

**AN INVESTIGATION ON THE EFFECTIVENESS OF
TRADITIONAL GOLD RECOVERY PROCESS FOR
JEWELLERY SCRAP**



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**LAPORAN AKHIR PENYELIDIKAN AN INVESTIGATION ON THE
EFFECTIVENESS OF TRADITIONAL GOLD RECOVERY PROCESS
FOR JEWELLERY SCRAP**

Merujuk kepada perkara di atas, bersama-sama ini disertakan 3 (tiga) naskah Laporan Akhir Penyelidikan bertajuk “**An Investigation on the Effectiveness of Traditional Gold Recovery Process for Jewellery Scrap**”.

Sekian, terima kasih.

Yang benar,

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ABSTRACT

AN INVESTIGATION ON THE EFFECTIVENESS OF TRADITIONAL GOLD RECOVERY PROCESS FOR JEWELLERY SCRAP

Statement of the Problem: : The problem statement in this research is “ to refining and recovering the gold scrap from the work bench . Current application in jewelry fabrication process includes technique like filing, piercing, grinding, drilling and etc are amongst the popular application that is widely used for a long time. All this while, the process has yielded various type of scrap. These scrap (in dust form) would eventually mix up with other form of dust from polishing wheel vacuum collectors and sweeping floor dust and it’s very difficult to recognize. Gold and other precious metals “lost“ during the fabrication process can be a significant cost factor that impacts product cost and business competitiveness. Much of the scrap generated in production can be cleaned and recycled, but contaminated scrap and other wastes need to be collected and refined back to pure gold to recover the value of the precious metal. Such scraps and wastes need to be pre-treated before refining to reduce costs and maximize recovery of precious metals.

Research Objectives: This study is intended to explore the traditional gold refining process and its uniqueness’. Thus, to give more focus to the research, two main objectives have been developed which is to measure reliability and effectiveness level of local traditional gold recovery method for jewellery scrap and to determine whether the traditional refining process could produce a high percentage of gold purity from the jewellery scrap. To do this, this research has gathered various inputs from credible sources and reference points such as World Gold Council (WGC) in United Kingdom for benchmarking purposes.

Methodology: Five stage of data collection adopted in this research include literature review, interview, observation/ case study and lab experiment. Respective lab experiments were conducted at Sirim Berhad, and Faculty of Mechanical Engineering, UiTM Shah Alam to derive and validate relevant findings.

Conclusion and recommendation: The nitrogen dioxide produced from the traditional gold recovery process caused the air pollution and derived to the safety issues. This problem relates to the quality control of each methods used by the refiners. The finding also derives that this method was unable to filter out all silver and copper element and in a same time affect the quality of gold in terms of percentage. Therefore, it is importance to produce a good, innovative device to recover gold especially in a work bench scrap to avoid any losses that can reflect to the profit margin with a safer and systematic system.

CHAPTER 1

INTRODUCTION

1.0 BACKGROUND OF THE STUDY

The production of gold jewelry will always generate scrap material, whether made by traditional techniques in a workshop or by mass production in a factory. Investment casting spruces and “webbing“ strip from stamping are two obvious examples of this, where the quality, i.e., alloy composition and cleanliness, are known. Thus, we are reasonably happy to directly recycle this material back into production after cleaning, with a low risk of producing poor quality jewelry of uncertain gold content.

Not infrequently, scrap defective jewelry from production—or damaged and worn items returned from customers or bought in the market—are also available, but the quality of this is more uncertain, and there is a higher risk, if recycled, of poor quality.

Certainly, in production, other forms of scrap materials and wastes are generated where we know contamination results in unclean materials. Polishing dusts and bench filings (lemel) are good examples here. We cannot recycle these types of materials without appreciable risk. Their direct use in production will

lead to quality problems, and we need to consider refining such materials back to pure gold.

These remarks are made purely from a technical perspective. However, there is also an economic aspect. The efficient recovery of scraps and wastes in gold jewelry manufacture is a vital component of a profitable jewelry manufacturing business, irrespective of whether it is a large factory or small, traditional workshop.

