

***KOCHIN INTERNATIONAL LIMITED***

***BUSINESS PLAN***

**FOR**

**GOLD PROCESSING (LEACHING )**

**PREPARED FOR**

**KOCHIN INTERNATIONAL LIMITED**

**KILINDI-TANGA**

## 1.0. Introduction

KOCHIN INTERNATIONAL LIMITED is a new company incorporated in Tanzania with Certificate of incorporation No. 154269940 dated 29<sup>th</sup> November 2021 the company is owned by 9 shareholders.

KOCHIN INTERNATIONAL LIMITED has acquired a land located at **Village, Kilindi District, Tanga region**. The proposed area will be used for gold leaching

KOCHIN INTERNATIONAL LIMITED vision is to offer our clients a reliable, secure and fast gold processing. KOCHIN INTERNATIONAL LIMITED also aim to be amongst the medium size company providing gold processing facility of high quality with environmentally friendly equipment by the year 2025.

KOCHIN INTERNATIONAL LIMITED location in **Mheza Village, Kilindi District, Tanga region** is very strategic as is the area with large and good quality gold deposit in Tanzania and availability of skilled work force is very fundamental for such project, **Kilindi district** is ideal place where abundant of skilled force are available that will lower overheads in running gold processing facility.

KOCHIN INTERNATIONAL LIMITED intend to procure the best equipment in order to be able to provide the best services for our clients, lower operation cost and increase gold recovery. KOCHIN INTERNATIONAL LIMITED goal is also to ensure that we build a business structure that will aid us in achieving our corporate goals and objectives.

KOCHIN INTERNATIONAL LIMITED intention in running a smooth business with as less hitches as possible is to ensure that we hire the right number of employees who not only have an understanding of the industry and are professionals but also are attuned to our corporate goals and vision and are committed to ensuring that these goals and visions are achieved.

KOCHIN INTERNATIONAL LIMITED intend to provide a conducive and friendly environment for our employees as well as ensure that they get the required training that is continuous in nature so as not only to enhance their skills and increase productivity for the organization but to also ensure that the skills gotten are the best across similar start-up such as ours in the industry.

## 2.0 Some Of Few Selected Machines and other items

- Jaw Crusher (Primary)
- Jaw Crusher (Secondary)
- Hydrocyclone
- Ball Mill
- Steel Balls
- Pendulum Feeder
- Vibrating Screen
- Air Blower
- Knelson Concentrator (Centrifugal)
- Belt Conveyor
- Slurry Pumps (Rubber Liners)
  
- Pre-installed powder coated steel cable basket/tray
- Pre-installed plastic control
- Biometric access control
- Fire Detection

- Electrical cabling
- Standby Diesel Generators and Bulk Fuel Tanks
- Fuel quantity and quality monitoring
- shaking table
- cones Reichert
- Jigs,
- Dry washers
- Sluice box
- Riffles
- The elementary equipment
- Flat trays
- Washing plants
- Spiral Concentrators
- Dredge is a machine
- Pachuca Tank

### 3.0 The Sponsors

**KOCHIN INTERNATIONAL LIMITED** will be sponsoring this project.

The Company is currently jointly owned by 9 shareholders.

Names of Shareholders	% of Shares	Nationality
Valathu Hassainar Azad P. O. Box 18, Kilindi, Tanga	15	India
Ashraf Kattungal Aliar P. O. Box 18, Kilindi, Tanga	15	India
Muhammed Bilal P. O. Box 18, Kilindi, Tanga	10	India
Arafath Asharaf P. O. Box 18, Kilindi, Tanga	10	India
Asnath Kattungal Asharaf P. O. Box 18, Kilindi, Tanga	10	India
Muhammed Rafeeq Mulakathu Psreed P. O. Box 18, Kilindi, Tanga	10	India
Nishamol Azad P. O. Box 18, Kilindi, Tanga	10	India
Fathima Farsana P. O. Box 18, Kilindi, Tanga	10	India

Ameena Azad P. O. Box 18, Kilindi, Tanga	10	India
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### 3.1 Objective of Study

The purpose of this study is to work out the technical and commercial details and financial viability of the project

### 3.2 Location

There are two considerations on this point. One is referred to the mine and the other is the treatment plant. Ideally the first one must be close to the plant, but sometimes the area and accessibility are serious issues. Probably, the most critical aspect is the plant location due to the idea is to have a good foundation for the buildings to be constructed and use the geography of the area. The latter is important because the gravity force must be utilized at maximum because the energy is an operative cost that will influence the economy of the project.

If the plant will be located near cold zones where the temperature can reach low values, the building must consider special protection due to exists the possibility of having frozen problems with the slurry. This situation is painful if the problem is not considered before. The project location of

treatment plant has been selected after considering all factors, the project will be located at **Mheza Village, Kilindi District, Tanga region.**

### **3.3 Profitability**

The economy and profitability of the project is influenced by the mining costs, operative costs, shipping costs, impurity levels, concentrate treatment charges and smelter/refinery returns. These factors have to be projected from the laboratory tests or scaled metallurgical tests. Basically, a gold concentrate has to be related to the mineralized block, gold distribution, diluents such as pyrite, graphite, clays, organic matter. KOCHIN INTERNATIONAL LIMITED have studied All these factors together in order to optimize the revenue of the project according to the mineralized zone.

