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CHARACTERIZATION AND GOLD BENEFICIATION STUDIES OF REPUBLIC OF GUINEA GOLD ORE

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ASSISTANT PROFESSOR
MUSTAFA ÖZER

Mineral Processing
Engineering Department

PROJECT TEAM

Assistant Professor

Mustafa ÖZER

Research Assistant

Yusuf ENES PURAL

Bsc Student

Zeynep DEMİRYÜREK

Signature ____________________

Mustafa ÖZER

İMZA TASDİK OLUNUR
Rapor İçeriğinin Sorumluluğu
İmza Sahiplerine aittir.

JULY-2021

THIS PROJECT WAS DONE FOR
AGL MINING COMPANY.

We would like to thank you for your cooperation and state that we are open to new collaborations and project ideas...

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ABSTRACT

At the request of **"AGL Turizm Medya Madencilik Sanayi ve Ticaret Ltd.Şti.",** the following studies were carried out within the scope of this project named “Characterization and enrichment of gold ore of the Republic of Guinea” and the results are given.

a)Characterization of the gold ore, b)Pre-enrichment experiments c)Bottle Roll Test d)Cyanide leaching experiments and e)All test results were evaluated and gold production process flow chart was created.

Within the scope of this report, information on mining activities, geology and mineralization of the republic of Guinea has been adapted from the referenced sources.

1. SHORT INFORMATION ABOUT GOLD MINING IN REPUBLIC OF GUINEA

Guinea’s gold is predominantly found in the Upper Niger basin in the Siguiri region, in the north-east of the country. The country produces an annual average of 8-10 tons of gold. Its potential reserves are estimated at 700 tons. Several companies operate industrially in Guinea to produce gold, including:

- Guinea Gold Corporation (SAG, an AngloGold Ashanti subsidiary), which produces 350,000 ounces per annum;
- Dinguiraye Mining Corporation (SMD), which produces 300,000 ounces per annum.
- In addition, Wega Mining, a subsidiary of Avocet Mining, has held an operating licence since 2015. It is currently in late-stage funding for operations in Guinea.

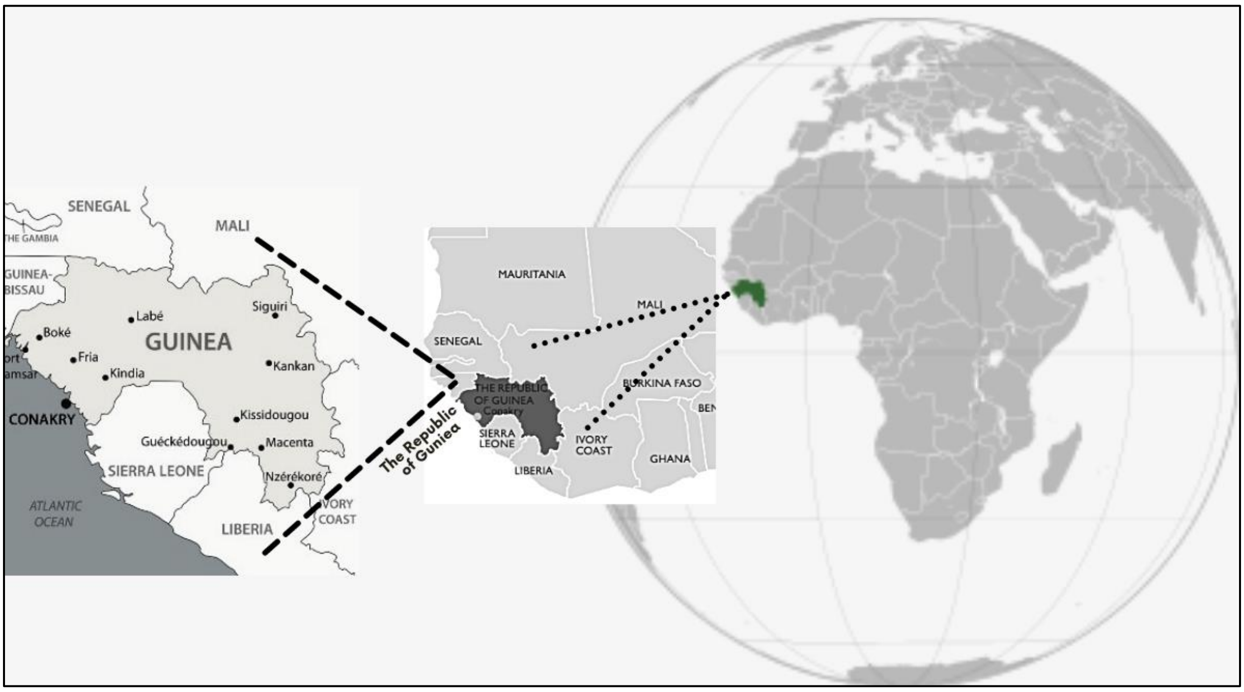


Figure 1. Location of the Republic of Guinea on the World Map

1.1. Geology

The geology of Guinea predominantly comprises of precambrian rocks, which have been strongly deformed by a series of orogenic events that affected the wider region of West Africa. The two principal events are the Liberian Orogeny and the Eburnean Orogeny (Birimian sequences). In Guinea, the geology can be grouped into three main subdivisions: a)Archaean gneissic rock, b)Paleoproterozoic greenstone and c)metasedimentary rock, or Paleoproterozoic granite terrains.

- **Archaean Gneissic Rock:** The Archaean rocks comprise granite, gneiss, and migmatite intercalated with high-grade schistose metasedimentary rock. These are remnants of the West African Craton, ancient shield rocks that formed circa 2.6–2.9 billion years ago (Ga). Recent mapping has enabled subdivision on the basis of age and lithology. The oldest rocks are high-grade metamorphic rocks (amphibolite to granulite facies), which pre-date the Liberian Orogeny, dated at between 2.8 and 3.05 Ga. The second of these subdivisions constitutes granitic batholiths of Liberian age (circa 2.6–2.8 Ga). The final subdivision contains two banded iron formation (BIF) ranges at Simandou and Nimba.

- **Paleoproterozoic Greenstone and Metasedimentary Rocks**: The northeast of Guinea is dominated by a vast area of Paleoproterozoic metasedimentary and metavolcanic rocks—referred to as the Siguiri Basin—which forms the host stratigraphy for the Mandiana Gold Project. The Siguiri Basin is bounded to the south by Paleoproterozoic plutonic rocks and to the north is buried by overlying Late Paleoproterozoic and Mesozoic sedimentary rocks. Marine detrital sedimentary siltstone and fine sandstone constitute the dominant lithologies within the basinal succession, but are intercalated with minor lava (pyroclastic rock) and are intruded by subvolcanic dikes and sills. All of the rocks are generally weakly metamorphosed, and the development of sericite as a secondary mineral is pervasive. Deformation within the basinal succession is heterogeneous: most of the metasedimentary and metavolcanic rocks possess an irregular foliation, with localized development of a stronger schistosity in shear zones and in the vicinity of plutonic contacts.

  Volcanic rocks within the basin have been dated at circa 2.1 Ga, leading to the interpretation that the Siguiri Basin succession is the same age as volcanic rocks in Birimian greenstone belts elsewhere in the wider West African region. The volcanic components within the basin share the same geochemical characteristics as modern-day subduction zones, suggesting that the basin originally had a convergent margin setting.

  Birimian greenstone rocks host world-class accumulations of gold in West Africa. In Guinea, the Siguiri Basin hosts the Siguiri, Lefa, and Kiniero mines, the principal gold producers of the country. Numerous other gold prospects occur throughout the basin, which extends east across the Malian frontier.

- **Paleoproterozoic Granite Terrains:** A large belt of granitic rocks separates the Archaean cratonic rocks to the south from the Siguiri Basin metasedimentary rock to the north. The belt has an average width of 50–100 kilometres and outcrops in an arc, with a general WNW–ESE strike. Several isolated plutons of Paleoproterozoic age fall outside of this arc within the Siguiri Basin and the Archaean domain. The granite terrain is dominated by a vast granodioritic batholith that is intruded by smaller granitic bodies such as monzogranite, biotite granite, and two-mica granite. The granite batholith is dated at circa 2.08 Ga, indicating that it was emplaced late in the Eburnean Orogeny. Its emplacement during this orogeny is thought to coincide with the development of large-scale sinistral shear zones along the southern margin of the plutonic belt, where it borders the Archaean domain.