The gold refining technique is a rather ancient wet chemical method whereby the gold bearing scrap is dissolved in a chemical based reaction process to extract the pure gold. It is one through a refining technique known as a separating and purifying of gold from other metals refining as distinct from smelting which is the separation of gold from non-metallic impurities. Refining is also defined as the process of removing impurities from a precious metal.

Gold going through refineries may either be recycled scrap being purified and upgraded, or on the final stage of its transformation from ore in the mine of bullion. The traditional refineries usually produced most of their gold bars by the chemical chlorine process simply because it was quicker to complete as compared to a modern electrolysis method. The traditional process has been inherited for years from one generation to another generation of local refiners leads to unavailability of public domain data for reference.

1.1 Gold Industry in Malaysia

According to Ministry Industry, Mineral and Geoscience Department in Kuala Lumpur, Malaysian Minerals Yearbook (2003) , Azemi Hj. Eki and Mohamad Yusof Che Sulaiman (2004) Malaysia is a gold producing country and its production on this mineral was about 4000MT yearly.

In general, most of the small-scale gold mines are located in the States of Kelantan, Pahang, and Terengganu. The following are some related information on the country's gold production and its values as in the Figure 1.1 below;

Figure 1.1 : Mineral Production In Malaysia

MALAYSIA'S PRODUCTION AND VALUE OF MINERALS 2004				
(Figures in brackets are previous year figures)				
Mineral	Production (tonnes except for gold)		Value (RM)	
Metallic Minerals				
Bauxite	2,040	(5,732)	163,384	(378,312)
Gold (gm)	4,220,635	(4,739,000)	190,688,289	(190,216,997)
Ilmenite	61,471	(95,148)	8,409,233	(14,367,348)
Iron ore	663,732	(596,612)	42,478,848	(29,830,600)
Rare Earth (Monazite)	1,683	(795)	1,260,079	(881,655)
Rutile	27,308	(18,472)	9,552,065	(6,446,728)
Struverite	121	(2,619)	1,857,350	(40,201,650)
Tin	2,745	(3,358)	88,581,150	(62,324,480)
Zircon	6,686	(3,456)	10,500,096	(2,985,984)
Silver (gm)	363,718	-	294,612	-
	Total		353,785,106	(347,633,754)
Non-Metallic Minerals				
Aggregates	73,006,418	(85,141,572)	950,931,657	(1,286,991,932)
Barytes	-	-	-	-
Clay (& earth materials)	22,108,711	(23,908,835)	205,112,249	(172,686,492)
Feldspar	79,220	(42,662)	2,663,684	(1,415,796)
Kaolin	326,928	(425,942)	32,299,338	(29,475,773)
Limestone (for cement)	19,967,537	(20,855,381)	124,701,860	(135,956,558)
Mica	3,544	(3,609)	1,231,646	(1,254,236)
Sand and gravel	18,371,019	(17,954,765)	194,702,013	(198,866,780)
Silica sand	631,402	(533,617)	26,721,476	(21,582,420)
	Total		1,538,363,923	(1,848,229,987)
Energy Minerals				
Coal	389,176	(174,800)	35,343,797	(14,333,600)
Grand total			1,927,492,826	(2,210,197,341)

Reference: Mineral and Geoscience Department, Kuala Lumpur (2004)



Plate 1.1 : Big and small scale gold industry in Malaysia - Paining gold sample process
and Penjom gold mine's

References: Department of Mineral and Geological, Kuala Lumpur

1.1.1 Jewelry in Malaysia

In Malaysia, Kelantan is one of the most popular state amongst gold jewelry buyers due to its renown “emas kelantan” via its unique traditional “design” concept offered at a very reasonable price, even sometimes lower than the industry gold prices.

The price and its unique design has been an attraction to local tourism and jewelry industry that indirectly spur the development of the local economic development. In general substantiate by my early observation, Kelantan is the most reknown state for small/medium scale gold jewelry making as compared to others states in Malaysia like Terangganu and Pahang.

Considering gold as an attraction, the price offered by some of the local jewellers has cautioned researcher’s thought of knowing on how gold are traded locally as it should follow the international or at least industry set-pricing.

