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"THE EFFECT OF GRAIN SIZE AND CYANIDE CONCENTRATION ON AGITATION LEACHING ON THE PERCENT RECOVERY OF GOLD SLUICE BOX TAILINGS AREA OF BATU SOPANG EAST KALIMANTAN"

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THE EFFECT OF GRAIN SIZE AND CYANIDE CONCENTRATION ON AGITATION LEACHING ON THE PERCENT RECOVERY OF GOLD SLUICE BOX TAILINGS AREA OF BATU SOPANG EAST KALIMANTAN

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Abstract. Tailing sluice box still contains 4.96 gpt of gold. Samples were taken for XRD and SEM-EDX testing.The XRD test results show that quartz is the dominant mineral, followed by clay and feldspar. Quartz mineral content is 46.87%, clay mineral content is 17.76% and feldspar mineral content is 27.80%. The clay mineral content which tends to be high affects the leaching process which makes the reaction take longer. The results of the diagnostic leach test using HCl solution and cyanide solution resulted in 39% Au gain. The results of the HCl pretreatment on the tailings grain size -150, -200, and -270 mesh got Au gain percentage of 23.6%, 29.6%, 44%. Tailings leaching with variations in cyanide concentrations of 500 ppm, 750 ppm and 1000 ppm resulted in gold recovery of 0.8%, 5.8%, and 7.8%. The highest gold gain was at -270mesh size and 1000ppm cyanide concentration with 72 hours leaching time.

Keywords: Leaching, Recovery, Gold, Cyanide concentration, Grain size, Tailing, Sluice Box

1 Introduction

Gold extraction starts from mining from nature to getting pure gold. Over time, the gold content in natural ores is getting thinner and more difficult to extract [1]. One of the gold extraction processes is through the hydrometallurgical process. Hydrometallurgy is a separation process through chemical reagents or solutions, one of the hydrometallurgical processes is leaching using cyanide reagents. Cyanide is a reagent that is widely used to extract gold in large and small scale industries [2].

In general, gold can be obtained through amalgamation or cyanidation processes. Over time, the amalgamation process is considered an unsafe process to process gold because it contains hazardous materials, so many countries have banned the use of this process. The advantage of this cyanidation process is that it is selective for precious metals such as the element Au. Amalgamation is only effective for processing ores that have high gold content,

while cyanidation is effective for processing low and high grade gold. The cyanidation process can be successful because it is influenced by several parameters including the grain size of the ore and the concentration of cyanide during the process.

Gold ores are usually classified by metallurgists into two main categories: free-milling and refractory ores. Free-milling ore is defined as gold ore that can be obtained above 90% extraction by conventional cyanide immersion. [3]

The sluice box process is the separation of valuable minerals from their impurity minerals by utilizing specific gravity, so that light specific gravity minerals will flow to the tailings area while valuable minerals in this case gold minerals will be retained because they have a higher specific gravity. Because this process utilizes specific gravity to separate valuable minerals, it has the disadvantage of not being able to separate gold which is still associated with impurity minerals. Therefore, there are still many gold minerals contained in the Tailing Sluice Box [4] . To prove this, the researchers will conduct XRD testing on the Tailing Sluice Box and perform a metallurgical diagnostic leaching test to determine the gold recovery in the tailings. The experimental method in this study was agitation leaching with variations in grain size and cyanide concentration.

2 Material And Method

2.1 Material

The feed material uses a tailing sluice box originating from Batu Sopang, East Kalimantan. The leaching reagent used NaCN dissolved in water with various concentrations of 500,750, 1000ppm. NaOH is used to control the pH in leaching. The reagents used for diagnostic leach are HCl with a concentration of 32% and also HNO3 with a concentration of 68%.

2.2 Method

Reduction of grain size in the tailing sluice box using a rod mill to determine the effect of grain size on gold recovery. The tailing sluice box that has gone through the grinding process is taken a sample of 50 grams for the acid digestion method to determine the head grade. The results of grinding are taken 500 grams for diagnostic leach. The diagnostic leach stage starts from cyanide leaching 1 (CN1) then HCl immersion then cyanide leaching 2 (CN2) then HNO3 immersion then cyanide leaching 3 (CN3) then residue analysis using Aqua Regia solution. Leaching was carried out using a bottle roller by dissolving NaCN as a leachate reagent. Leach using parameters 40% solid, Ph 10.5 , agitation speed of 65rpm. The variation of cyanide concentration used was 500, 750, and 1000ppm. Variations in grain size used are -150, -200, and -270 mesh.

To determine the Au content in the tailing sluice box, SEM-EDX, Diagnostic Leach, and Acid Digestion tests were carried out. In the SEM test, testing was carried out at 2 different locations using 250x magnification with BSE lens. To determine the Au content in the tailing sluice box, an acid digestion test was carried out. This method is done by dissolving 50 grams of sample in Aqua Regia then separating the solids and taking the solution for AAS testing.

