# A Study on Recovery of Gold Leaching from Tailing of Moedi Moemi Gold Mine Using Column Leach Test

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***Abstract:*** *The main objective of this research is to extract the gold from the tailings which are dumped at Moedi Moemi gold mines southeast of Mandalay, in central Myanmar, and which lies about 80 kilometers north of Naypyidaw by using the CIP processing technology. These tailings contain gold between (0.9-2.75)g/t. A bulk sample about 100kg from tailing pond was used to conduct this study. The grade and the moisture content were determined. The natural pH of the tailings and their particles size distribution were also determined. Nearly 97% of the tailing was coarser than 74 µm. The sample showed that 22% of the distribution of the gold is under the size 74 µm and 78% of the distribution of the gold is over the size 74 µm. The cyanide concentration, residence time and lixiviant pH have a significant effect on the leaching efficiency of gold. In this study, pH of 11 and cyanide concentration of 0.05% were used. The experiments are conducted by changing the rates of flow from the overhead tank to the inlet of the column in achieving the same ponding depth. The recoveries of the column leaching test with different flow rates (1, 2, 3, 4 and 5 ml/s/m$^2$) are amount 26, 39, 53, 71 and 65 % respectively.*

***Key Words:*** *gold recovery, column leaching, tailing, Moedi Moemi*

## 1. INTRODUCTION:

Tailings, generated from mineral processing, used to be regarded as deserted by-products. However, with the exploitation and gradual depletion of the mineral resources all over the world, the reuse of tailings for recycling their residual valuable minerals become a necessity. The growing demands of gold necessitate efforts towards optimizing the gold yield from gold concentration processes with particular emphasis on recovery from gold tailings [1].
Cyanidation tailing is the residue produced from gold plants which use cyanidation (direct cyanide leaching process) to extract gold. In China, It is estimated that more than 2.45 million tons of cyanidation tailings are discharged into tailing ponds every year [2]. Most of these cyanidation tailings contain gold and some valuable minerals, such as copper minerals, lead minerals, zinc minerals and sulfide minerals. For example, the cyanidation tailing from Ariab Mines North East of Sudan contains gold between (1.1-1.4)g/t [3]. The cyanidation tailing from Shandong Province Nan in China contains 1.10 g/t Au 18.81 g/t Ag, 0.21% Cu and 0.33%Pb [4].

The process of recovery makes sense only if the cost of the recovery is much less than the value of the precious metal. Mechanical separation, pyrometallurgical, hydrometallurgical, and biohydrometallurgical techno-logies have been extensively used to recover gold from secondary sources [5]. Gold has mostly been leached out from ores, secondary sources and gold containing spent materials by cyanidation [5], [6]. The hydrometallurgical process has been utilized more often than the pyro-metallurgical process. Compared with pyro-metallurgical processes, the hydrometallurgical method is more exact, predictable, and more easily controlled [7].

As heap-leach-only operations are becoming more frequent, and operating margins even of operations that employ multiple extractive technologies (i.e. concentration of higher grade portion of the ore body by flotation and heap leaching of the low grade test) are tightening, more attention needs to be focused on improving heap performance in terms of rate of extraction as well as total extraction [8],[9].

Adequate ore testing is critical to the success of a new heap leaching operation. Ore amenability to cyanide leaching is determined by agitation leaching such as bottle roll test or magnetic stirring test. These simple tests are used to determine cyanide and lime (or caustic) requirements as well as the extent of gold and silver extraction (total extractability). If cyanide extraction is feasible and heap leaching is being considered then column leaching tests [10].

This paper discusses laboratory study of the column leaching tests. However there are many other parameters that affect the process of leaching behavior and are responsible for column leaching experiments have been conducted to analyze. Column experiments were set up in order to evaluate the effects of different irrigating solutions and residence time.

## 2. MATERIAL AND METHOD:

### *A. Mineral*

The mineral used in this study was the tailings which are dumped at Moedi Moemi gold mine southeast of Mandalay, in central Myanmar, and which lies about 80 kilometers north of Naypyidaw by using the CIP processing technology. Chemical analysis of the sample revealed the composition of 0.9 to 2.75 g/t Au. From the XRD result, it can be seen that the quarts, tourmaline, and iron oxides were the major minerals in the cyanidation tailing.