The simple search has triggered more value when the researcher managed to understand and obtain relevant data now on how local supply chain gold industry cycles. The new findings has helped the researcher to mitigate the issues with jewelry scrap resulted from the jewelry making process. The main issue that lingers

within the researcher's mind is that what happen to the jewelry scrap?

The short interviews with local jewelers in year 2003 has derived one most important information. The interview revealed that the jewelry waste/scrap is sold to the third party to recover the gold within the scrap through some cycle we called "gold recovery process". It is a process that takes place to recover a substantial amount of gold purity from the jewelry scrap/waste.

1.2 PROBLEM STATEMENT

The problem statement in this research is **to refine and recover the gold scrap from the work bench** . Current application in jewelry fabrication process includes technique like filing, piercing, grinding, drilling etc are amongst the popular application that is widely used for a long time. All this while, the process has yielded various type of scrap material resulted from jewelry bench work, filings, clippings scrap, jewelry pieces, grinding, wheel dust, casting spill, spruces, strip pot sludge and etc.

These scrap (in dust form) would eventually mix up with other form of dust from polishing wheel vacuum collectors and sweeping floor dust and it's very difficult to recognize.

Gold and other precious metals “lost” during the fabrication process can be a significant cost factor that impacts product cost and business competitiveness. Much of the scrap generated in production can be cleaned and recycled, but contaminated scrap and other wastes need to be collected and refined back to pure gold to recover the value of the precious metal. Such scraps and wastes need to be pre-treated before it is refined to reduce costs and maximize recovery of precious metals.

We should note that one should not continuously recycle “clean” scrap. Periodic refining of scrap is important to remove deleterious, embrittling impurities that tend to build up over time and lead to quality problems.

Thus, in any jewelry production situation, scraps and other wastes that is created need to be collected and refined for technical and economic reasons. One question that will be face is whether to send them to a third party refiner or to refine it in-house.

Which is preferable will depend on several factors, including economics and, not least, the availability of the technical skills needed to ensure full recovery of the gold if it is done in-house. Refining in-house will also require access to analytical facilities.

1.3 RESEARCH OBJECTIVES

This study is intended to explore and revisited traditional gold refining process that could be possibly introduced to small/medium scale jewelers house/goldsmith for in-house refining process. Thus, to give more focus and clarity to the research, 2 main objectives have been developed as follows:

- a) To measure reliability and effectiveness level of local traditional gold recovery method for jewellery scrap.
- b) To determine whether the traditional refining process could produce a high percentage of gold purity from the jewellery scrap

1.4 SCOPE OF STUDY

As the objectives of this research is clearly drawn up to ensure accurate findings, the following scope gives more clarity and clarification on how the study could be conducted to achieve research objectives.

Thus, the study is confined to the following activities :

- i. The recovery of gold scrap material that derived from the jewelers work bench.
- ii. The focus group in this research comprises small and medium scale jewellers and refiners. Thus, Kelantan state has been selected as an

areas of study due to the fact it has the highest number of local and small/medium scale jewellers and refiners population.

- iii. To assess local refinery capability to refine and recover the pure gold from the jewelry waste/scrap.
- iv. To determine quality level of the extracted pure gold from the traditional method through a rigorous and systematic laboratory testing and evaluation process.

1.5 SIGNIFICANT OF THE STUDY

In some states, sending materials to a third party refiner is not always a realistic option and so an in-house refining capability becomes a necessity. The jewelers' wishing to refine his scrap materials in-house is face with the dilemma of which process technology to choose.

Some are best suited for primary refining of ores on the larger scale and others are more suited for secondary refining scraps and wastes, particularly on the small scale, typical of jewelers' needs. Process efficiency is clearly important if all the gold and other precious metals are to be recovered economically.

The jewelry process has an indirect impact to the jewelry weight and quality. The process can cause the quantity and the weight of the raw materials (gold) reduced slightly as compared to the original weight measurement. It is very difficult to identify the quantity of the scrap due to its physical existence in dusty form.