Vol. 7, No.1, Januari 2024, Hal: 27-34
DOI:https://doi.org/10.30596/rmme.v7i1.16941
ISSN 2622-7398
http://jurnal.umsu.ac.id/index.php/RMME
Jurnal Rekayasa Material, Manufaktur dan Energi

Performance Comparison Of Self Aeration Flotation Machine Vs Induced Air Flotation Machine With The Additional Effect Of Variation Of SiBX Dosage On % Recovery of Cu and Au At North Concentrator PT. X Papua

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ABSTRACT
Comparison of the performance of self aerating vs induced water flotation machines with the effect of adding SiBX dose variations on % recovery of Cu and Au, so that it can be carried out to optimize the recovery process of Cu and Au at PT. X Papua. It was carried out at the Cl concentrator plant scale, using three types of SiBX dosage variations, namely 5 g/t, 10 g/t, and 15 g/t which were applied to both types of flotation machines. Furthermore, mineral assay and XRD tests were carried out. The results of % recovery of Cu and Au as a whole show that the self aerating flotation machine is able to remove Cu and Au more effectively than the water induced flotation machine for all coarse, medium, and fine mineral size fractions. Recovery of Cu and Au is influenced by the hydrodynamic properties of the two types of engines. The effect of adding variations in SiBX doses was less significant on % recovery of Cu and Au.

***Keyword** : SiBX, flotation machine, hydrodynamic*

INTRODUCTION

PT. X Papua uses the flotation process, which is the process of separating valuable minerals by utilizing the differences in the surface properties of minerals and gangue [1]. The flotation process involves use of chemicals which function as collectors which play a role in changing the surface properties of valuable minerals from hydrophilic to hydrophobic, then chemicals which function as froth play a role in stabilizing the froth (bubbles) so that these valuable minerals can be removed and separated from impurities (gangue) [2]. Focus of this research is on the North Concentrator, North Concentrator is divided into two types, namely self aeration flotation machine and induced aeration flotation machine. Flotation machine must have four functions properly, namely, firstly it must have good contact between solid particles and air bubbles, secondly the machine is able to form a stable froth, thirdly is it able to keep solid particles circulating in the form of a slurry, and the fourth has the ability to move the froth [3]. Froth flotation is the most important copper processing technique applied in mineral processing industry throughout the world. Froth flotation was patented in 1906 originally permitting the mining of complex ores with low-grade content of economic minerals which would have otherwise been regarded as uneconomic[4]. Froth flotation is a highly versatile method for physically separating particles based on differences in the ability of air bubbles to selectively adhere to specific mineral surfaces in a mineral/water slurry [5], and influence of the degree of dispersion of mineral slurries entering a flotation machine is complex and has permeated the technical literature for quite sometime [6]. Both types of flotation machines is to compare the performance of the flotation machines to the percentage of recovery of Cu and Au. The minerals can be classified into polar and non-polar based on their surface properties. The mineral surface of non-polar minerals is formed from weak molecular bonds and is hydrophobic, while polar minerals are formed from covalent or ionic bonds which easily react with water molecules and are hydrophilic [7]. In the flotation process, air bubbles are passed in the slurry as a medium which will transport valuable minerals to the surface leaving the impurities (gangue) sinking as tailings. This can happen if the valuable mineral is hydrophobic or water repellent. Various chemical reagents are added to assist theprocess of separating and collecting valuable minerals as concentrates. The collector consists of a primary to change the surface properties of valuable minerals, in this case copper sulphides, from hydrophilic to hydrophobic

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so they can be lifted by bubbles. Aero 7249 is selective for removing copper sulphides minerals. Aero 7249 is a phosphor based collector, a mixture of dithiphosphates and monothiophosphates. This chemical is heteropolar with two chain ends that serve two functions. One end selectively adheres to the mineral surface and the other end is hydrophobic which adheres to the bubbles [3]. The secondary collector has the same function as the primary collector, namely changing the surface properties of valuable minerals. But SiBX is less selective than Aero 7249. This SiBX removes pyrite, sphalarite, and other sulfide minerals. Thus causing a lower concentration level with a high recovery rate. SiBX is expected to increase Au Recovery, because Au is associated with other sulfide minerals, not only with copper sulphides. One of the results of this study shows that with increasing the dose of SiBX used, it also increases the recovery of particles that have less than 25% copper sulfide content. In addition, with the increase in the dose of the collector used, the attachment time decreases and the flotation rate also increases. This is because by increasing the number of SiBX collectors, it expands the surface of valuable Cu minerals that can be covered by SiBX molecules so that the hydrophobic properties of the mineral surfaces increase and more minerals can be lifted by the froth [8]. Frother is a chemical with an alcohol base with an alcohol content of up to 80%. The function of the frother is to reduce the surface tension between the water-bubbles so that the froth/bubble is more stable and strong enough to lift minerals [3].