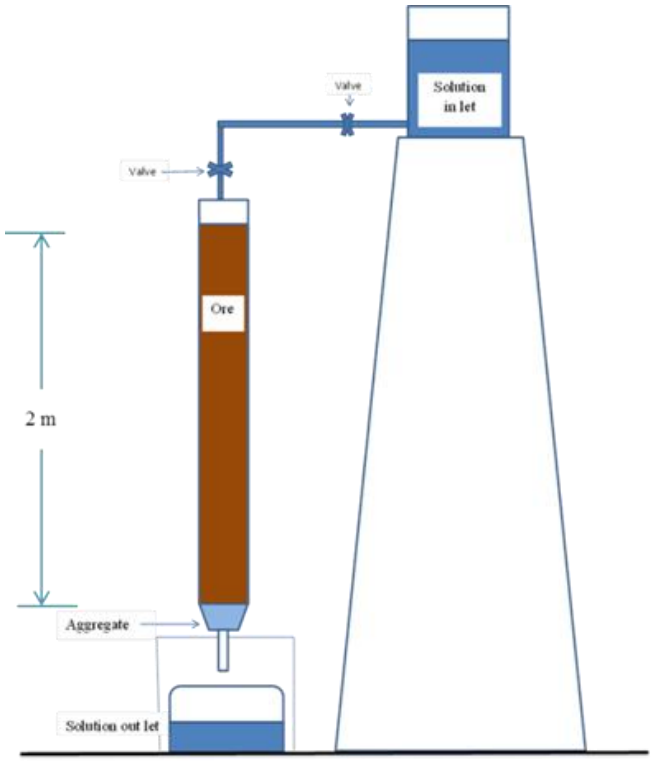


Fig. 1 Column Leach apparatus

### *B. Experimental Procedure*

Particle size analysis was done in phases using US standard sieves to separate the tailing sample into different size fractions. Sieve sizes of 595 µm, 297 µm, 210 µm, 149 µm, 105 µm and 74 µm were used. The sieves were arranged using geometric progression based on √2 with the sieve having the largest aperture on top. 1K g of the sample was used for each sieving set. The sieves were taken apart and the tailing sample retained on each sieve was weighed. Each of the fractions was assayed.

In the experiment, Column Leach apparatus is as shown in Fig.1. The feed cyanide solutions were loaded in a 25 L overhead tank, in order to maintain pH and NaCN strength. The irrigating rate was adjusted by drip set beyond the exit of the overhead tank. The leaching process was simulated in a percolation mode in 5 filtration PVC columns 2.0 m in height and 76 mm in diameter. The average weight of the tailing from Moedi Moemi gold mine charged into the each column was 10 kg. In this study, pH of 11 and cyanide concentration of 0.05% were used.

Further, cyanide solution is irrigated from the inlet of the overhead tank to top of the each column at 1, 2, 3, 4 and 5 ml/sec/$m^2$. Pregnant solution is collected from the bottom of each column for 63 days.

### *C. Measurement and Analysis*

The elemental analysis of the sample and solution samples were determined by wet chemical analysis method and Atomic Absorption Spectrophotometer (AAS).

TABLE.1 THE GOLD DISTRIBUTIONS IN THE SIEVED FRACTIONS

| Fraction size in µm | Retained weight (% ) | Au (g/t) | Au distrib. (%) |
|---|---|---|---|
| 297 | 31 | 2.98 | 35.1510032 |
| 210 | 28 | 1.479 | 15.75745123 |
| 149 | 20 | 1.864 | 14.18520675 |
| 105 | 10 | 2.13 | 8.104745271 |
| 74 | 8 | 1.704 | 5.187036974 |
| -74 | 3 | 18.935 | 21.61455658 |

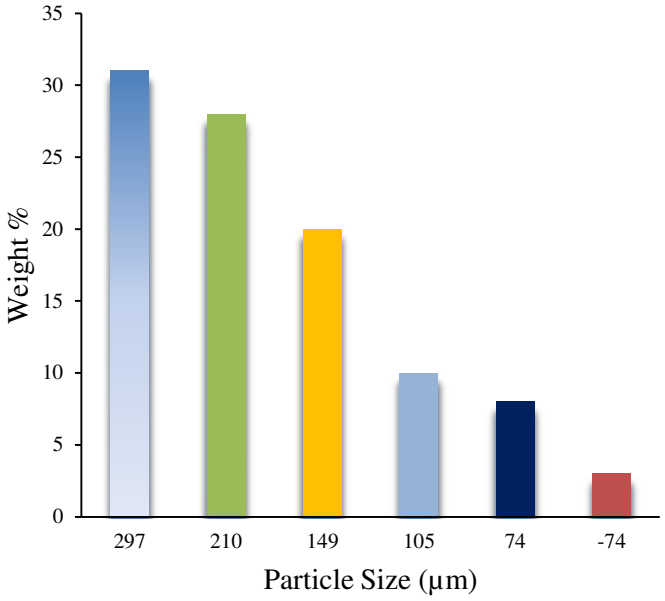


Fig.2 Size analysis of sample.