1.2. Mineralization

Mineralization in the Mandiana property consists dominantly of quartz vein in float and numerous boudinaged and broken quartz veins with clay altered wallrock near the orpaillage pits. Pyrite and arsenopyrite are the main sulphides in gold bearing veins. Free gold is reported. Secondary (placer) gold deposits are also reported in the property. Exploration work has identified several zones of gold mineralization that are located on (Figure 2).

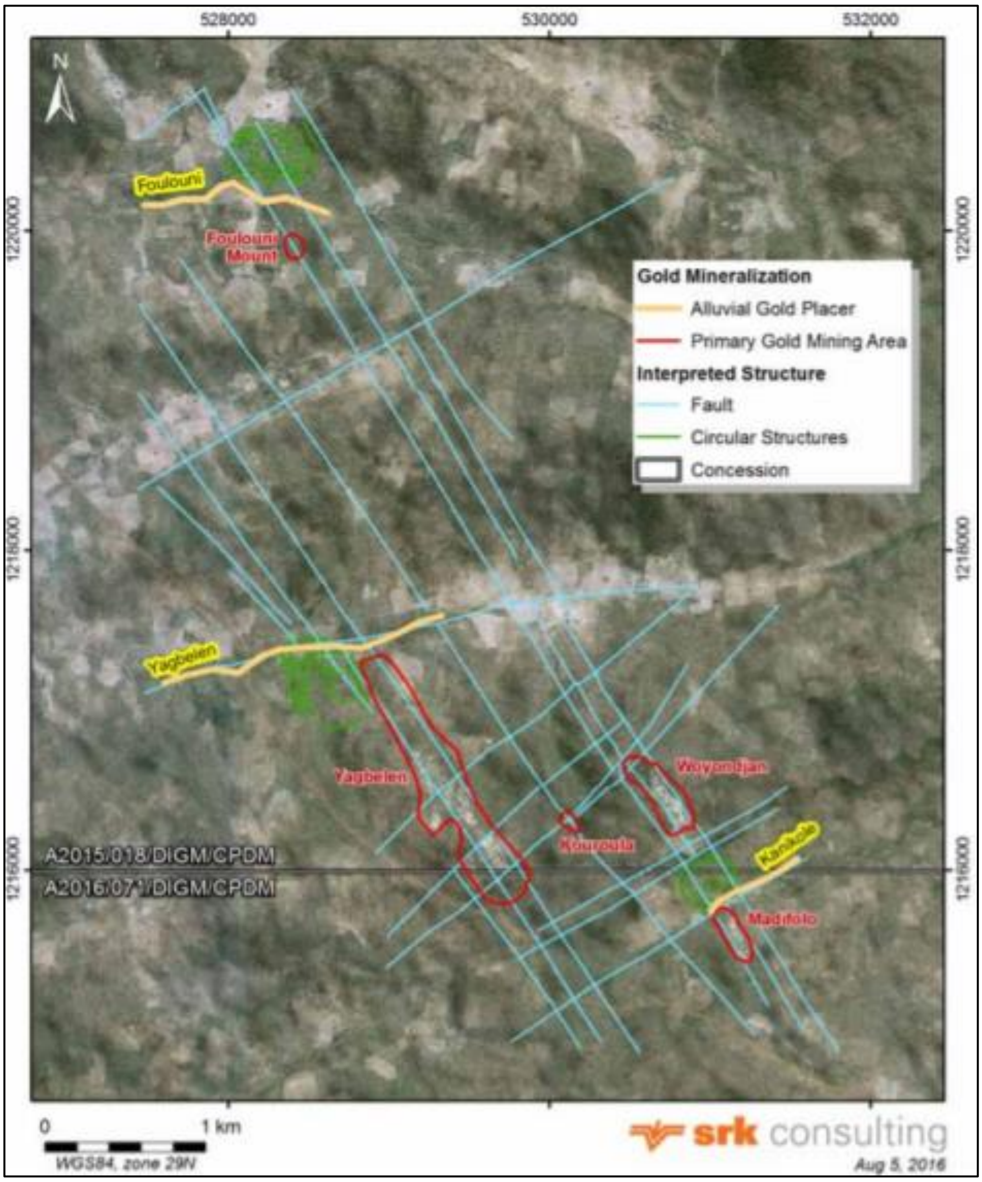


Figure 2. Location of Gold Mineralization Identified on the Property and Initial Interpretation of Structures from Satellite Imagery in the Yagbelen and Woyondjan Zones-(*Source: Arthur, J. and Pittuck, M., 2014)*

Reverse circulation drilling in the Yagbelen area during 2013 encountered the following main zones of quartz veins: the north-northwest trending Foloukatou, Daoudabe, Daoulemba-Folountou, and the north-south trending Foulanibe-Kadossa zone. The Foloukatou zone hosts the Foloukatou orpaillage and includes numerous old pits and recent mines exploited with metal detectors. Its length is more than 200 metres and width on surface ranges from 50 to 70 metres. The Daoudabe zone was mined by local orpaillers and drilled with no significant mineralization returned. The zone's width is approximately 100 metres and length approximately 200 metres. The Daoulemba-Folount ou zone hosts large recent orpaillages. Its length is approximately 600 metres and width up to 100 metres. The Foulanibe-Kadossa zone hosts recent orpaillages. Its length is more than 1000 m and width ranges from 100 to 130 metres.

The Woyondjan sector has southeast to east-southeast trending white to light grey auriferous quartz veins with pyrite, rare arsenopyrite, and minor limonite and goethite partially filling open spaces form stockwork style mineralization. The mineralized zone has a length of 800 metres and width of 130 metres. Orpaillages in the Folouni sector are interpreted to exploit placer style gold mineralization.

The Sidylamin sector has been exploited recently with metal detectors mineralization consists of quartz-pyrite vein zones 550 metres in length and maximal width of 300 metres. Its shape is complicated and the trend of the gold veins is not known. The Masafren sector has a zone of north-south trending quartz veins with approximate 800 metres length and 350 metres maximal width. The Namatous sector has recent orpaillage in numerous shallow pits north-south-trending quartz vein zones 1000 m in length and 350 metres in width.

Weathering across the licence area is very deep (up to 200 metres) and tends to be deepest over the main gold-bearing zones. Weathering is likely a function of the enhanced permeability along the mineralization structures. Within the area of the main orpaillage workings, the metasedimentary rocks are pervasively altered by kaolinite and cut by quartz veins and breccia, which contain redbrown oxides, interpreted to be the weathering product of sulphides. Orpailleurs extract gold from both quartz vein material and altered host rocks.

2. FIELD VISIT AND SAMPLING FROM FIELD

AGL Company representative took the gold ore sample used in the project during his visit to the region on 27 March - 16 April. Company representative Cem Tekin, who is an expert in gold mining and geology, carried out a wide fieldwork in an area of 12 km^2. In this process, as can be seen from the photographs(Figure 3 and 4), ore samples were taken to represent the whole region and prepared to be taken to Turkey as a 70 kg package after crushing and sample reduction processes. This prepared ore sample was delivered to the laboratories of Istanbul Technical University Mineral Processing Engineering Department on April 28, 2021.

Figure 3. Photos from the Field Study conducted for sampling-1

Figure 4. Photos from the Field Study conducted for sampling-2

3. ORE CHARACTERIZATION STUDIES

The gold ore sample from Republic of Guinea disseminated in laterite and saprolite that developed under conditions of tropical weathering (Figure 5) over a wide variety of bedrock types but distal to known bedrock gold deposits.

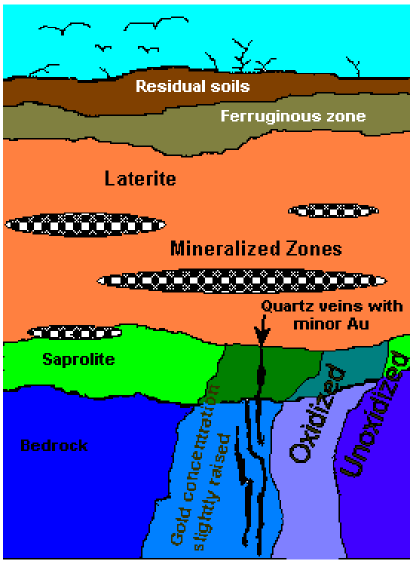


Figure 5. Idealized cross section of laterite-saprolite Au deposit. Vertical scale is in terms of meters; horizontal scale is in terms of kilometers.