3. Result And Discussion

3.1 Mineralogical and Metallurgical Test Results Tailing Sluice Box

In the results of the SEM – EDX test, it was found that the Au content shown in Figure 1. The Au content in the tailings was also strengthened by the results of the diagnostic leach. The diagnostic leach results show the distribution of the association of Au with minerals in the ore. The diagnostic results showed that Au was dominant in minerals that were soluble in the HCl reagent. The results of diagnostic leach are shown in table 1.

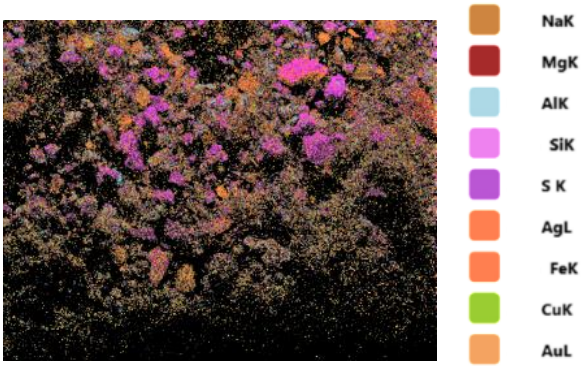

Fig. 1. SEM-EDX Test Results of Tailings Samples 200mesh

Table 1. Diagnostic Leach Test Result

Sampel	AAS (mg/l)	Recovery Au (%)
CN1	0,3	3,00
HCL	3,378	37,47
CN2	0,27	1,86
HNO3	1,4	17,77
CN3	0,23	3,49
ARA (Residu)	2,2	36,41

The AAS reading on the acid digestion test results was 4.9725 gpt.

The three test results indicate that the tailing sluice box still contains Au. However, the diagnostic leach results in table 1 show that the Au contained in the tailing sluice box is

associated with minerals. The Au native content in the tailing sluice box is very small. This proves that the native Au content in the tailings is only about 3% of the cumulative Au.

The results of the Au test in this study can categorize that the Au contained in the tailing sluice box is refractory. This is in accordance with Marsden, 2006 which categorizes refractory based on the acquisition of Au [5]

The refractory level is proven by the diagnostic leach test results in table 1. The percentage recovery at CN1 of 3% represents the native gold that can be obtained, this means that the remaining gold that can be obtained from the cumulative diagnostic leach is gold that is associated or even trapped in the minerals contained in the leach. ore.

The XRD test results shown in table 2 show that the dominant mineral is dominated by quartz and followed by feldspar. The XRD results also found 17% clay minerals. The clay content in the tailing sluice box will affect the leaching kinetics to be slower than no clay minerals at all, this is evident in the results at -270mesh taken Au at 72 hours. This is also explained by Hausen and Bucknam who wrote "Clay minerals were also found to be able to adsorb gold, though to a lesser degree. Hausen and Bucknam (1984) examined the adsorption of aurocyanide onto illite, kaolinite and montmorillonite but found the adsorption was very low in comparison with the adsorption onto carbon constituents in the ore"[6].

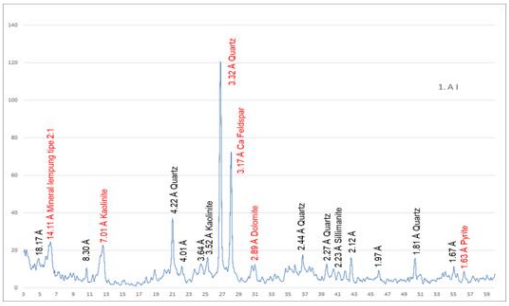

Fig. 2. XRD Test Result

Table 2. XRD Test Quantitative Results

Mineral	(%)
Quartz	46,87
Clay	17,76
Feldspar	27,8
Pyrite	3,14
Dolomite	4,43
Total	100

3.2 The Effect of Grain Size on the Percentage of Au Recovery in Tailings

The results of the Leaching Test are influenced by grain size. This is evidenced by the difference in the percentage gain in each grain size used in the study. At the size of -150mesh, -200mesh and -270mesh HCl pretreatment was able to obtain 23.6%, 29.6%, and 44% of the total cumulative gold obtained. Figure 3 of the graph shows that the highest Au gain occurs when the grain size is -270mesh. This means that the grain size affects the acquisition of Au.

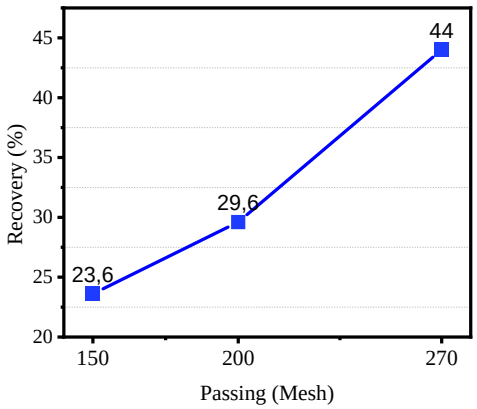

Fig. 3. Effect of Grain Size on the Percentage of Au Recovery in HCl Pretreatment

The results of the cyanidation test showed that the grain size of -270mesh was able to obtain Au with a recovery percentage of 7.8% at 72 hours. At the size of -150mesh and -200mesh, the percentage of Au recovery was not found because the concentration of HCl during pretreatment was too large so that the HCl function which should only free gold trapped in minerals becomes a reagent that extracts and dissolves gold.