MATERIAL AND METHOD

Material

Slurry from the flotation process at North Concentrator.

Equipment

Stages 1 Samping

The equipment; plastic bag, bucket, deep cutter, hanlf moon cutter, cylinder cutter.

Stages 2 Measurement of the mass of wet and dry samples

The equipment; Digital and analog mass balance, Filter press, Filter paper, Oven.

Stages 3 Mixing

The equipment; Roller, Conical mixer, Bucket.

Stages 4 Splitting

The equipment; Rotary splitter, Riffle splitter.

Stages 5 Rotary

The equipment; Sieve 50#; 65#; 100#; 150#; 270#; 400#; 500#, Brush, Rotary machine.

Stages 6 Pulverize

The equipment; Pulverize machine, Spatula, Brush, Paper bag, Pressured air.

Method

The dosage variations used are classified into three levels, namely Low SiBX (5 gr/ton), Medium SiBX (10 gr/ton), and High SiBX (15 gr/ton). Samples taken at the sampling stage consisted of feed, concentrate and tailings. Sampling point for feed is in the feed box before being distributed to rougher flotation, then sampling point for concentrate is at rougher flotation stage 1 and rougher flotation stage total which is a combination of concentrate samples at stage 1, stage 2 and stage 3 for self aerating flotation machine, as well as stage 1, stage 2, stage 3, and stage 4 for induced air flotation machines. Tools for sampling are deep cutters for tailings, half moon cutters for concentrate, and cylinder cutters for feeds. Sampling were carried out three times according to the variation in the secondary collector dose used. The transition between sampling from one condition to the next is ±30-45 minutes. This time span is based on Retention Time on the rougher flotation North Concentrator. For each sampling condition, the sampling interval is every 10 minutes for six cuttings. After the sampling has been completed, the feed, concentrate and tailing samples are subjected to sample preparation in the metallurgy laboratory.

RESULT AND DISCUSSION

Solid Sample Percentage

Figure 1 shows the % solid slurry rougher feed, rougher concentrate stage 1, rougher tail stage 1, rougher concentrate total stage, and rougher tail total stage from two types of self-aerating flotation machines of (43,72%; 11,37%; 38,69%; 14,32%; and 44,73%) and induced water of (41,69%; 21,26%; 36%; 19,56%; and 43,24%) at low dose variations of SiBX 4,62 gr/t.

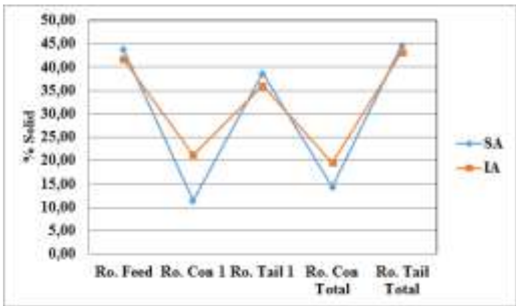

Figure 1. % Solid with low SiBX dosage variations

Figure 2 shows the % solid slurry rougher feed, rougher concentrate stage 1, rougher tail stage 1, rougher concentrate total stage, and rougher tail total stage from two types of self aerating flotation machines of (43,72%; 11,37%; 38,69%; 14,32%; and 44,73%) and induced water (41,69%; 21,26%; 36%; 19,56%; and 43,24%) at various SiBX dose medium 11,29 gr/t.

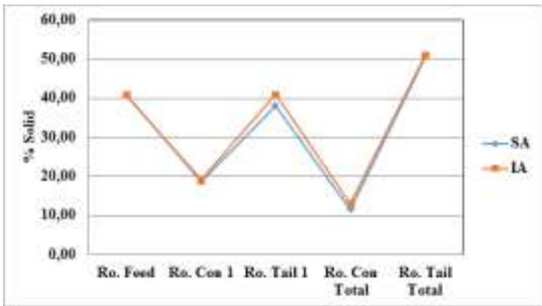

Figure 2. % Solid with variations in medium SiBX dosage

Figure 3 shows the % solid slurry rougher feed, rougher concentrate stage 1, rougher tail stage 1, rougher concentrate total stage, and rougher tail total stage from two types of self-aerating flotation machines of (42,13%; 20,33%; 37, 13%; 11,02%; and 45,80%) and induced water of (41,81%; 23,60%; 36,74%; 15,39%; and 44,47%) at high SiBX dosage variations 14.46 gr/t.