As the result of the microscopic studies and chemical analysis carried out, gold in the composition of the ore was found together with iron oxides and quartz, as well as clay minerals. According to the results of the chemical analysis carried out (Table 1 and Figure 6). The high content of Fe (129874 ppm) is due to iron oxides, while the Al (26628 pp) content is due to clay minerals in the ore composition.

Table 1. Chemical analysis of gold ore

Au, ppm	Fe, ppm	Al, ppm	Pb, ppm	Zn, ppm	Cu, ppm	Co, ppm	Ni, ppm	K, ppm	Na, ppm	Ca, ppm	Mg, ppm
18.19	129874.8	26628.2	75.2	82.2	40.8	45.2	19.8	950.5	41.1	375.8	265.6
Cr, ppm	**Mn, ppm**	**Cd, ppm**	**Zr, ppm**	**As, ppm**	**Ba, ppm**	**Te, ppm**	**V, ppm**	**Ga, ppm**	**La, ppm**	**Ce, ppm**	
279.9	447.3	7.4	16.4	64.9	49.2	21.1	217.0	25.2	10.9	63.7	

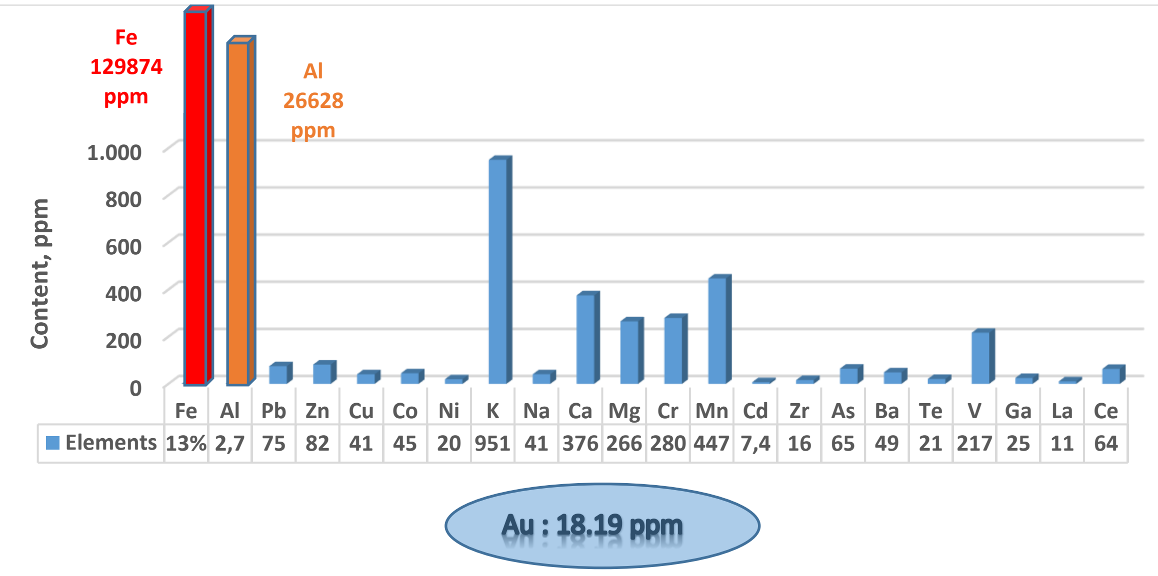


Figure 6. Chemical analysis of gold ore (Graphical view)

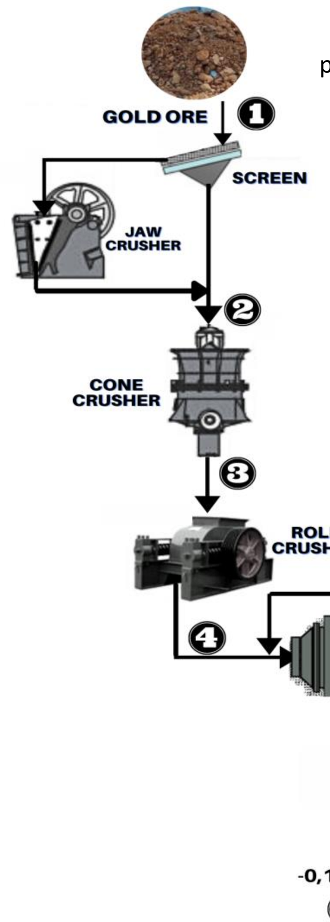


Figure 7. Comminution proces applied in this study

As is known, mineral processing and metallurgy engineering begin with a size reduction process. The aim here is to liberate the (gold) mineral or grain that is desired to be enriched and to increase the surface area as much as possible. For this purpose, Comminution proces, the flow chart of which is given in the Figure 7, was applied in order to liberate the gold grains dispersed in the quartz. Sieve analyses were made at each point (1, 2, 3, 4, 5, 6 and 7) indicated in the flowchart, and the size distributions of the products obtained after each size reduction process were determined.

1. Original Sample
2. Cone Crusher Feed
3. Cone Crusher Output-Roll Crusher Feed
4. Roll Crusher Output-Ball Mill Feed
5. Ground sample to under -0,5 mm
6. Ground sample to under -0,3 mm
7. Ground sample to under -0,150 mm

Sieve analysis were performed on the ore taken from the field and delivered to the University laboratories, the results are also given in Table 2 and the size distribution curve is given in Figure 8. According to Figure 8, the maximum size of the ore is about 60 mm, the d_{80} size of the ore is 20.5 mm and the d_{50} size is 7 mm.

Table 2. Sieve Analysis Result of Original Sample (Number-1)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
+50	4.0	4.0	100.0
-50+30	7.0	11.0	96.0
-30+19	12.0	23.0	89.0
-19+9	18.0	41.0	77.0
-9+5.6	16.6	57.6	59.0
-5,6+3,35	9.4	67.0	42.4
-3.35+2	9.2	76.2	33.0
-2+0.85	8.8	85.0	23.8
-0.85+0.5	3,0	88.0	15.0
-0.5+0.212	6,4	94.4	12.0
-0.212+0.106	3.9	98.3	5,6
-0,106	1.7	100.0	1,7
FEED	100,0		

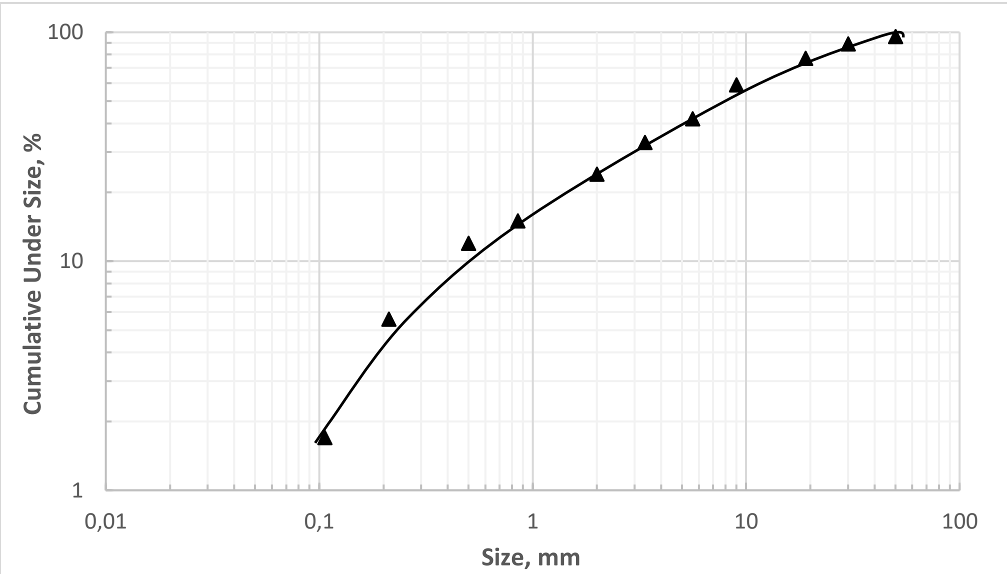


Figure 8. Size Distribution Curve of Original Sample

As can be seen from the flow chart in Figure 7, after the ore was sieved from 30 mm in size, over sieve (+30 mm) which has 11% of the total ore was crushed with a jaw crusher. The product number 2 obtained was fed directly to the cone crusher. The product (Number-3) obtained as a result of the crushing of this material in the cone crusher was fed to the Roller crusher and the product (Number-4) obtained from here was subjected to fine size reduction (grinding). Grinding stage is a wet process and the roll crusher output (Number-4) was ground below the particle size of 0.5 mm, 0.3 mm and 0.150 mm. These products, shown as 5,6 and 7 in Figure 7, were used in gravity enrichment experiments. Sieve analyses of all products (Number-1,2,3,5,6,7,8) obtained in the size reduction process are performed and the results are given in Tables 3,4, 5,6,7 and 8. In addition, the size distribution curves of the original sample and crushing products (Cone and Roll crusher) are given in Figure 9, and the size distribution curves of the grinding products are given in Figure 10.