At -270mesh the percentage recovery at 72 hours was 7.8%, this is gold trapped in HCl-soluble minerals. Even though it got a recovery percentage of 7.8%, the concentration of 5M HCl used was still too high because it got a very high percentage of recovery compared to the cyanidation process

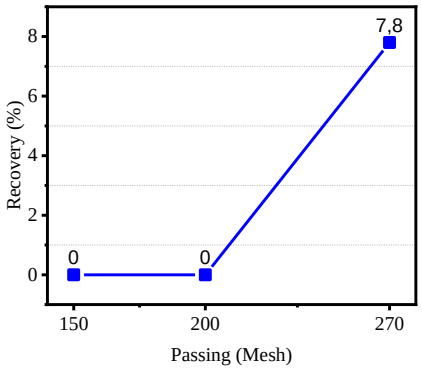

Fig. 4. Effect of Grain Size on Au Recovery on Cyanidation at 72 Hours

3.3 Effect of Cyanide Concentration on the Percentage of Au Recovery in Tailing Sluice Box

From the results of the cyanidation test, gold was obtained at the size of -270mesh at 72 hours with various concentrations. The concentration used in this study was the CN concentration calculated from 53% of the total NaCN used. From the results of the research then made into a graphic image as follows.

Figure 5 shows the highest percentage gain at a concentration of 1000ppm CN. From the graphic data, it can be explained that the higher the cyanide concentration used, the higher the percentage of Au gain. However, the use of high concentrations of cyanide will increase production costs, so it must be considered in the addition of cyanide.

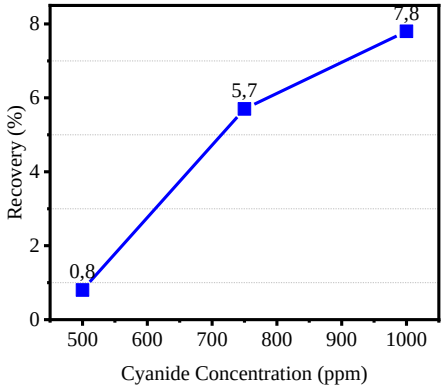

Figure 5. Effect of Cyanide Concentration on Au Obtainment in Cyanidation at 72 Hours

3.4 Results of the Effect of Grain Size and Cyanide Concentration on Agitation Leaching on Au Recovery in Tailing Sluice Box

The effect of grain size and cyanide concentration on gold recovery can be plotted in the following graphic image. Maximum results can be achieved with a grain size of -270 mesh and a cyanide concentration of 1000ppm

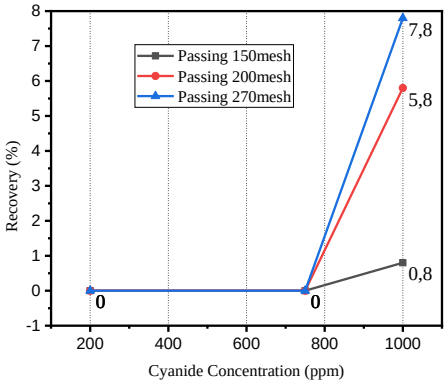

Fig. 6. Effect of Grain Size and Cyanide Concentration on Au Recovery in Cyanidation at 72 Hours.

4. Conclusion

Based on the results and discussions that have been carried out, the conclusions of this study are as follows.

1. The result of tailing sluice box test through acid digestion test for head grade determination is 1.6575 ppm Au. The test results through the diagnostic leach test resulted in a lot of Au elements associated with minerals that were soluble with HCl.
2. The effect of grain size on Au recovery was indicated by Au recovery in HCl pretreatment at -150mesh, -200mesh, and -270mesh sizes of 23.6%, 29.6%, and 44%. The effect of grain size was also shown by the acquisition of Au in the cyanidation process of sizes -150, -200 and -270 at 72 hours at concentrations of 1000ppm CN of 0%, 0%, and 7.8%.
3. The effect of cyanide concentration on Au recovery was shown by increasing Au recovery at -270mesh size at 72 hours. The higher the concentration, the higher the percentage of Au gain. The percentage of Au recoveries at 500, 750, and 1000 ppm were 0.8%, 5.8%, and 7.8%, respectively.
4. Grain size and cyanide concentration have an influence on the percentage of Au recovery. Maximum results were obtained with a grain size of -270 mesh and a cyanide concentration of 1000ppm. This variation gets a gold recovery percentage of 7.8%

5. Acknowledgements

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