

## **82. PROFILE ON PLACER GOLD RECOVERY**

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## **I. SUMMARY**

This profile envisages the establishment of a plant for the recovery of placer gold with a capacity of 4 tonnes per annum.

The present demand for the proposed product is estimated at 3.8 tonnes per annum. The demand is expected to reach at 4.15 tonnes by the year 2017.

The plant will create employment opportunities for 43 persons.

The total investment requirement is estimated at Birr 13.42 million, out of which Birr 8.46 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 14 % and a net present value (NPV) of Birr 2.35 million discounted at 8.5 %.

## **II. PRODUCT DESCRIPTION AND APPLICATION**

Gold, recognizable by its yellowish cast, is one of the oldest metals used by humans. Gold's aesthetic properties combined with its physical properties have long made it a valuable metal. Gold, whose chemical symbol is *Au*, is malleable, ductile, and its high thermal and electrical conductivity as well as its resistance to oxidation make its uses innumerable. Gold's ability to be drawn in to thin wire (ductility) enables it to be deposited onto circuits such as transistors and to be used as an industrial solder and brazing alloy.

Gold alloys are measured by Karats (carats). A Karat is a unit equal to 1/24 part of pure gold in alloy. Thus, 24 Karat (24K) gold is pure gold, while 18 Karat gold is 18 part pure gold to 6 parts other metal.

### **III. MARKET STUDY AND PLANT CAPACITY**

#### **A. MARKET STUDY**

##### **1. Past Supply and Present Demand**

The total global supply of gold in 2005 was 4,040 tonnes growing at 4.9% as compared with 3,850 tonnes of gold supplied in 2004. On the other hand world mine production in 2005 was 1% higher than that of 2004. Of the total world production 75% was accounted for the first ten gold producing countries namely, South Africa, Australia, USA, China, Peru, Russia, Indonesia, Canada, Uzbekistan and Papua New Guinea.

Ethiopia's share from the world mine production is not more than 0.2% indicating a negligible level of gold mining in the face of world gold production.

The average gold mine production of Ethiopia in 2001 – 2005 was 3.76 tonnes ranging between 3.4 and 3.9 tonnes.

The world mine production is a constant function ranging between 2,400 and 2,500 tonnes of gold. Thus the current effective global demand for gold is estimated at 2,450 tonnes. The world gold mine production by country is presented in Table 3.1.

**Table 3.1**  
**GOLD WORLD MINE PRODUCTION IN TONNES**

Sr. No.	Countries	Years							
		1998	1999	2000	2001	2002	2003	2004	2005
1.	South Africa	465	451	431	395	399	373	340	295
2.	Australia	310	301	296	280	266	282	259	262
3.	USA	366	341	353	335	298	277	258	256
4.	China	178	173	180	185	192	205	215	225
5.	Peru	94	128	133	138	157	173	173	208
6.	Russia	115	126	143	153	168	170	163	169
7.	Indonesia	124	127	125	166	142	141	92	140
8.	Canada	166	158	156	159	152	141	129	119
9.	Uzbekistan	80	85	85	87	90	90	93	90
10.	Papua New Guinea	62	66	75	67	63	68	74	67
11.	Ethiopia	2.5	4.9	5.2	3.9	3.7	3.9	3.4	3.9
12.	Others	537.5	609.1	607.8	591.1	619.3	636.1	640.6	635.1
<b>Total</b>		<b>2500</b>	<b>2570</b>	<b>2590</b>	<b>2560</b>	<b>2550</b>	<b>2560</b>	<b>2440</b>	<b>2470</b>

*Source: US Geological Survey*

## 2. Projected Demand

Gold is mainly consumed in four major segments of jewelry, fabrications, electronics dentistry and imitation coins and other industrial applications. The demand for gold as represented by the consumption in 2005 reveals a growth of 99 tonnes in jewelry & 117 tonnes in total fabrications as compared with 2004.

Electronics industrial and decorative uses increased by 5% and 3%, respectively while medals and imitations coins increased 41%.

The world outlook in the gold industry is more expansion for new gold resources increase and focus on areas of historical gold production and expansion of production.

Therefore in this study the growth rate of gold mine production of 1% achieved in 2004 – 2005 is applied in the projection of mining production. The global mining production and Ethiopian mining production projections are presented in Table 32.

**Table 3.2**  
**DEMAND FOR MINING PRODUCTION OF GOLD IN TONNES**

<b>Year</b>	<b>World Mining Production of Gold</b>	<b>Ethiopian Mining Production of Gold</b>
2008	2,475.5	3.80
2009	2,499.2	3.84
2010	2,524.2	3.87
2011	2,549.5	3.91
2012	2,574.9	3.95
2013	2,600.7	3.99
2014	2,626.7	4.03
2015	2,653.0	4.07
2016	2,679.5	4.11
2017	2,706.3	4.15

### **3. Pricing and Distribution**

Distribution of gold in the domestic market will be handled through direct delivery to jewelries while export of gold will be handled with export marketing department organized to search for markets for the envisaged project. As a rare product the marketing activities will be focused on better alternatives of price, long-term relations, reliability and networks. The current price of 24 carat gold at Addis Ababa is Birr 150

per gramme, assuming 25% markup by retailers, the price for the product under study will be Birr 120.