## 3. RESULTS AND DISCUSSION:

It was shown in Table.1 that nearly 97% of the cyanidation tailing was coarser than 74 µm. Based on the results obtained from gold distribution in different particle size, mean grade were measured about 2.6 g/t. With regard to high distribution of gold particles in particle size coarser than 74 µm. The analysis sample showed that 22% of the total gold is constituted in sizes smaller than 74 µm and 78% of the total gold is constituted in sizes larger than 74 µm.

The volumes of each collection barrel were recorded every 2 day from the time when the solution began to flow out of the column. For five flow rates as 1 ml/sec/$m^2$, 2 ml/sec/$m^2$, 3 ml/sec/$m^2$, 4 ml/sec/$m^2$ and 5 ml/sec/$m^2$ , leachate has been taken from each column and analysed for their concentration of gold.

The dependence of gold recovery on the leaching time and irrigation rate is shown in Figs. 4. Leaching of sample of tailing with the cyanide solution irrigation rate 1 ml/s/$m^2$ in column 1 afforded only 26% gold into leach after 63 days of column leaching. The recovery is gradually increased with increasing time. In column 2, the recoveries of gold with irrigation rate 2 ml/s/$m^2$ was achieved 39% after 63 days. In column 3, the recoveries of gold with irrigation rate 3 ml/s/$m^2$ get 50% after 63 days. Up to 71% gold was recovered from the column 4 after 63 days . For 63 days, the recovery of gold into the solution amounted to, 65% in column 5 .

Although increasing irrigation rate of solution, the recoveries of gold increase, Column 5 with flow rate 5 ml/sec/$m^2$ decrease recovery in 65% (Fig.5).

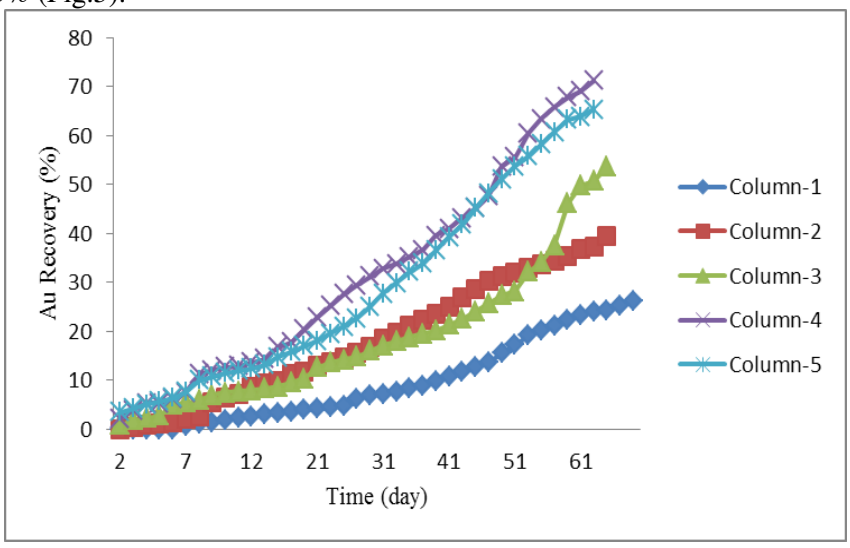


Fig. 4 Comparison of Gold Extractions on Column 1,2,3,4 and 5

## 4. CONCLUSIONS:

During the experiments it was possible to get excellent recoveries of column leaching test. In column 4, with the irrigation rate 4 ml/s/m$^2$, the recovery of gold was 71%. This preliminary column leach test is promising and is proposed as a potential method of economically extracting gold from tailings. However additional research work will still need to be conducted to determine the ultimate extent of gold extractions achievable by cyanidation. This study should be considered as a first step in the development of methodology for the design and planning of heap leaching plants. Future studies should include at least: effect of other variables, such as particle size, and development of methodologies which permit prediction of optimum conditions during the operation.

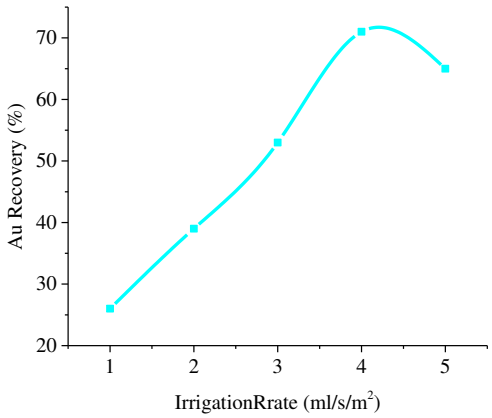


Fig.5 Recovery of gold in different flow rate for 63 day

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