Table 3. Sieve Analysis Result of Cone Crusher Feed or the sample from jaw crusher (Number-2)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
-30+25	4,1	4,1	100
-25+19	10	14,1	95,9
-19+13	14	28,1	85,9
-13+9	10,4	38,5	71,9
-9+5.6	12,8	51,3	61,5
-5,6+3,35	13,8	65,1	48,7
-3.35+2	8,6	73,7	34,9
-2+0.85	10,4	84,1	26,3
-0.85+0.5	3,8	87,9	15,9
-0.5+0.212	6,6	94,5	12,1
-0.212+0.106	2,9	97,4	5,5
-0,106	2,6	100	2,6
FEED	100		

Table 4. Sieve Analysis Result of Cone Crusher Output (Number-3)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
+9	2.3	2.3	100.0
-9+5.6	18.9	21.2	97.7
-5.6+3.35	28.6	49.8	78.8
-3.35+2	11.5	61.4	50.2
-2+0.850	15.9	77.3	38.7
-0.850+0.5	5.9	83.1	22.8
-0.5+0.212	8.8	91.9	16.9
-0.212+0.106	6.0	97.9	8.1
-0.106	2.1	100.0	2.1
Total	100.0		

Table 5. Sieve Analysis Result of Roll Crusher Output (Number-4)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
+3.35	10.1	10.1	100.0
-3.35+2	20.1	30.2	89.9
-2+1.19	15.9	46.1	69.9
-1.19+0.850	14.1	60.2	53.9
-0.850+0.5	18.4	78.6	39.8
-0.5+0.212	11.0	89.6	21.4
-0.212+0.106	6.4	96.0	10.4
-0.106	4.0	100.0	4.0
Total	100.0		

Table 6. Sieve Analysis Result of Ground Sample to under 0,5 mm (Number-5)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
-0,5+0,3	6,6	6,6	100
-0,3+0,212	18,9	25,5	93,4
-0,212+0,150	20,9	46,4	74,5
-0,15+0,106	18,4	64,8	53,6
-0,106+0,075	13,1	77,9	35,2
-0,075+0,053	9,2	87,1	22,1
-0,053+0,038	5,3	92,4	12,9
-0,038	7,6	100	7,6
Total	100.0		

Table 7. Sieve Analysis Result of Ground Sample to under 0,3 mm (Number-6)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
-0,3+0,212	4,4	4,4	100
-0,212+0,150	18,4	22,8	95,6
-0,15+0,106	20,4	43,2	77,2
-0,106+0,075	19,9	63,1	56,8
-0,075+0,053	14,3	77,4	36,9
-0,053+0,038	8,3	85,7	22,6
-0,038	14,3	100	14,3
Total	100		

Table 8. Sieve Analysis Result of Ground Sample to under 0,150 mm (Number-7)

Size Fraction, mm	Weight, %	Cumulative Over Size, %	Cumulative Under Size, %
-0,150+0,106	8,6	8,6	100
-0,106+0,075	24,3	32,9	91,4
-0,075+0,053	15,9	48,8	67,1
-0,053+0,038	18,2	67,0	51,2
-0,038	33,0	100,0	33,0
Total	100.0		

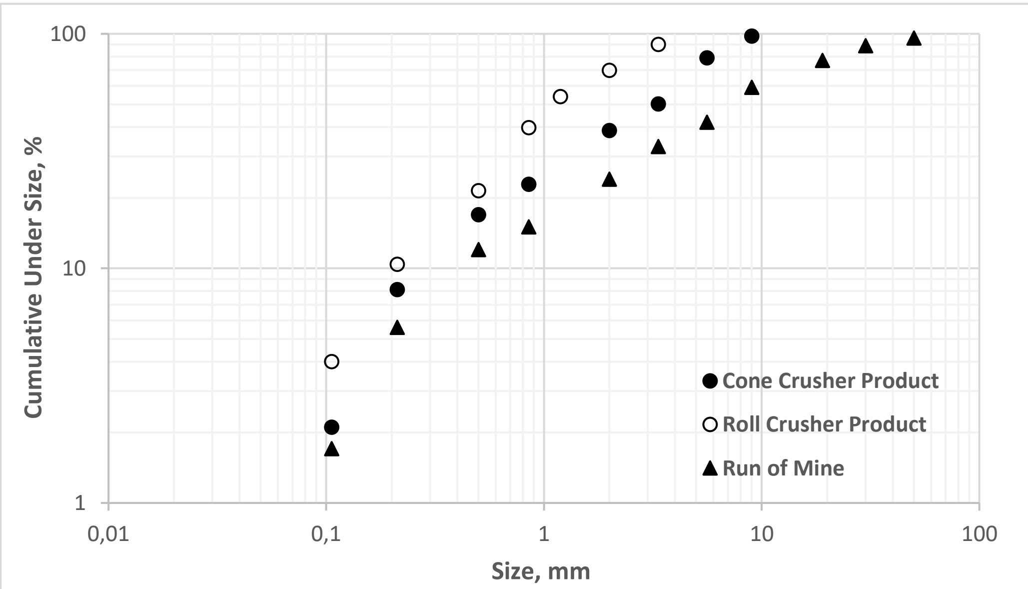


Figure 9. Size Distribution Curves of Crusher products and run of mine

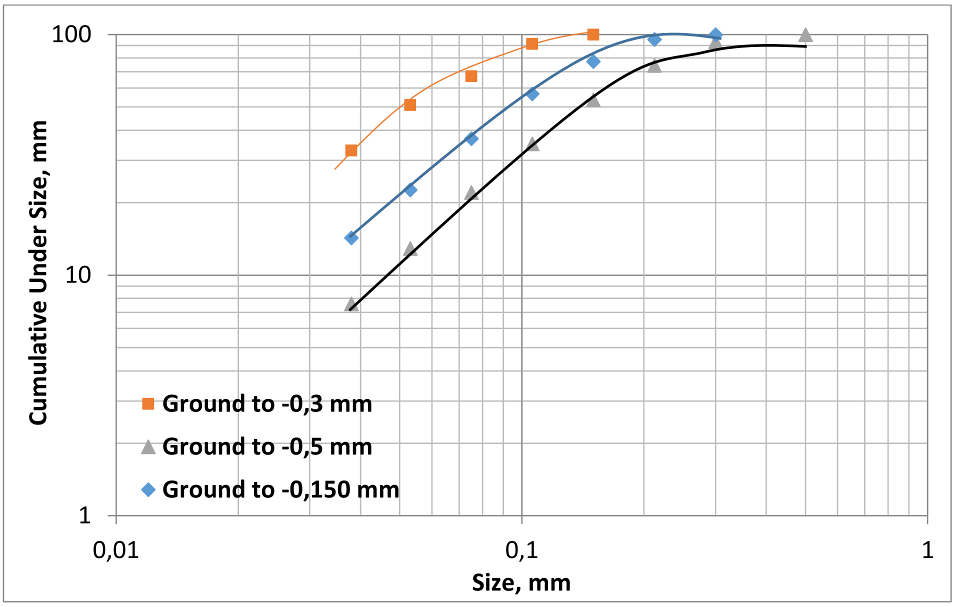


Figure 10. Size Distribution Curves of Grinding Products

4. GRAVITY SEPARATION STUDIES

Due to the high specific gravity of gold in such ore deposits, it is possible to separate it from other minerals with lower specific gravity by gravity enrichment processes. Several gravity separators use to concentrate heavy minerals such as gold. From jigs and sluice box to high G-force gravity centrifuges, knowing which to use for optimal mineral processing can be complex and difficult to understand. There are many factors to consider when constructing the ideal circuit; a critical factor is the size of the particles you intend to recover. Here is a brief summary of some of the most common mineral separation processes and gravity separation devices mapped to the particle size they are most suitable for recovery (Figure 11).