## **B. PLANT CAPACITY AND PRODUCTION PROGRAMME**

### **1. Plant Capacity**

As per the market study presented above, the envisaged porcelain insulator manufacturing plant will have a production capacity of 4.00 tonnes of gold per year working 300 days, single shift of eight hours a day.

### **2. Production Programme**

The plant is expected to start production at 75% of its capacity in the first year, 85% and 100% in the second and third year of operation.

## **IV. MATERIALS AND INPUT**

### **A. RAW MATERIALS**

In lode or vein deposits, the gold is mixed with another mineral, often quartz, in a vein that has filled a split in the surrounding rocks. The raw material for the placer of gold is ore. The cost of raw material is assumed to be only royalty payment which is 3% of the total sales i.e Birr 240,000.

## **B. UTILITIES**

Electricity, water and diesel fuel are the three basic utilities required by the placer gold recovery plant. Annual electric energy required is 35,000KWH. The annual expenditure on electricity is therefore Birr 16,576. Annual water consumption is estimated at 100,000m<sup>3</sup>, which costs Birr 1,000,000 and annual diesel fuel cost at birr 5.49/lts is estimated at Birr 274,500. Thus the total annual utilities requirement is estimated at Birr 1,291,076.

## **V. TECHNOLOGY AND ENGINEERING**

### **A. TECHNOLOGY**

#### **1. Production Process**

Gold is obtained from lode deposits by drilling, blasting, or shoveling the surrounding rock. Lode deposits often run deep underground. To mine underground, miners dig shafts into the ground along the vein. Using picks and small explosives, they then remove the gold ore from the surrounding rocks. The gold ore is then gathered up and taken to a mill for refinement.

Placer deposits contain large pieces of gold ore (nuggets) and grains of gold that have been washed downstream from a lode deposit and that are usually mixed with sand or gravel. The three main methods used to mine placer deposits are hydraulic mining, dredging, and power shoveling. All methods of placer deposit mining use gravity as the basic sorting force.

In the first method, a machine called a “hydraulic giant” uses a high pressure stream of water to knock the gold ore off of banks containing the ore. The gold ore is then washed down into sluices or troughs that have grooves to catch the gold.

Dredging and power shoveling involve the same techniques but work with different size buckets or shovels. In dredging, buckets on a conveyor line scoop sand, gravel, and gold ore from the bottom of streams. In power shoveling, huge machines act like shovels and scoop up large quantities of gold-bearing sand and gravel from stream beds.

Hydraulic mining and dredging are outlawed in many countries because they are environmentally destructive to both land and stream.

Thus, the following method is adopted for placer gold recovery plant.

*Cyanidation* also involves using chemicals to separate the gold from its contaminants. In this process, the ground ore is placed in a tank containing a weak solution of cyanide. Next, zinc is added to the tank, causing a chemical reaction in which the end result is the precipitation (separation) of the gold from its ore. The gold precipitate is then separated from the cyanide solution in a filter press. A similar method is *amalgamation*, which uses the same process with different chemicals. First, a solution carries the ground ore over plates covered with mercury. The mercury attracts the gold, forming an alloy called an *amalgam*. The amalgam is then heated, causing the mercury to boil off as a gas and leaving behind the gold. The mercury is collected, recycled and used again in the same process.

## 2. Source of Technology

The technology for the placer of gold recovery can be obtained from the following reference:

Mc Cracken, Dave. Gold Mining in the Nineteen Nineties: The complete Book of Modern Gold Mining Procedure. New Era Publications, 1993.

<http://www.madehow.com>

## B. ENGINEERING

### 1. Machinery and Equipment

Plant machinery and equipment required for placer gold recovery plant is presented in table 5.1. The total investment cost of plant machinery and equipment is estimated at Birr 8.47 million.

**Table 5.1**

**LIST OF MACHINERY AND EQUIPMENT AND COST PLACER GOLD  
RECOVERY FOR PLANT**

Sr. No.	Description	Qty.	Cost (Birr)'000		
			LC	FC	Total
1	Grinding Mill	1	-	350.00	350.00
2	Mining Equipment	L.S	-	4,550.00	4,550.00
3	Filter Press	1	-	220.00	220.00
4	Compressor	1	-	345.00	345.00
5	Generator-Diesel-500 KVA	1	-	625.00	625.00
6.	Tanks	2	65.00	-	65.00
7	Chemicals	LS	-	135.00	135.00
<b>Total</b>				<b>6,225.00</b>	<b>6,225.00</b>
Insurance, Customs Duty, Inland Transport, Bank Charge, Etc.			2,243.75	-	2,243.75
<b>Grand Total</b>			<b>2,243.75</b>	<b>6,225.00</b>	<b>8,468.75</b>

## **2. Land, Building and Civil Works**

The envisaged plant will require a total land area of 30,000m<sup>2</sup>. The total land lease value for 80 years at the rate of Birr 0.4 per m<sup>2</sup> is therefore Birr 960,000. The floor space required for the building of and other facilities will be about 800m<sup>2</sup>. The total estimated cost of building and civil works at the rate of Birr 2,300 per m<sup>2</sup> is about Birr 1,840,000. Therefore, the total cost of land, building and civil works is estimated at Birr 2.80 million.