### **4.0 Gold Recovery**

Gold recovery comprises similar stages to the processing of most ores. First, the valuable minerals to be separated from the gangue through concentration. The final concentrate will be obtained by repeated processing and is smelted or leached in order to get a Dore bar. In general, the concentration of gold will include three stages: roughing, cleaning and scavenging. The reason of concentration is to separate the raw material into two products, concentrate and tails. Ideally, in free gold recovery, all the

gold will be in the concentrate and the other part will be in the tails. Separations are not perfect and some waste material is reported into the concentrate and some gold particles remains in the tails. Intermediate products are called middlings and can be defined as particles that belong in either the concentrate or tails. Sometime, this product is a serious problem. Roughing can be considered as the upgrading of the ore to produce either a low grade, preliminary concentrate or to reject tails that contain gangue at an early stage. The equipment used in this part can produce a large amount of concentrate and permit the recovery of a very high percentage of gold, produce clean tails or a combination of both. The most common equipments are cones Reichert, jigs, sluices and dry washers.

The rougher concentrate is sent to the cleaning stage in order to eliminate impurities; the process can be as simple as washing black sands by using a vanning dish. Mineral concentrates can pass through several stages of cleaning before a final concentrate is obtained. The equipment employed in this stage is the same equipment used in the rougher stage. Other equipment such as a shaking table is employed in the cleaning stage and let to obtain clean gold concentrates.

The last stage is called scavenger and consist in to process tails from rougher and cleaning stages before discarding. The material is treated

through equipment that concentrates the last particles of gold. This stage is included according to the design adopted in the operation and can be simple or complex depending on the ore type. In operations where there is amalgamation, this stage is employed to recover quicksilver that otherwise will be reported in the environment. In general, the equipment employed in the other stages can be used in this stage.

There are some considerations related to the concentration process. Recovery is the percentage of gold in the raw ore collected in the concentrate. For example, a recovery of 85% means that 85% of the gold is reported in the concentrate and the remaining part is in the tails. A concentrate grade is the gold content in the concentrate and usually is expressed in grams per tonne (g/t) or ounces per tonne (oz/t). The ratio of concentration is the proportion of the weight of the feed to the weight of the concentrate. For example, if 500 tonnes ore feed are processed and 100 kilos of concentrate is obtained, the ratio of concentration is 5,000. If we compare this value with a mine operation whose ratio of concentration is 2,000 and the concentrate grade is similar, the second operation is economically better due to don't need excessive raw ore in order to get a good gold concentrate.

Exist an inverse relationship between recovery and concentrate grade. This means, the higher the concentrate grade, the lower the total recovery. In general, some valuable mineral is lost in producing a high-grade concentrate. Under this consideration, the higher concentrate grade is easier to refine reducing refinery costs. For each operation, a special combination of grade and recovery must be achieved to get optimum incomes.

### **Gravimetric concentration**

Concentration by gravimetry was the first method employed to concentrate minerals and has been the bastion of concentration for many years. Froth flotation has been a competitor due to gravity concentration is not able to give the sharpness of separation possible with flotation. Gravity concentrator has two main characteristics, coarse gold particles can be recovered and the operative cost is low.

The difference between the specific gravity of gold (19.0) and the low specific gravity of the gangue (2.7) makes gravity concentration the primary means of recovery free gold particles. In general, gravity separation has some advantages over flotation and leaching, it needs significant lower capital investment, less power and low handling costs. Also waste material disposed in the environment is less harmful.

As was mentioned, the high specific gravity of gold is an advantage, but there are negative characteristics of free gold that tend to affect its recovery. Basically, flattened particles, cavities and irregularities reduce the effective specific gravity of gold and could cause it to float rather than sink. The flat shape of tiny particles can create hydroplaning.

It has been noted that the size and shape of a particle has a very significant effect on its settling velocity due to the gravity is related to the mass of the particle. Under this idea, coarse gravel must be removed by screening from the feed before trying gold recovery. Usually, a grizzly followed by a trommel is appropriate to perform this operation. Then, it will important to consider elaborate feed sizing if the gold particles have big variable distribution.

### **Sluice**

A sluice is defined as a channel through which controlled amounts of diluted slurry. Sluice box and riffles are one of forms of gravity separation equipment. The medium size of this equipment to be employed by the company the company will use sluices made of aluminum or steel. sluice section of 12 feet long and one foot wide. As a rule, a long narrow sluice is more efficient than a short wide one. The sluice must slope 4 to 12 inches

per 12 feet depending on the water available, the coarse particle to be processed and the possible gold particle size.

The riffles in a sluice retard material flowing in the water that forms the sand bed that traps heavy particles and created turbulence. This turbulence causes heavy particles to tumble and repeatedly exposes them to the trapping medium. An overhanging lip known as Hungarian riffle increases the turbulence behind the riffle that agitates the sand bed improving gold recovery. Riffles are fabricated of wood, rocks, rubber, steel and they are 1-1/2 inches high, placed from one half inch to several inches apart. The riffles are commonly fastened to a rack that is wedged into the sluice so that they can be easily removed.

### **Riffles**

Riffles and other material are used to line sluices for enhanced recovery. Long-strnad Astro Turf carpet, screens and rubber mats will be employed.

### **Typical operative parameters are listed below:**

- Slurry, steady and pre-screened at 5 mm
- Percent solids, 15%. Clayed material needs special conditions
- Flow velocity, depend on box width and slope
- Stream depth, 20-30 mm

- Slope, 10-25 degrees
- Length, 2-5 m
- Width, depend on flow speed
- Water, 30-70 m<sup>3</sup>/h/m

To perform efficiently, a sluice needs large amounts of water. Enough water must be added to the feed to build up a sand bed in the bottom of the sluice. For maximum recovery, the flow should be turbulent, yet not forceful enough to wash away the sand bed, clear water is run through the sluice until the riffles are clear of gravel. A pan or barrel is placed at the discharge end to prevent loss of concentrate. Starting from the head of the sluice, riffles are carefully washed into the sluice. According to the model, any bottom covering is removed and washed into a separate container. Clean up continues until all riffles are washed. Large particles of gold should be removed by hand, and then the concentrate is washed out of the sluice or dumped into an appropriate container. The concentrate can be smelted or cleaned more by panning. After clean up, the sluice is reassembled and more ore is processed.