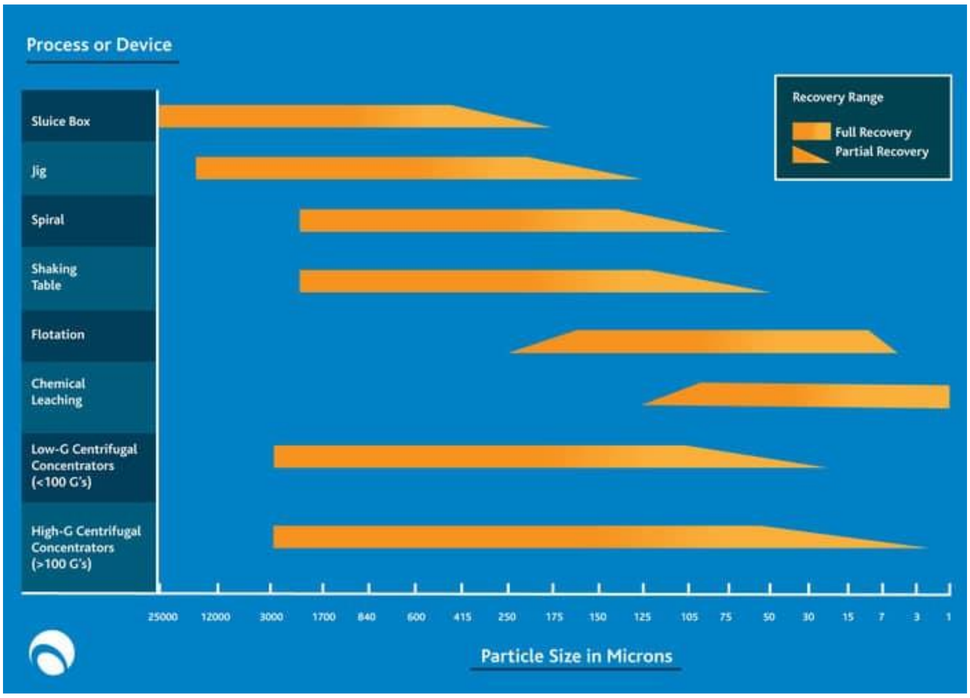


Figure 11. Most common mineral separation processes and gravity separation devices (adapted from https://seprosystems.com/wp-content/uploads/2019/05/Gravity-Concentration.jpeg

Mozley Table and Knelson Separator were used in the gravity Separation experiments carried out to recover gold with high yield and content from gold ore. Initial experiments were carried out with a Mozley Table using samples (Number 5, 6 and 7) ground to three different sizes (-0.5 mm; -0.3 mm and -0.150 mm).

Mozley Table (The super-panner) given Figure 12 is a miniature-shaking table into which are built most, if not all, of the motions used in panning. The super-panner is a miniature-shaking table into which are built most, if not all, of the motions used in panning. As Gravity separator, any desired texture of decking can be used on the super-panner, linoleum and stainless steel being sufficient for most work. Adjustments are for side and end shake, slope, bump, stroke length and speed, and sluicing water.

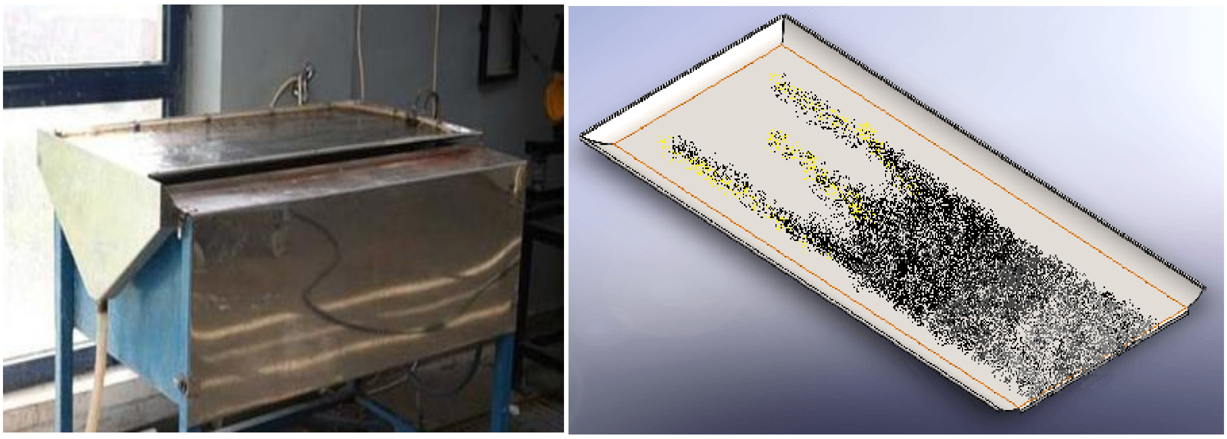


Figure 11. Mozley Table (the super-panner) used in the experiments

In the gravity concentration experiments, ores ground to 0.5 mm, 0.3 mm and 0.150 mm in particle size (see size distribution in Figure 10) were used. The flowsheet given in the Figure 12 was applied for each ores has different particle size and the experiment results obtained are given in the Table 9.

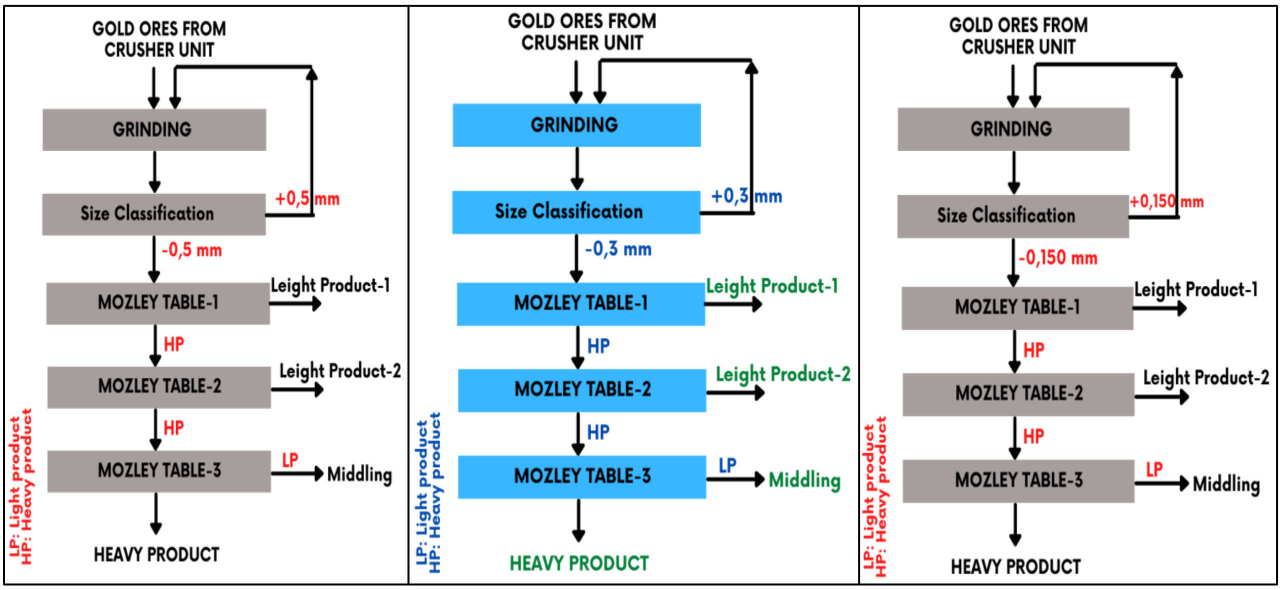


Figure 12. The of experiments using Mozley Table (the super-panner)

Table 9. The Results of Gravity Experiments used Mozley Table (the super-panner)