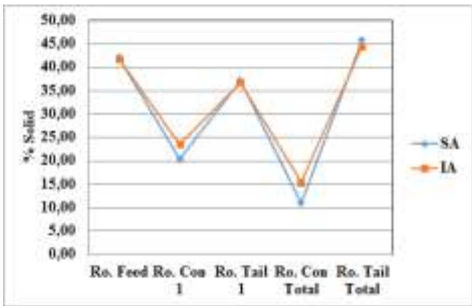

Figure 3. % Solid with variations in high SiBX dosage

Particle Size Distribution and XRD Test Results

Figure 4 shows P80 and D50 sample feeds from the self aerating flotation machine and induced air flotation machine. At low, medium, and high SiBX dosage variations, the feed distributed to self-

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aerating flotation machines has P80 values (209, 164, and 199,67) in µm units and induced air flotation machines have P80 values (200, 199, and 197) µm. Meanwhile, the value of D50 feed for self-aerating machines is (81, 68, and 79,83) µm, and the value of D50 feed for induced air flotation machines is (74, 81, and 78) µm. These data show that the feed originating from the feed box has relatively the same particle size, thus showing that the particles are distributed evenly to the self-aerating and induced air flotation machines and no segregation occurs for processing in the rougher flotation circuit [9].

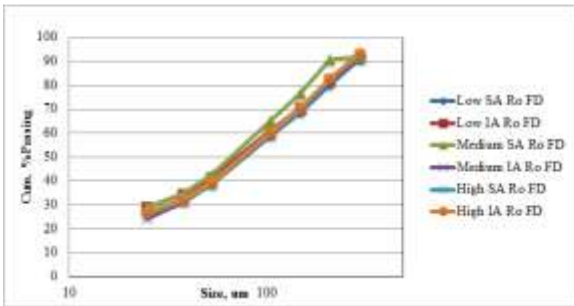

Figure 4. P80 and D50 sample feeds from the two flotation machines

Figure 5 shows P80 and D50 samples of rougher concentrate stage 1 from self aerating (SA) and induced air (IA) flotation machines. Sequentially from low, medium and high doses of SiBX the P80 value of the self aerating flotation machine (SA) was 129,7; 101,50; and 125,21µm, while for the rougher concentrate stage 1 sample, the flotation induced air (IA) machine had a P80 value of 115,04; 106,23; and 127,65 µm.

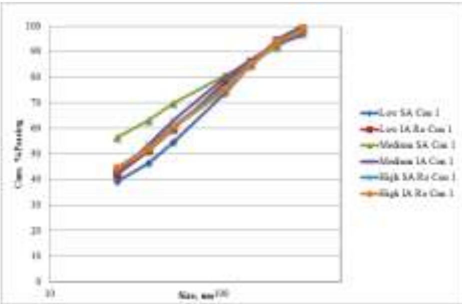

Figure 5. P80 rougher concentrate stage 1 sample

Figure 6 is a graph of the P80 distribution of the rougher concentrate total stage sample. The P80 rougher concentrate total stage value of the self aerating (SA) flotation machine with low, medium, and high SiBX dosage variations was 222,81; 101,50; and 82,81 µm, while the P80 value of the rougher concentrate total stage flotation induced air (IA) machine with variations in low, medium and high SiBX doses was 117,39; 101,50; and 47,62 µm. The effectiveness of the machine's ability to remove coarse mineral particles is influenced by the working mechanism of the flotation machine. Bubbles which play a role in lifting valuable minerals in self-aerating flotation machines have a shorter surface travel distance than bubbles traveling to the surface in induced air flotation machines, so bubbles in self-aerating flotation machines are more stable than bubbles in induced air flotation machines [10]. Minerals with coarse size fractions require a compatible froth, so that they do not collapse before touching the overflow launder and falling back into the pulp [11], [12].