### **Riffles separate heavy and light particles**

Gold recovery with sluices will vary depending on several factors. Fine gold losses can be minimized by cleaning up more frequently, reducing the

speed of the slurry flow to around 0.50 to 0.80 m/s., and decreasing the feed size by performing a previous screening. Some experienced operators have increased recovery by adding a liner to the sluice to trap fine gold and other have lengthened sluices to increase the residence time and the trapping area.

Sluices are used due to their low cost and availability. They need little supervision and maintenance; they can tolerate large fluctuations in feed volume; they are portable and can be achieved acceptable gold recoveries. Unfortunately, there some disadvantages such as very fine particles are not recovered, needs frequently clean up, and is important to have a big source of water. Some manufacturers offer sluice boxes fabricated for specific conditions.

### **Jigs**

Jigging is one of the oldest methods of gravity concentration. The elementary equipment is a hindered settling device consisting of shallow, flat trays with perforated bottoms that contains layers of high-density material such as particles of steel balls through which water pulsates up and down. The direction of flow through the bed is reversed several times. In this way, the bed is dilated by the forward stroke of a plunger and compacted by the plunger's backward stroke.

In general, this equipment uses the differential acceleration of particles of different specific gravity to separate gold minerals and gangue. The slurry containing the minerals to be concentrated is fed onto a permeable screen. The jig operates by the periodic movement of water pulse through the screen. Stratification in a bed of particles results from the repeated pulsation of a current of fluid up through the bed. The particles in the bed are expanded so that when pulsation finish, the particles are allowable to consolidate under the influence of gravity. The expansion and contraction is repeated in a cycle operation until the heavy and light particles are stratified according to their densities (specific gravity).

The jigs operate by the periodic movement of water through the screen. The upward velocity of the water brings all the particles into a suspension with particles surrounded by liquid. The water maintained in this movement and then allowed to drain back through the grid. The bed of particles collapses back onto the screen and differential acceleration of particles occurs during this stage of the process. The next figure shows the expansion and contraction of bed particles.

### **Bed**

Typically, jigs are able to treat coarse material and for this reason they are located in the grinding circuit. They can receive slurry from the ball mill

discharge or hydrocyclone underflow. The idea is to recover gold minerals soon in order to avoid overgrinding. The concentrate is collected at the bottom of the jig and the tails are moving out of the jig at the top of the bed. Although most gold is collected at the bottom, coarse gold particles like nuggets can stay at the top due to the screening opening size is smaller than the nugget.

### **Shaking Table**

This is one of the best equipments employed to obtain clean gold concentrates. They consist of a ruffled deck on some type of support. A motor placed on one side drives a small arm that shakes the table along its length. The table has riffles that are not more than one inch high and cover almost half table. Varied riffle designs are available in the market and each manufacturer has a special according to its use. The table oscillates horizontally and concentrates the heavy particles due to inertia differences created by the brisk, reciprocating motion of the inclined deck of the table. Coarse particles feed need long strokes at lower speeds and fine particles need shorter strokes at faster speed.

Deck sizes range from 18 by 40 inches for laboratory tests to by 15 feet for industrial applications. Tables can treat 175 t/d. The equipment is fabricated

with two basic deck types, rectangular and diagonal. The first one is roughly rectangle shaped with riffles parallel to the long dimension. The second group is irregular rectangles with riffles at an angle. In both types the shaking motion is parallel to the riffle pattern. The diagonal decks are usually constructed of wood and metal, and are lined with rubber or plastic. These materials have a high coefficient of friction that aids gold recovery.

### **Washing plants**

This kind of plant is oriented to reject non-valuable material and reduce the problems produced by fine material, specifically when the clay content is high. In general, washing plants are able to perform classification, concentration and Recovery of gold minerals from Placer/Alluvial Fields and hard rock. They can be combined with other concentration plants.

Washing plants have an important advantage, they are easily moved and some of them were designed with water tanks for use in places where the water source can be a problem. Small designs can treat 150 to 180 cubic meters per hour at 20% solids.

A point very important is the screening due to is the first separation operation and the screen surface must be designed considering the apertures for the passage of fine material. The screening area must be enough to support the weight of material being screened, also have to be flexible to

promote vibrating forces and light to avoid obstructions so that the throughput can not be affected. Typically, a grizzly is included at the beginning of the washing plant. The oversize material can be rejected if the gold is present in fine particles and can feed the crushing circuit when there are interesting amounts of free gold (nuggets). A gravimetric device such as a jig can be included in the design of the equipment. The flowsheet must consider several options so that the operations can be able to treat different gold ores.

### **Dredging:**

Dredging is an underwater excavation performed to recover gold from placer deposits. Initially, the excavation need to make a channel, the continuous dredging will let you know the potentiality of the deposit. Obviously, dredging is not exclusive for mining purposes; this operation can be employed to clean lakes and different aquatic environments that must stay safety for navigation purposes.

Essentially, a dredge is a machine that removes material from aquatic environments. In this way, the process involves a digging operation of underwater placer deposits by using two types of equipments, cutter head and cutting bucket line. During the operation, digs, scrapes removes material and send it onto the platform that is located in the dredge.

Normally, the ore is treated on the dredge by washing, screening and concentration operations. The non-valuable material is returned to the water. The final place is selected considering environmental aspects.