Size, mm	Products	Weight, %	Au Content, ppm	Au Recovery, %
-0,500 mm	Heavy Product	14,70	63,1	46,2
	Middling	23,40	20,9	24,4
	Light Product-2	22,70	12,9	14,6
	Light Product-1	39,20	7,6	14,8
	FEED	**100,00**	**20,07**	**100,0**
-0,300 mm	Heavy Product	11,4	112,4	64,9
	Middling	16,5	16,9	14,1
	Light Product-2	28,1	9,9	14,1
	Light Product-1	44	3,1	6,9
	FEED	**100**	**19,74**	**100,0**
-0,150 mm	Heavy Product	9,5	186,91	89,1
	Middling	14,1	12,80	9,1
	Light Product-2	25,9 **76,3**	0,78 **0,49**	1,0
	Light Product-1	50,4	0,34	0,9
	FEED	**100,0**	**19,95**	100,0

As result of the concentration experiments carried out in three different sizes, it is seen that the gold liberation size is approximately 0.150 mm below. With a gravity separation of sample ground to this size, 76% of the total ore can be removed with Au content of 0.49 ppm. Considering the (tailings) contents of light products obtained in sizes above this size (-0.5 mm and -0.3 mm); high Au contents were obtained in tailings due to insufficient liberation of gold (3.1 ppm for -0.3 mm ; 7.6 ppm for -0.5 mm). By gravity enrichment, a concentrate with a high Au content (186.91 ppm) can be obtained, and the remaining part of products (90.5% of the total ore and 2.41 ppm Au content) can be evaluated by cyanidation process.

In the second stage of gravity separation experiments; Knelson separator operating by using centrifugal force was used to concentrate gold under the 0.150 mm in size where the grain liberation is sufficient. The Knelson concentrator given in Figure 13 is a vertical axis bowl-type centrifugal concentrator that uses a fluidized bed to perform its concentrating duty. It was first introduced as a semi-batch unit and has gone through several iterations of design leading to the development of a continuous discharge machine. It has now become almost an essential unit operation in any gold processing plant to assess the gravity recoverable gold content in the ore as well as to recover fine free gold from the grinding circuit. (https://www.911metallurgist.com/knelson-concentrator/)

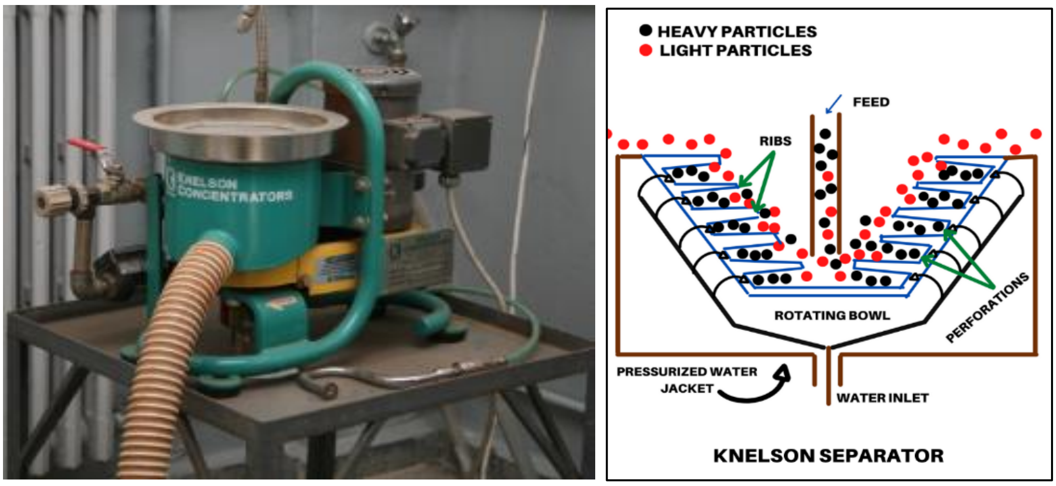


Figure 13. KNELSON Separator used in the experiments

The results of the experiment, which was carried out in three stages according to the flowsheet given in Figure 14, are shown in Table 10.

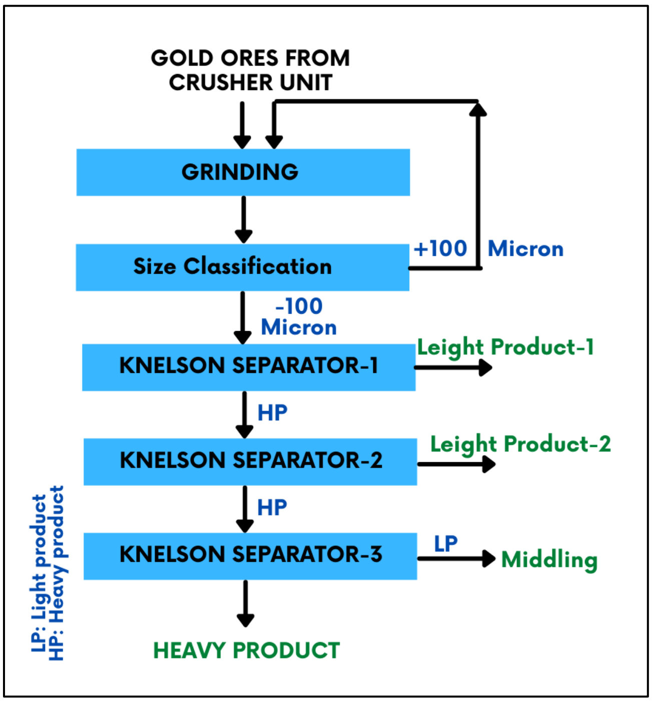


Figure 14. The flowsheet of experiments using Knelson Separator

Table 10. The Results of Gravity Experiments used Knelson Separator

Products	Weight, %	Au Content, ppm	Au Recovery, %
Heavy Product	11,3	149,00	86,1
Middling	7,0	24,65	8,8
Light Product-2	37,1	2,20	4,2
Light Product-1	44,7 **81,8**	0,42 **1,22**	1,0
FEED	**100,0**	**19,57**	**100,0**

When the results of the Knelson separator test carried out with the ore under 0.150 mm size are examined; where a light product (tailing) in the amount of 45% of the ore can be discarded with a content of 0.42 ppm. When this amount is 81.8%, a tailing of 1.22 ppm can be removed. On the other hand, the heavy product (149 ppm Au content) can be taken with the Knelson separator, and the sum of 87.1% of the other products (3.01 ppm Au content) can be evaluated by the cyanidation process.

5. CHEMICAL BENEFICIATION STUDIES (Cyanidation)

Cyanidation is one of the most widely used methods to extract gold from ores. The use of cyanide leaching for gold recovery depends on the nature of the gold ore (sulfurous or oxidised) and the properties of the ore. Additionally, gold is insoluble in sulfuric, hydrochloric, or nitric acids, but can be dissolved in aqua regia (a mixture of nitric and hydrochloric acids). On the other hand, the most important fact about gold in this case is that it is soluble in dilute cyanide solutions. Therefore, cyanide is used as a lixivant during the leaching process to carry out gold extraction using this hydrometallurgical process.

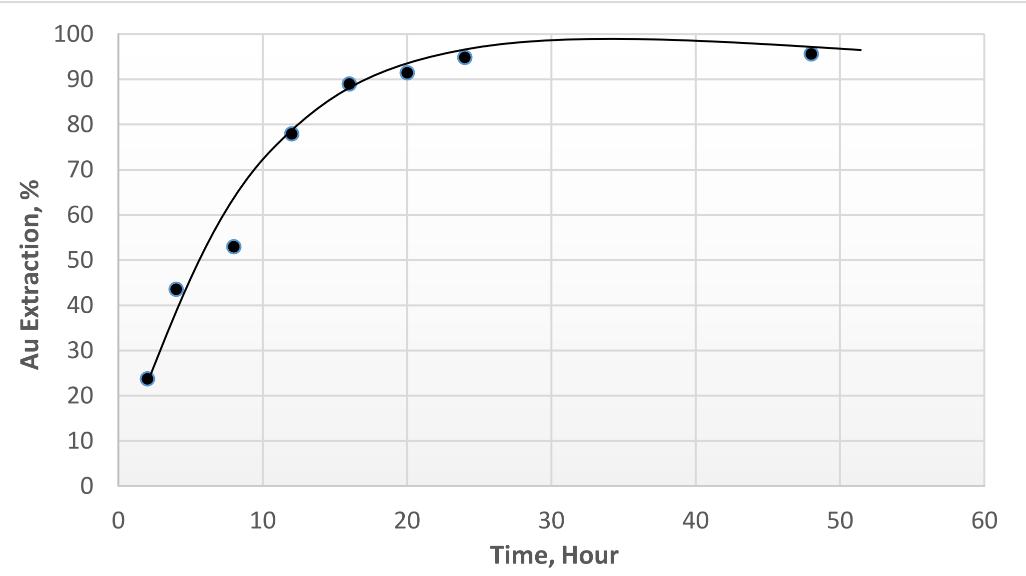
All of the chemical enrichment studies were carried out with original ore samples ground below 100 microns. In this context, Firstly the bottle roll test were carried out. As it is well known; Cyanide bottle roll tests are the industry standard initial stage in assessing the gold recovery possible by cyanide leaching and provide information on expected recovery rates, reagent costs and required addition rates. It will also provide an accurate indication of the results you can obtain from your pilot plant and commercial scale leach circuit.