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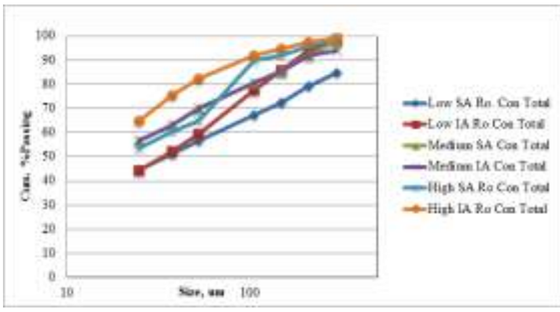

Figure 6. P80 and D50 samples of rougher concentrate total stage

Figure 7 is a graph of the P80 distribution of the rougher tail sample total stages of both self-aerating and induced air flotation machines. The self aerating flotation machine showed a P80 value at low, medium, and high SiBX dosage variations of 184,6; 219,03; and 218,80 µm, while the P80 value of the water-induced flotation machine with varying doses of low, medium, and high SiBX was 207,64; 242,22; and 215,48 µm. The P80 value of the sample from the self aerating flotation machine is smaller than the P80 value of the sample from the induced air flotation machine.

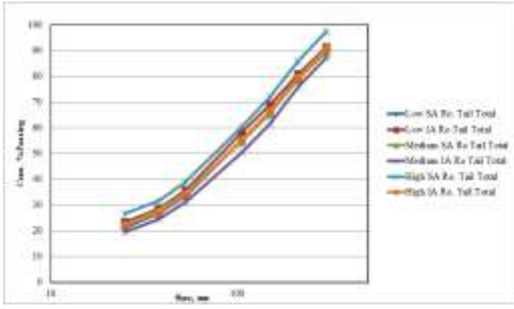

Figure 7. P80 and D50 samples of rougher tail total stage

Effect of SiBX Dosage Variation on Cu and Au Recovery

The chemicals or reagents used consist of a frother, a collector consisting of a primary collector and a secondary collector, and a pH modifier. This study used the addition of low, medium, and high SiBX dosage variations to determine the effect on % recovery of Cu and Au.

Figure 8 below is a graph of recovery Cu stage 1 from the two self-aerating (SA) flotation machines of 84,11%; 84,63%; and 82,70% and induced water (IA) of 76,13%; 71,24%; and 47,94% for the three variations of low, medium, and high SiBX doses. Data recovery of self-aerating (SA) Cu machines showed a slight increase from low SiBX doses to medium doses and recovery decreased when high SiBX dose variations were used. The recovery value of the self-aerating (SA) flotation machine still shows an increase, in the study of Boris Albijanic [8] with increasing doses of SiBX used, it also increases the recovery of particles that have less than 25% copper sulfide content.

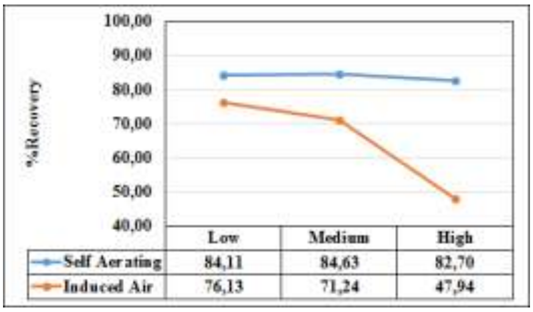

Figure 8. % Recovery of Cu stage 1 with various doses of SiBX

Figure 9 shows a graph of the total stage Cu recovery from the two self-aerating (SA) flotation machines of 94,13%; 90,17% and 93,19% and induced water (IA) of 92,07%; 84,86%; and 89,81% for the three variations of low, medium and high SiBX doses.

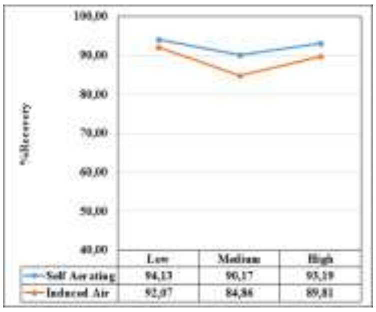

Figure 9. % Recovery of Cu total stage with variations in SiBX doses

Figure 10 shows data on Recovery Au stage 1 values from both self aerating (SA) and induced air (IA) flotation machines at the three variations of low, medium, and high SiBX doses respectively (79,47%; 76,11%; and 75,27%) and (61,39%; 62,69%; and 54,45%).