### **Flotation**

Flotation is one of the most important gold recovery processes and its main restriction is to recover coarse gold particles ranging from 400 to 250  $\mu\text{m}$ . This process recovers fine particles of free gold, gold associated in any form with sulphides, and native gold present in polymetallic deposits with certain degree of oxidation. For many years, a combination of amalgamation, cyanidation and flotation made possible to get high gold recoveries. With the time the technology and design consideration changed and flotation and/or cyanidation processes are the favorite combination. When gold is recovered by flotation, a high grade concentrate contains gold and can give an extra value to copper and lead concentrates. The concentrate can be ground, roasted, treated by cyanidation and the final product is gold bullion.

Considering the fact that native gold and electrum have variable composition and different parts of the same particle could present different composition, the recoveries of these particles by flotation is possible due to they are naturally floatable. Also, there is a theory about the effect of silver

content on gold flotation rate. By this theory, if there are two silver-gold particles, the particle with higher silver content has a high flotation rate. This effect is probably influenced by the galvanic interactions between silver, gold and grinding media.

Native gold is floatable by chemical or physical actions on its surface. In this way, free gold particles affected by work-hard can have better floatability than a clean surface. Alluvial gold particles are normally flakey and have received deformation and flattening during their formation from the host rock and transport to the final location. This action created work hardening. During comminution, gold surface is contaminated by minerals and steel from grinding media. This process promotes flotation.

## **Leaching**

### Cyanidation

When we have to mention hydrometallurgical treatments, the cyanidation process must be mentioned initially due to has been employed in the gold mining industry for a long time. Basically, the process is supported by two facts, gold is soluble in dilute solutions of cyanide, and second, the pregnant solution can be processed successfully by using zinc powder or activated carbon and electrowinning. In other words, the process involves several steps from crushing until obtaining a Dore bar.

The basic principle of the cyanidation process is that alkaline cyanide solutions have a preferential dissolving action on the precious metals contained in an ore. The reaction generally accepted is shown below:

The gold dissolution rate is dependent on the concentration of NaCN and the alkalinity of the solution, the optimum pH is around 10.5. For efficient leaching, the gold should occur as free, fine-size, clean particles in an ore. The presence of certain minerals such as oxidized copper minerals is a poison for the process due to copper will be dissolved in first instance and the free cyanide will not be used for gold dissolution. Also, it is important to mention that an adequate supply of dissolved oxygen must be present in the cyanide process.

### **Cyanidation by agitation**

Cyanidation by agitation and heap leaching are the most employed processes for treating gold ores. The first one comprises several steps: crushing and grinding operations oriented to liberate gold particles so that they can be leached. The comminution product must be 80-90% passing 75  $\mu\text{m}$ . Normally, the process is employed when the gold content is ranging from 5 to 15 g/t. The grinding circuit is the first cyanidation circuit and the ball mill works as leaching drums. Once liberation is complete, the next step is to agitate the slurry to perform a complete dissolution of gold. The

solution and the non-valuable ore must be separated directly is the gold content is high, otherwise must be enriched by using activated carbon. The pregnant solution from the activated carbon is eluted and feeds the electrolytic cell where gold will be recovered in form of cathodes. If the solution is rich enough can be treated by zinc powder and the precipitated obtained (cement) obtained will be sent to retorting and smelting. For gold extraction the strength of cyanide solution ranges from 0.01 to 0.05%. Lime is added to the process in order to have a pH near to 10-11.

The different minerals foreign substances can affect the cyanidation process in a number of different ways. Silver is usually present with gold either in small or high amounts. The silver content in gold ores may range from 1 g/t to 300g/t. Oxidized copper minerals may be dissolved by the cyanide leach solution and thus consume large quantities of NaCN and oxygen. Arsenic minerals may also interfere with cyanidation. Realgar and orpiment react rapidly with the cyanide solution and inhibit the dissolution of gold. Arsenopyrite, generally oxidizes very slowly in an aerated cyanide solution and has very little adverse effect on the leaching of gold. Stibnite affects negatively the cyanidation process. The presence of base metal ions such as  $\text{Fe}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$ , and  $\text{Mn}^{2+}$  makes slow the cyanidation of gold. Other negative compounds are carbonaceous materials because they act as

adsorbents for the gold dissolved by cyanide solutions. Organic substances such as wood, oil, and grease, slow down cyanidation of gold by consuming the dissolved oxygen in the pregnant solution.

### **Pachuca Tank**

CIP tanks are connected by launders with screens

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CIP circuit

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Heap leaching can be considered as a percolation process on ore piles. The process is characterized for its economic cost against the agitated leaching process when the ore deposit has a low gold content. Typically the process can process ores whose gold content is 0.8-1.1 g/t. The leaching solution is spread at the top of the pile and the pregnant solution will have to percolate through the pile. The design considers special drainage pads for pregnant liquid collection. The design is influenced by the manner of occurrence of the gold or gold host minerals, geological characteristics of the ore, and the volume of the deposit. Operations are conducted on ore stacked on impermeable pads. Special pad and piping systems are required to collect and transport de pregnant solution so that the losses of gold to the ground can be eliminated. Commonly, the materials used for constructing the pads

are rock mixed with bentonite, asphalt mixed with gravel, reinforced concrete pads, and rubber covers on an excavated area.

There are two popular heap leaching designs, one is called short-term leaching of crushed ore, and the other is a long term leaching of run of mine ore. The first one comprises one or two crushing stages previous to form the ore pile. Cyanide solution percolates through the heap leaching the gold and silver and is collected on the pregnant solution pad. The ore is crushed to a size that will give good liberation of gold minerals. In most operations with this crushing stage, the ore is crushed until two-three inch. A finer size can be considered if the ore needs fine liberation. The leach cycle is normally from 20 to 30 days. When the leaching cycle is complete, a new crushed ore is piled.