In the Bottle Roll Test; the gold sample, which was completely ground under 100 microns, was prepared at pulp density of 30% and subjected to Bottle roll test under the conditions given in the Table 11. The pH of the solution was taken and adjusted to between 10,5- 11 with lime. Cyanide at 2 g/l concentration was added and the slurry mixed with cyanide was rolled for the retention time of 48 hours. The final pH was taken, the pulp was filtered and the gold pregnant solution was obtained. The solution was then analyzed for gold. The solid residue was washed thrice to remove any adhering gold, dried and analyzed for residual gold.

Table 11. Bottle Roll Test conditions

Particle Size, micron	**-106 micron**
Pulp Density, %	%30
pH	held constant between 10.5-11 by adding lime
sampling times from bottle	2, 4, 8, 12, 16, 20, 24, 48 hour

According to the results of the bottle-roll test (Figure 13); by the cyanidation of the ore, it has been revealed that 95.6% of the gold can be taken into solution. If the duration gets 24 hours, this value will be 94.8%.



Sampling Time, hour	**2**	**4**	**8**	**12**	**16**	**20**	**24**	**48**
Au Extraction , %	23,7	43,5	52,9	77,9	88,9	91,4	94,8	95,6

Figure 14. Bottle Roll Test Results

6. LEACHING EXPERIMENTS

After the bottle roll test, in which the dissolution kinetics of gold ore in cyanide leaching and the highest possible Au dissolution efficiency were determined, laboratory scale gold dissolution (leaching) experiments were carried out. Leaching experiments were performed in 400 mL beakers with a stirrer. Into beaker was added 100 g of gold ore, and 233 mL of water solution, the desired quantities of leaching reagents (0.25; 0.5; 0.75; 1 and 2 g/l NaCN) were also transferred into the beaker. The pH of the solution was taken an d adjusted to between 10,5- 11 with lime. After 24 hours, the pulp was filtered and the gold pregnant solution was obtained. The solution was then analysed for gold. The solid residue was washed thrice to remove any adhering gold, dried and analysed for residual gold. In initial leaching experiments carried out for 24 hours, the change of gold extraction in different NaCN concentration is given in Figure 2.

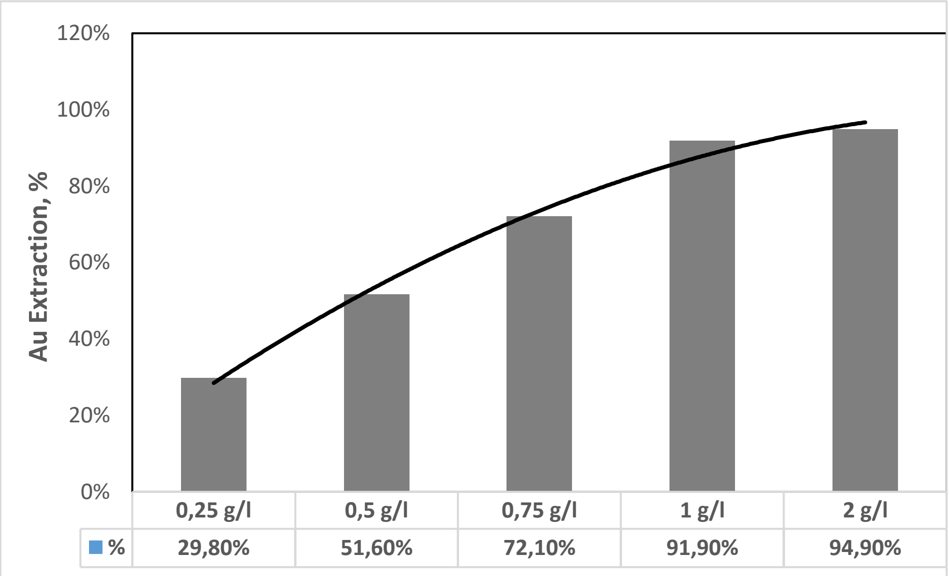


Figure 15. The effect of NaCN amount in gold extraction

As It is seen from Figure 15; Gold extraction is not sufficient at NaCN values less than 1 g/l (<90% Au Extraction). Au extraction, which is 91.9% at the amount of 1 g/l NaCN, increases to 94.9% at the amount of 2 g/l.

Although the use of NaCN amount was doubled, the optimum value was taken as 1 g/l NaCN concentration due to efficiency increase of only 3% and experiments were carried out at different leaching times (4, 8, 16, 24, 48 hours) by keeping this value constant. The results of the gold extraction are presented in Figure 16.

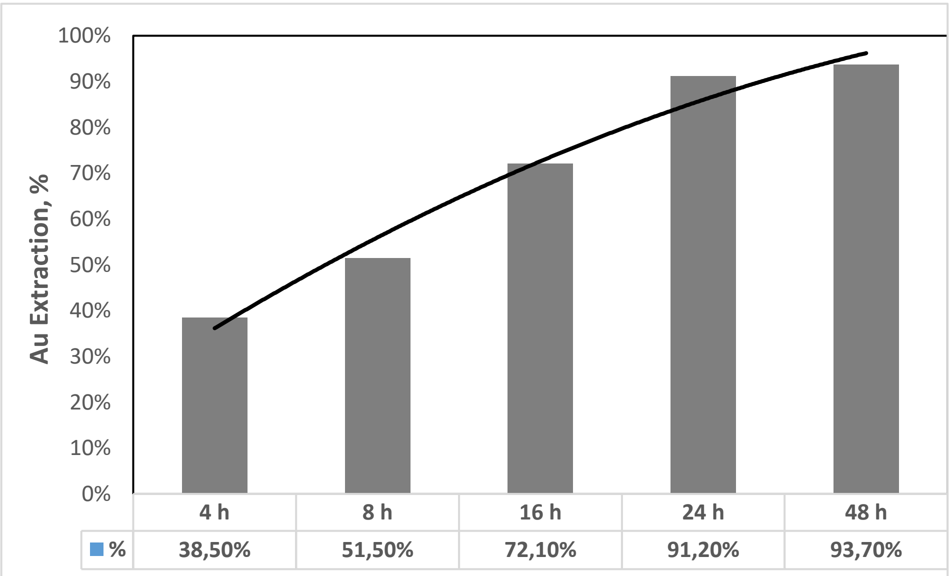


Figure 16. The effect of leaching time in gold extraction

7. CONCLUSIONS

Gold ore of Rebublic of Guinea containing iron oxides, silicates and clay minerals has an Au content of 18.19 g/t. After the gravity enrichment experiments carried out in different feeding size, it was determined that sufficient au liberation was below 0.150 mm. As result of the enrichment experiment carried out in feeding size of under 0.150 mm by Mozley table, 76% of the total ore can be removed as residue with an Au content of 0.49 ppm. On the other hand, we can say that, the heavy product (concentrate) obtained at the end of 3 stages has an Au content of 186.91 ppm, and by increasing the number of stages, the concentrate amount of 9.5% can be reduced and higher Au contents can be achieved. Although similar results were obtained in the experiments performed using the Knelson separator, the Mozley Table has given better performance due to the easier control of the product on the Mozley Table.

As the result of these studies, very high gold extraction were obtained in cyanide leaching processes due to the nature of the ore. At a concentration of 2 g/l NaCN, extraction rates of 95.9 Au can be achieved with 48 Hrs of leaching. In addition, even with a lower 1 g/l NaCN concentration and a lower leaching time (24 hours), the gold recovery will be 91.2%. In the light of all these results obtained from the all studies, this kind of gol ore can be evaluated within the scope of the alternatives explained bellow (1, 2 and 3). All alternatives is also given as flowsheets in Figure 17, 18 and 19.