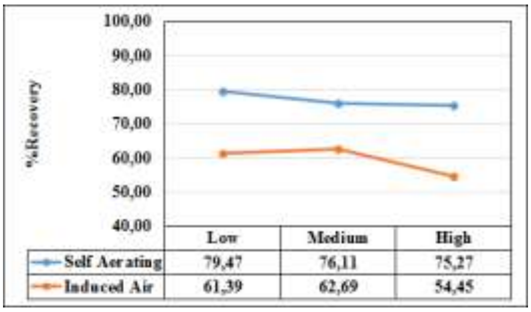

Figure 10. % Recovery Au stage 1 with variations in SiBX doses

Figure 11 is a graph of the total Recovery Au stage values for the three variations of low, medium, and high SiBX doses of the two types of self-aerating (SA) flotation machines of 80,99%; 84,98%, and 85,52% and Induced water (IA) of 77,10%; 71,44%, and 79,10%.

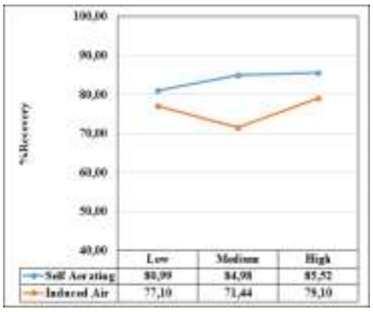

Figure 11. % Recovery Au total stage with variation of SiBX dosage

In **Figure 12** and **Figure 13** below are the recovery values of insol in the flotation process with three conditions of low, medium, and high SiBX dosage variations. Insol is a gangue that has hydrophilic or hydrophobic properties. The minerals belonging to this gangue include talc, graphite, native sulfur, pyrite, pyrrhotite, and arsenopyrite. Data on Cu and Au Recovery values previously did not show any effect of using SiBX dose variations on Recovery values. Increasing recovery with increasing collectors, it is also stated in the study that there is an optimal point of collector use dose, pH, and ionic bond strength for the shortest attachment time and the highest recovery of minerals in the flotation process[13].

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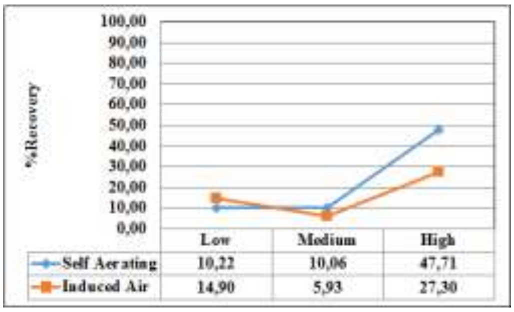

Figure 12. % Recovery Insol stage 1 with various doses of SiBX

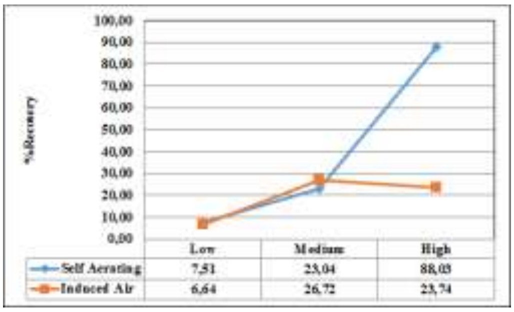

Figure 13. % Recovery of Insol total stage with various doses of SiBX

Figure 13 shows the total recovery insol stage values of the two types of self aerating (SA) and induced air (IA) flotation machines at the three variations of low, medium, and high SiBX doses respectively (7,51%; 23,04%; and 88,03%) and (6,64%; 26,72%; and 19,63%).

CONCLUSIONS

- The performance of the self aerating flotation machine in Cu and Au Recovery was greater than that of the water induced flotation machine in the coarse, medium, and fine particle size fractions.
- Water induced flotation machines are effective in lifting valuable minerals in medium and fine size fractions, but for coarse size fractions water induced flotation machines are less effective in lifting valuable minerals.
- The use of low, medium, and high SiBX dosage variations did not have a significant effect on Cu and Au recovery, both from self aerating flotation machines and induced air flotation machines.
- The effect of using various SiBX doses in this study was seen from the recovery of the insol, namely there was an increase in Cu and Au recovery values from low, medium and high doses of SiBX.

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