The second option is the most economical option and the ore is taken directly from the blasting. A typical ore size is six inch. A heap constructed under this design can treat high tons of material. Most heaps look like truncated pyramid 25 to 40 feet high. The height is in based on ore permeability, residual alkalinity, cyanide strength and dissolved oxygen.

### **Pad Construction**

The leaching solution is introduced onto the heaps by spraying from perforated plastic tubes, and by sprinkling using plastic sprinkler heads.

The pregnant solution can be treated by activated carbon or zinc powder (Merryl Crowe process). The second is applied in many operations, but the final decision is based on the silver/gold ratio and economic considerations. Activated carbon does not recover much of the silver, but the gold recovery is high. In other words, the efficiency of the recovery process is influenced by the silver content.

### **Heap leaching process**

Agglomeration:

Basically, this process can be used by small miners who are used to recover free gold particles by batch procedures. The process has been developed considering environmental aspect. It is well known that small miners employ mercury to recover free gold and part of this liquid metal is released to the environment. The process is an alternative to the amalgamation process. The agglomeration process is based on the formation of agglomerated particles with coal and is known as Coal Gold Agglomeration (CGA). This process was developed and patented by the British Petroleum research group and the key concept of the process is the formation of hydrophobic and oleophilic particles from slurries into agglomerates formed from coal and oil. The oil forms a link between gold particles and coal, and the last one act as a carrier of gold particles.

Agglomerates are recycled to increase their gold recovery and once they are almost saturated are separated burned, and smelted to get a gold ingot.

The most appropriate auriferous ores for the process are placers, old tailing deposits, and some gold with easy liberation after grinding. In these deposits, the gold must be free and fine. Then, it is necessary to verify this condition by doing mineralogical studies that must cover all the deposit in order to assure its applicability in the project.

Agglomeration is a particular case of oil-agglomeration. In this case, the agglomerates are formed in an aqueous system when a second liquid contacts a hydrophobic particle like the carbon. When there is stirring and mixing, the oil is extended on the surface of hydrophobic material and creates bridges among the particles, and the hydrophilic particles stay in an aqueous suspension. The CGA process for the treatment of auriferous ores is based on the natural hydrophobicity and oleophilicity of gold. This property is considered by some researches as a form of easy superficial contamination.

Having an appropriate mixing condition and a specific oil/carbon ratio, it is possible to obtain agglomerates due to the interfacial tension of the oil and the capillary attraction of the oil bridges between particles. Next figure

shows schematically the formation of coal-oil agglomerates and the contact with gold particles.

### **Formation of coal-oil agglomerates**

The coal-oil agglomeration process combines one of the classic separations in the treatment of coal ores. The principle is to recover hydrophobic particles of gold by using an oily phase. The process consists in mixing the slurry with coal-oil agglomerates. The oleophilic particles penetrate into the agglomerates which can be recovered by screening or flotation.

Geometallurgy must be applied at the moment of considering this process because there are important parameters to be considered at the moment of studying the applicability of the process. Some parameters are the following: the contact time of agglomerates with the ore, reagent dosage, and the ratio carbon/ore.

### **CGA Flowsheet**

An important characteristic is the fact that the rate of gold recovery is not affected by the agglomerate. The nature fluidity of the agglomerates allows that gold particles can be absorbed in the oil phase, which is 12-27% of agglomerate. Then, rate of gold recovery is not limited by the metallic content of the product. The metallic content of agglomerates is influenced by the gold content, gold recovery, and carbon/ore ratio. For example, it has

been determined that ores with 1 g/t of gold will form agglomerates with 1,050 – 1,550 g/t of gold. The recovery can be improved by adding surfactants. This action is similar to the conventional flotation.

When the agglomerates are formed with carbon particles smaller than 37  $\mu\text{m}$ , the gold recovery reaches a maximum value due to a better mechanical strength among agglomerates. If the agglomerates have a bigger size, the adhesion between oil and carbon will not be appropriate and the agglomerate will collapse. In general, the presence of sulphides does not affect the gold recovery due to the fact that gold is more hydrophobic than sulphides. However, there is point that affects slightly the gold recovery.

The auriferous ore is ground and later mixed with coal-oil agglomerates in mechanical tanks. The process can work in counter current, like a CIP plant, using screens for retaining the agglomerates and the slurry goes to the next tank. Alternatively, the ore and agglomerates can pass through several tanks so that the agglomerates can be recovered by flotation, and later can be recycled until reach a specific amount of gold.

The agglomerates are recycled in order to contact fresh ores and increase the gold content. In this way, the process is a development of spherical agglomeration for recovering fine particles by using coal-oil agglomerates.

The agglomerates are burned in order to produce a product with high gold content or can be smelted for producing metallic gold. The process involves simple and known unitary processes: mixing, flotation, burning, and smelting.

**The main advantages of the process are listed below:**

High recovery of gold independently of the particle size, from 5 to 100  $\mu\text{m}$ . The process let to recover fine gold which is difficult to be recovered by gravimetric devices, and the coarse gold can be recovered from gravimetric concentrates. Thus, the process is an alternative to amalgamation and cyanidation.

The process can be employed in small or big scale.

The short time in reactors, let to have lower capital cost.

The reagents consumption is low which creates low operating cost. This is especially important when the cyanidation process has high costs.

The recovery is not limited by the capacity of the carbon. Then the rate of gold recovery trend to be constant in the time.

It is not utilized cyanide or mercury. The process considers the environmental aspect KOCHIN INTERNATIONAL LIMITED is considering to use this process after analyzing all process pros and cons of each process

## **5.0 Major global trading hubs**

The landscape for wholesale gold trading is quite complex and constantly evolving. The three most important gold trading centers are the London OTC market, the US futures market and the Shanghai Gold Exchange (SGE). These markets comprise more than 90% of global trading volumes and are complemented by smaller secondary market centres around the world (both OTC and exchange-traded).