Alternative-1: Direct recovery of ore containing 18.19 g/t Au by cyanide leaching

Alternative-2: By a pre-enrichment process (Gravity Separation), 76% of the total feed will be removed as tailing with 0.49 PPM Au content, and only 24% of the total ore (82.24 ppm Au content as a result of enrichment) will be subjected to the Cyanidation Process.

Alternative-3: While the concentrate with high Au content obtained by a pre-enrichment process (gravity separation) will be sent directly to the acacia reactor, a cyanidation process can be performed for the remaining 2.41 pp material with 90.5% of total feed.

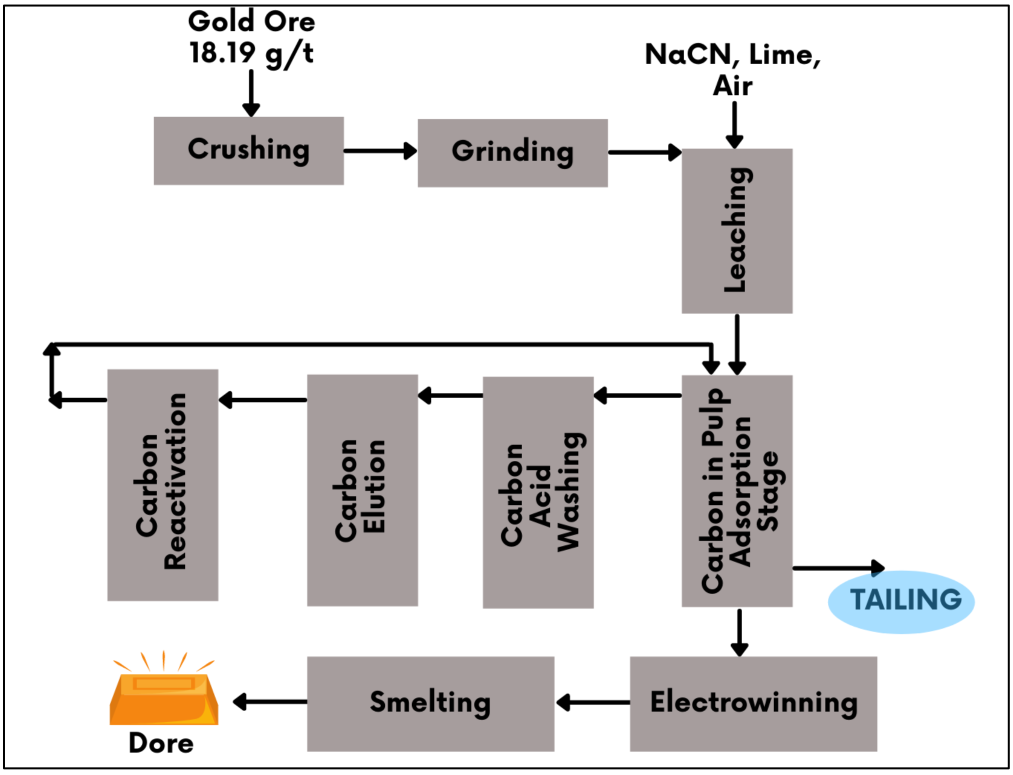


Figure 17. Alternative-1 for Gold production

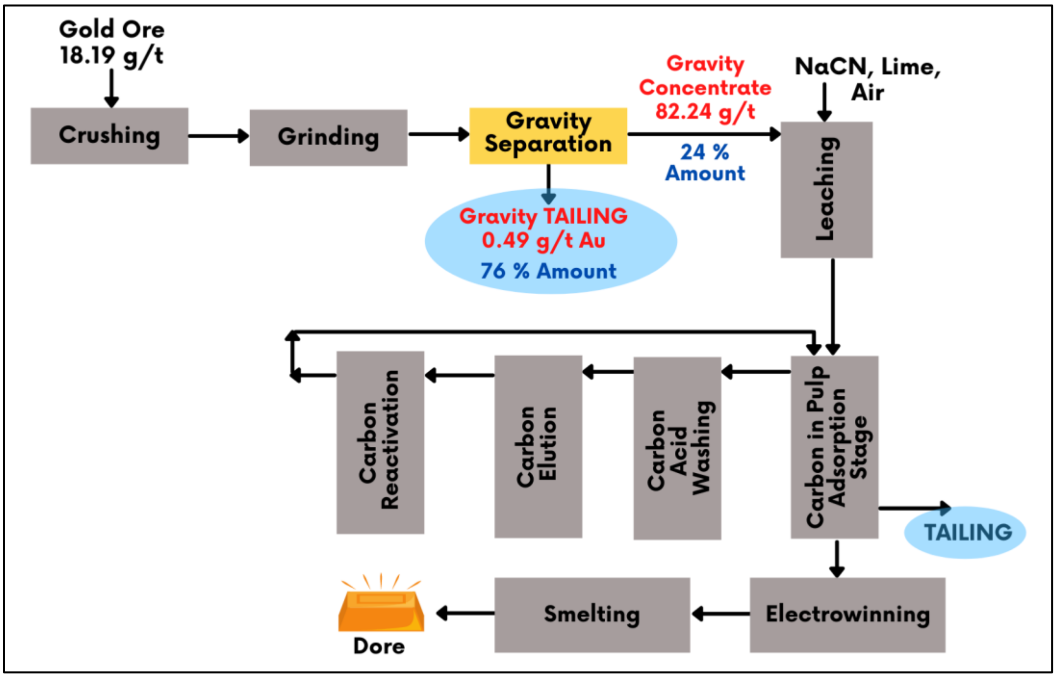


Figure 18. Alternative-2 for Gold production

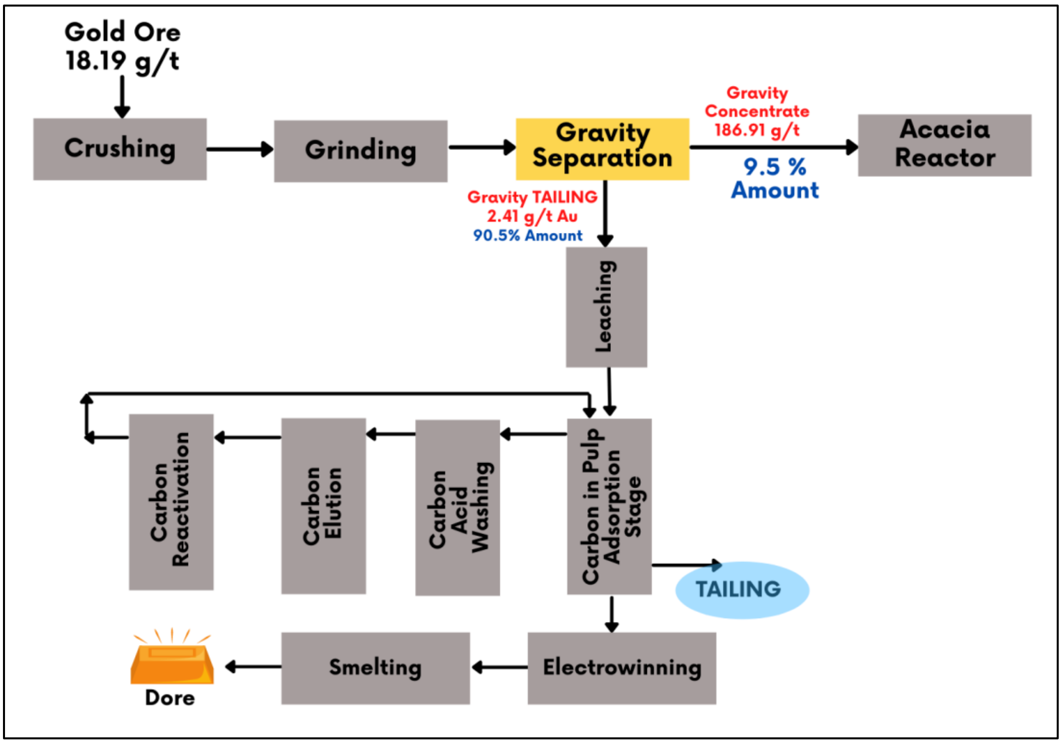


Figure 19. Alternative-3 for Gold production