## **VI. MANPOWER & TRAINING REQUIREMENT**

### **A. MANPOWER REQUIREMENT**

The placer gold recovery plant will require manpower both for administration and production activities. The total number of manpower is 43, of which 14 are administration staff and 29 are involved in production activities.

The total labor cost is Birr 423,000. The detail manpower requirement and estimated annual salaries are presented in Table 6.1.

**Table 6.1****MANPOWER REQUIREMENT AND ESTIMATED LABOUR COST**

Sr. No	Job Title	No. of Persons	Salary (Birr)	
			Monthly	Annual
1	General Manager	1	2,500	30,000
2	Secretary	1	1000	12,000
3	Production & Technical Head	1	1,800	21,600
4	Commercial Head	1	1,800	21,600
5	Finance & Administration Head	1	1,800	21,600
6	Personnel	1	1,200	14,400
7	Accountant	1	750	9,000
8	Accounts Clerk	1	400	4,800
9	Cashier	1	500	6,000
10	Sales person	1	500	6,000
11	Purchaser	1	500	6,000
12	Store Keeper	1	500	6,000
13	Quality Controller	1	800	9,600
14	Shift Leader	3	750x3	27,000
15	Operator	9	550x9	59,400
16	Assistant Operation	9	350x9	37,800
17	Laborer	3	200x3	7,200
18	Mechanic	1	850	10,200
19	Electrician	1	850	10,200
20	Driver	2	500x2	12,000
21	Guard	2	250x2	6,000
	<b>Sub – Total</b>	<b>43</b>		<b>338,400</b>
	Employee's Benefit 25% basic salary			84,600
	<b>Grand Total</b>			<b>423,000</b>

## **B. TRAINING REQUIREMENT**

The supervisor, skilled workers and quality control worker need at least two weeks training on the technology, maintenance and quality control. For the rest, on-the-job training will be sufficient on the start up period by the specialists. Total training cost is estimated at about 85,000 Birr.

## **VII. FINANCIAL ANALYSIS**

The financial analysis of the placer gold recovery project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 year
Source of finance	30 % equity
	70 % loan
Tax holidays	5 years
Bank interest	8.5 %
Discount cash flow	8.5 %
Accounts receivable	30 days
Raw material local	30 days
Work in progress	1 days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days

## **A. TOTAL INITIAL INVESTMENT COST**

The total investment cost of the project including working capital is estimated at Birr 13.42 million, of which 47 per cent will be required in foreign currency.

The major breakdown of the total initial investment cost is shown in Table 7.1.

**Table 7.1**  
**INITIAL INVESTMENT COST**

Sr. No.	Cost Items	Total Cost (‘000 Birr)
1	Land lease value	960
2.	Building and Civil Work	1840
3.	Plant Machinery and Equipment	8468.75
4.	Office Furniture and Equipment	50
5.	Vehicle	400
6.	Pre-production Expenditure*	1468.20
7	Working Capital	236.27
	<b>Total Investment cost</b>	<b>13423.17</b>
	<b>Foreign Share</b>	<b>47.21</b>

\* *N.B Pre-production expenditure includes interest during construction ( Birr 813.01 thousand ) training (Birr 85 thousand ) and Birr 570.19 thousand costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

## **B. PRODUCTION COST**

The annual production cost at full operation capacity is estimated at Birr 3.81 million (see Table 7.2). The material and utility cost accounts for 40.09 per cent, while repair and maintenance take 4.43 per cent of the production cost.

**Table 7.2****ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)**

<b>Items</b>	<b>Cost</b>	<b>%</b>
Royalty fee	240	6.28
Utilities	1291.08	33.81
Maintenance and repair	169.36	4.43
Labour direct	228.75	6.00
Administration Costs**	194.25	5.09
<b>Total Operating Costs</b>	<b>2121.44</b>	<b>55.61</b>
Depreciation	1154.91	30.24
Cost of Finance	540.11	14.15
<b>Total Production Cost</b>	<b>3818.86</b>	<b>100</b>

**C. FINANCIAL EVALUATION****1. Profitability**

According to the projected income statement, the project will start generating profit in the second year of operation. Important ratios such as profit to total sales, net profit to equity (Return on equity) and net profit plus interest on total investment (return on total investment) show an increasing trend during the life-time of the project.

## 2. Break-even Analysis

The break-even point of the project including cost of finance when it starts to operate at full capacity ( year 3 ) is estimated by using income statement projection.

$$\text{BE} = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 70 \%$$

## 3. Pay Back Period

The investment cost and income statement projection are used to project the pay-back period. The project's initial investment will be fully recovered within 6 years.

## 4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 14 % and the net present value at 8.5 % discount rate is Birr 2.35 million.

## D. ECONOMIC BENEFITS

The project can create employment for 43 persons. In addition to supply of the domestic needs, the project will generate Birr 0.423 million in terms of tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.