### **5.1 The London OTC market**

The London OTC market has historically been the centre of the gold trade and today comprises approximately 70% of global notional trading volume per our estimates. The London market attracts participants from all around the world and sets the twice daily global reference benchmark for gold, the LBMA Gold Price. Uniquely the market in London trades 400-ounce bars ‘Good Delivery’ bars which are stored in the member vaults of the London Precious Metals Clearing Limited (LPMCL) and the Bank of England. London’s unique vaulting infrastructure with its strictly enforced chain of custody, as well as the sizeable stocks of gold that reside within it, contribute to London often being referred to as the ‘terminal market’. The London market also enjoys a time zone advantage, bridging Asian and US

trading hours, and benefits from its status as a leading global financial services hub.

Notwithstanding the London market's pre-eminence, it has been losing relative share of global trading volumes. In 2015 banks operating in the market stopped submitting forward offered rates (GOFO rates) which were used to establish the market's forward curve, one of several symptoms of a market that has become increasingly fragmented. The World Gold Council's initiative to partner with a consortium of leading financial players and the London Metal Exchange to introduce LMEprecious is a direct response to these pressures. This suite of exchange-traded contracts seeks to modernize and introduce efficiencies to the heart of the gold trading market.

## **5.2 The US futures market (COMEX)**

Despite London's leading role in the physical market, the COMEX derivatives exchange operated by CME Group has become an increasingly important venue in driving price discovery. Trading activity on COMEX is primarily concentrated on the 'active month' (nearest dated) contract which acts as a proxy for the spot price. Only a small number of contracts physically settle into delivery of bars into COMEX vaults but the market is nonetheless tightly linked to physical markets through a very active

Exchange for Physical (EFP) market. Notably, a steadily increasing share of COMEX volume is transacted during Asian market hours reflecting the exchange's success of tapping into Asian market growth.

### **5.3 The Chinese market (SGE & SHFE)**

The largest purely physical spot exchange in the world is the Shanghai Gold Exchange. Established in 2002 under close oversight of the People's Bank of China, SGE has enjoyed a rapid rise to prominence that has mirrored China's growing importance in the gold market. In 2016 SGE introduced the Shanghai Gold Price benchmark to cement China's role as a price-setter, to help the internationalisation of the RMB and to broaden international participation in the Chinese market. It should be noted that SGE's spot and deferred contracts are complemented by very active futures trading on the Shanghai Futures Market (SHFE), although the two exchanges are not directly linked.

#### **Secondary market centres**

Other important markets include Dubai, India, Japan, Singapore and Hong Kong. There are exchanges in all these markets offering a range of spot trading facilities or listed contracts but these have not attracted the liquidity seen on the market's primary venues. Nonetheless, these markets play an important role to varying degrees in serving local demand or acting as

regional trading hubs. For example, Hong Kong has long acted as a gateway to the Chinese market and Singapore is establishing itself as an important focal point for trading in the ASEAN region.

## **6.0 2021 Gold Price Prediction, Trends, & 5-Year Forecast**

So while we take predictions with a grain of salt, let's look at what might be ahead for gold price in 2021 and the next 5 years.

### **Gold Price Prediction Chart**

The table below shows the gold price prediction from various consultancies and independent analysts. Not all gave a forecast for both time periods, but what they've stated publicly. Here's what they think is ahead for gold.

<b>Gold Price Predictions 2021 and Beyond</b>		
	<b>2021</b>	<b>Long-term</b>
AG Thorson, CMT	\$2,300	
Bank of America	\$2,063	
Bloomberg Intelligence		\$4,500
Capital Economics	\$1,900	
CIBC	\$2,300	
Citigroup	\$2,100	
Commerzbank	\$2,300	
CPM Group/Jeff Christian	\$1922 Avg.	Significantly higher than \$2,000
Credit Suisse	\$2,200	
Edelweiss		\$2,600-\$2,800 in a few years
Frank Holmes/US Global		\$4,000 in 2023
Goldman Sachs/Jeff Currie	\$2,300	
iGoldAdvisor		Significant advance through 2023
Kitco News Survey/average	\$2,300	
Kimble Charting Solutions		\$3,000
Lyn Alden Advisor		An endgame that can shoot gold way past my model to the upside
Mark Mead Baillie/FX Empire	\$2,401	
Metals Focus	\$2100 or higher	
Peter Krauth	\$2,300	
Ross Norman/Metals Daily*	\$2,275	
PM Analyst Lawrence Williams	\$2,225	

You can see that most analysts predict gold will exceed \$2,000 per ounce in 2021. Two project it will average in the \$1,900-range. And of those I found, all are very bullish long-term (though this survey is not exhaustive, as there are always analysts who are bearish).

### **6.1 The average price of gold in Tanzania**

Today 25<sup>th</sup> December 2021 Gold Price in Tanzania = 132,372 TZS per Gram. 10 Grams Gold Rate = 1,323,717 TZS. Equivalent to US\$60

## 6.2 Annual Production capacity

The company is planning to produce 10,000 gram per year of processed gold

## 6.3 Cost of goods available for sale

The company has estimated cost of goods available for sale plus other operating cost to be 60% of total revenue

## 6.4 Market Potential

The market research conducted by **KOCHIN INTERNATIONAL LIMITED** reveals that there is a very big market potential domestically and internationally

to absorb company's products, The use of gold as national reserve is increasing and the use of gold jewellery is increasing too

## 7.0 Project's Investment Capital

The estimated capital investment cost of the project is US\$ **701,000**.

