mass is obtained which will be used to calculate mass recovery. The drying process is carried out at a temperature of 100℃ -115℃ using an oven so that the water content in the concentrate reaches 0%

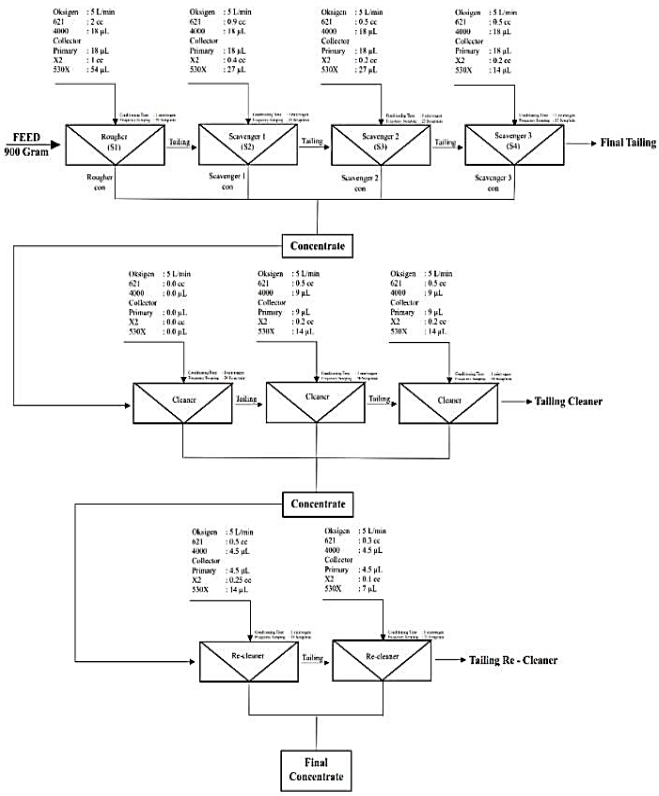

Figure 2. Flotation Process Scheme

3. RESULT AND DISCCUSION

From the flotation tests carried out, mass recovery and metal recovery will be calculated for each test carried out

A. calculation

- *%Mass recovery*

The following is the formula used to calculate mass recovery

$$\%\, Mass\ Recovery = \frac{Mass\ Concentrate}{Mass\ Feed} \times 100\%$$

Data from mass recovery calculations can be seen in Table 2

Tabel 2. Result of *Mass Recovery*

Test	*Feed*	*Au Assay* (ppm)			*Metal recovery* (%)	
		TC	TRC	FC	R	FC
1	900	153.8	39.3	37.7	24.01%	4.19%
2	900	139.8	31.15	44.2	25.64%	4.91%
3	900	124.9	41.1	42.6	23.18%	4.73%
4	900	143.6	39.7	34.2	24.17%	3.80%

- *%Metal recovery*

The following is the formula used to calculate metal recovery

$$\%\ Metal\ Recovery = \frac{C.c}{F.f} \times\ 100\%$$

Data from metal recovery calculations can be seen in Table 3

Tabel 3. Result of *Metal Recovery*

Test	*Feed*	*Au Assay* (ppm)			*Metal recovery* (%)	
		TC	TRC	FC	R	FC
1	1.16	0.72	2.25	15.3	74.33%	55.25%
2	1.16	0.38	0.58	20.25	92.57%	85.73%
3	1.16	0.74	1.30	12.75	66.00%	52.03%
4	1.16	0.50	1.90	13.30	57.67%	43.57%

B. Discussion

Samples have been tested by fire assay to determine the metal content and levels in the feed, concentrate and tailings of each sample. Specifically for collector 2, variations were carried out for each test, in test one did not use a collector, in test 2 it used 7042, in test 3 it used 7042 A, in test 4 it used 7042 W. Based on the results of these tests, the % mass recovery obtained from flotation results using variations reagent collector obtained results in test 2 using 7042 of 25.64% on rougher and 4.91% on final concentrate. In test 3 using 7042W it was 23.18% in rougher and 4.73% in final concentrate. In test 4 using 7042A it was 24.17% in rougher and 3.80% in final concentrate. The % metal recovery results from flotation using a variety of collector reagents obtained results in test 1 of 74.33% for the rougher and 55.25% for the final concentrate. In test 2 it was 92.57% on rougher and 85.73% on final concentrate. In test 3 it was 66.00% on rougher and 52.03% on final concentrate. In test 4 it was 57.67% on

rougher and 43.57% on final concentrate. The reagents used in this test are activator 621, collector 1 4000, collector 3, frother 530x.

The comparison of mass recovery and metal recovery in the final concentrate can be seen in Figure 3 and the comparison of mass recovery and metal recovery in the rougher can be seen in Figure 4

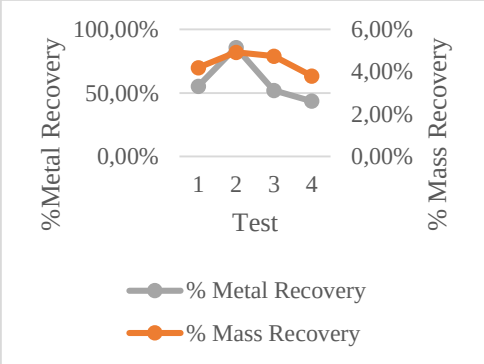

Figure 3. Comparison of *Mass recovery* dan *Metal Recovery* Pada *Final Concentrate*

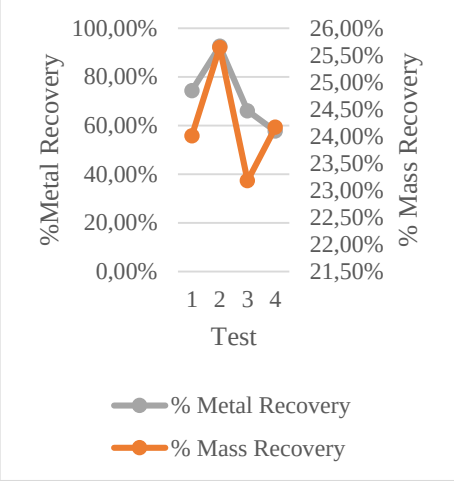

Figure 4. Comparison of *Mass recovery* dan *Metal Recovery Rougher*

The flotation process in test 2 was considered good enough to increase concentrate levels and increase recovery of flotation results. This can be seen in the high mass recovery and metal recovery results when compared to other tests.

4. CONCLUSION

Based on the results of the experiments that have been carried out, the following conclusions are obtained:

1. The optimal % mass recovery for flotation results using a variation of collector reagent 2, namely in test 2 using 7042, was 25.64% for the rougher and 4.91% for the final concentrate.

2. The optimal % metal recovery from flotation results using a variation of collector reagent 2, namely in test 2, was 92.57% for the rougher and 85.73% for the final concentrate.

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