### **KOCHIN INTERNATIONAL LIMITED COST STRUCTURE**

<b>PARTICULAR</b>	<b>US\$</b>
<b>Land and Buildings</b>	<b>50,000.00</b>
<b>Machinery &amp; Equipment</b>	<b>200,000.00</b>
<b>Motor Vehicles</b>	<b>80,000.00</b>

<b>Furniture &amp; Fixtures</b>	<b>2,000.00</b>
<b>Pre exp</b>	<b>5,000.00</b>
<b>Others</b>	<b>4,000.00</b>
<b>Working Capital</b>	<b>360,000.00</b>
<b>TOTAL</b>	<b>701,000.00</b>

For the project to be a reality a total investment amounting to US \$701,000. is needed

**(i) Land and Building (industrial premises): US\$50,000**

The project has identified and secured long term lease to accommodate machineries and also to be used as project office.

**(ii) Machinery and Equipment: US\$ 200,000**

Some US\$200,000 is anticipated to be spent on the purchase of different types of machines, working tools and equipments accommodating new technology

**(iii) Motor Vehicles:US\$80,000**

The project will need 1 truck, 1 Land Cruiser, and 1double cabin pick. These vehicles will be used to facilitate project business and double cabin pick up for administrative purposes.

**(iv) Furniture: US\$2,000**

This investment cost item has been estimated to cost US \$70,000. It will consist of office furniture such as tables, chairs, telephone, fax, machines, file cabinets, sofa chairs etc.

**(v) Pre-Operational Expenses: US\$ 5,000**

They cover things like company registration, expenses spent in exploring the viability of the project, especially the market/client identification exercise. Also included under this item are issues like consultancy fees, legal fees and recruitment and training costs of personnel.

**(vi) Initial Working Capital: US\$360,000**

Assumptions for working capital requirements have been estimated that it will cost US\$360,000. This will involve purchasing of raw materials, daily operating costs etc.

**7.1 Financing pattern**

Project will be financed by US\$300,000 and the remaining 401,000 contribution from company shareholders and cash flow from business

**8.0 Financial Analysis**

**8.1 Considerations and Assumptions:**

The corporate tax charged is 0% of the profits for 8 years. Capital investment allowance is 50%. The capital assets are exempted from custom

duty and Value Added Tax. The straight-line method to depreciate the project's capital items has been applied.

Revenues have been conservatively estimated based on experience of the promoters and trends in the industry.

## **8.2 Projected Revenue**

For projection purposes, it is assumed that the economic life of the project is five years, and that revenue commence from the first year of operation.

### **KOCHIN INTERNATIONAL LIMITED PROJECTED REVENUE LTD**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Revenue</b>	<b>600,000</b>	<b>630,000</b>	<b>661,500</b>	<b>694,575</b>	<b>729,303</b>	<b>765,768</b>

## **8.3 Projected Profit and Loss Statement**

The Income and Expenditure Statement shows the projected income for the 6 years period. The position depicted is that the project earns profit throughout its life. Accumulated after profits grow from. US\$**147,560** in first year to US \$ **1,064,181** in the 6th year

**KOCHIN INTERNATIONAL LIMITED PROJECTED INCOME & EXPENDITURE  
STATEMENT (US\$)**

	1	2	3	4	5	6
<b>Revenue</b>	600,000	630,000	661,500	694,575	729,303	765,768
<b>Operating Expenses:</b>	360,000	378,000	396,900	416,745	437,582	459,461
<b>Profit before Depreciation &amp; Interest</b>	240,000	252,000	264,600	277,830	291,721	306,307
<b>Interest</b>	18,000	13,500	9,000.00	4,500.00	-	-
<b>Depreciation</b>	11,200	11,200	11,200	11,200	11,200	11,200
<b>Gross Profit</b>	210,800	227,300	244,400	262,130	280,521	295,107
<b>Tax (30%)</b>	63,240	68,190	73,320	78,639	84,156	88,532
<b>Profit After Tax</b>	147,560	159,110	171,080	183,491	196,365	206,575
<b>Accumulated Profit</b>	147,560	306,670	477,750	661,241	857,606	1,064,181

## 7.5 Projected Cash Flows

This is shown in the financial statements. The project has a positive end of year cash flow from year 1st, i.e., US\$176,760 of operation to the 6th year i.e., US\$ 1,176,381

### KOCHIN INTERNATIONAL LIMITED PROJECTED CASH FLOW " US\$"

<b>SOURCES:</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Profit before interest and depreciation</b>	<b>0</b>	<b>240,000</b>	<b>252,000</b>	<b>264,600</b>	<b>277,830</b>	<b>291,721</b>	<b>306,307</b>
<b>Equity</b>	<b>401,000</b>						
<b>Loan</b>	<b>300,000</b>						
<b>Total Sources</b>	<b>701,000</b>	<b>240,000</b>	<b>252,000</b>	<b>264,600</b>	<b>277,830</b>	<b>291,721</b>	<b>306,307</b>
<b>Applications:</b>							
<b>Capital expenditure</b>	<b>332,000</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	
<b>working Capital &amp; Others</b>	<b>369,000</b>						
<b>Cash</b>	<b>0</b>	<b>176,760</b>	<b>183,810</b>	<b>191,280</b>	<b>199,191</b>	<b>207,565</b>	<b>217,775</b>
<b>Tax</b>	<b>-</b>	<b>63,240</b>	<b>68,190</b>	<b>73,320</b>	<b>78,639</b>	<b>84,156</b>	<b>88,532</b>

<b>Sub total</b>	<b>701,000.00</b>	<b>240,000.00</b>	<b>252,000.00</b>	<b>264,600.00</b>	<b>277,830.00</b>	<b>291,721.00</b>	<b>306,307.00</b>
<b>Total applications</b>	<b>701,000.00</b>	<b>240,000.00</b>	<b>252,000.00</b>	<b>264,600.00</b>	<b>277,830.00</b>	<b>291,721.00</b>	<b>306,307.00</b>
<b>Accumulated cash</b>		<b>176,760</b>	<b>360,570</b>	<b>551,850</b>	<b>751,041</b>	<b>958,606</b>	<b>1,176,381</b>

## 7.6 Projected Balance Sheet Statement

The projected shareholders equity increases from US\$ 401,000 in 1<sup>st</sup> year to loan US \$1,577,381 in 6<sup>th</sup>

### KOCHIN INTERNATIONAL LIMITED PROJECTED BALANCE SHEET " US \$"

<b>Fixed Assets</b>	-						
<b>Opening balance</b>	-	<b>332,000</b>	<b>320,800</b>	<b>307,800</b>	<b>294,800</b>	<b>281,800</b>	<b>268,800</b>
<b>Additions</b>	-						
<b>Total Long-term Assets</b>	-	<b>332,000</b>	<b>320,800</b>	<b>307,800</b>	<b>294,800</b>	<b>281,800</b>	<b>268,800</b>
<b>Less depreciation</b>	-	<b>11,200</b>	<b>11,200</b>	<b>11,200</b>	<b>11,200</b>	<b>11,200</b>	<b>11,200</b>
<b>Closing balance</b>	-	<b>320,800</b>	<b>309,600</b>	<b>296,600</b>	<b>283,600</b>	<b>270,600</b>	<b>257,600</b>

<b>Working capital</b>	<b>369,000</b>	<b>200,000</b>	<b>369,000</b>	<b>369,000</b>	<b>369,000</b>	<b>369,000</b>	<b>369,000</b>
<b>Accumulated cash</b>	-	<b>445,725</b>	<b>909,570</b>	<b>1,392,585</b>	<b>1,895,872</b>	<b>2,420,590</b>	<b>2,967,953</b>
<b>Total assets</b>	<b>369,000</b>	<b>966,525</b>	<b>1,588,170</b>	<b>2,058,185</b>	<b>2,548,472</b>	<b>3,060,190</b>	<b>3,594,553</b>
<b>Financed by</b>							
<b>Equity</b>	<b>401,000</b>	<b>401,000</b>	<b>401,000</b>	<b>401,000</b>	<b>401,000</b>	<b>401,000</b>	<b>401,000</b>
<b>Accumulated profit</b>	-	<b>176,760</b>	<b>360,570</b>	<b>551,850</b>	<b>751,041</b>	<b>958,606</b>	<b>1,176,381</b>
<b>Total equity</b>	<b>401,000</b>	<b>577,760</b>	<b>761,570</b>	<b>952,850</b>	<b>1,152,041</b>	<b>1,359,606</b>	<b>1,577,381</b>
<b>Long term loan</b>	-	<b>300,000</b>	<b>225,000</b>	<b>150,000</b>	<b>75,000</b>	-	-
<b>Bank overdraft</b>	-	-	-	-	-	-	-
<b>Total debts</b>	-	<b>300,000</b>	<b>225,000</b>	<b>150,000</b>	<b>75,000</b>	-	-
<b>Total equity and debts</b>	<b>401,000</b>	<b>877,760</b>	<b>986,570</b>	<b>1,102,850</b>	<b>1,227,041</b>	<b>1,359,606</b>	<b>1,577,381</b>

## 7.7 Projected payback period

Total investment is US \$ 701,000 cash accumulation third year is US\$ 904,295.00 which is more than the initial investment by US\$ 203,295 the project payback Period is within 3years,

The project has a relatively short payback period. It is remarkably impressive for a project whose investment is as big as US\$701,000 being recovered within 3years.

### KOCHIN INTERNATIONAL LIMITEDPAYBACK PERIOD

Year	Profit After Tax	Depreciation	Total Cash Flow	Accumulated Cash Flow
1	147,560	11,200	158,760	158,760.00
2	416,465.00	11,200	427,665	586,425.00
3	306,670	11,200	317,870	904,295.00
4	477,750	11,200	488,950	1,393,245.00
5	661,241	11,200	672,441	2,065,686.00
6	857,606			

## 8.0 Economic Aspects

Implementation of this project will have the following social and economic values

- The project is an ideal option for utilization of the available gold mineral resources

- The project will create employment for **12** people on permanent contract basis as well as on temporary basis.
- It will create more business opportunities to local suppliers which will also have a economic trickledown.
- It will generate substantial revenue to the government in the form of corporate tax, value added tax and pay as you earn.
- The project will have transfer of knowledge and skills to gold process management
- Increase of foreign currency

## 9.0 Implementation

Project implementation is expected to be relatively very short once project has been approved it is estimated that construction of hotel will be completed within one year: -

### **KOCHIN INTERNATIONAL LIMITED Implementation**

<b>S/N</b>	<b>ACTIVITY</b>	<b>PERIOD</b>
1	Processing TIC Certificate of Incentive	January 2022
2	Placing order of machines	February– March 2022
3	Installing machines	March 2022

4	Recruitment	April 2022
5	In house training	April- May 2022
4	Testing production	May 2022
6	Commercial operations	June 2022

## **10.0 Conclusion & Recommendations**

The project is technically feasible, financially viable, and economically sound, provided the sponsors will manage it efficiently.

It is recommended that the project be approved by Tanzania Investment Centre and be granted the TIC Certificate of Incentives with its associated privileges and benefits as provided for under the Tanzania Investment Act, 1997.