

IDENTIFYING THE GOLD PURITY VERIFICATION TECHNIQUES UTILIZED BY SMALL AND MEDIUM-SIZED JEWELLERY INDUSTRIES IN MALAYSIA

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ABSTRACT

Due to its inherent value, gold is regarded as one of the planet's most valuable and precious substances. It is also regarded as one of the most secure assets in the world. Globally, gold is extensively utilized in several different kinds of industries, which includes investment, jewellery, and the manufacturing of gold coins and bars. Malaysians frequently utilized gold for foreign trade, investment, gifts, and wedding dowries. As the demand for real and high-purity gold grows, the trustworthiness of gold-testing tools is called into question. It has always been challenging to determine the constituents of the gold and platinum groups, commonly referred to as precious metals (Barefoot and Van Loon, 1999). The analysis of gold's purity in Malaysia's SMEs jewellery industry is the main goal of this study. It investigates the most prevalent testing methods used by SMEs, such as acid testing (touchstone), fire assay, and X-ray fluorescence (XRF). The study also examines the issues that SMEs confront in ensuring that gold purity meets industry requirements and attempts to uncover the core causes of gold identification mistakes. Integrating a mixed-methods research approach, this study combines quantitative surveys with qualitative interviews to acquire a full understanding of industry practices. The study's findings are predicted to considerably improve the precision of gold testing methodologies, develop quality control practices, and increase assurance and regulatory compliance frameworks in Malaysia's small and medium scale jewellery industry.

Keywords: Gold Purity, Gold Quality, Jewellery Industry

1. INTRODUCTION

Since antiquity, gold has been universally recognized as one of the most ancient and valuable elements on earth due to its intrinsic value (Blose & Shieh, 1995). Beyond its economic value, gold functions as a sociocultural status symbol, signifying wealth, power, authority, and social position within society (Batchelor & Gulley, 1995). Globally, demand for gold comes from various sources including as a reserve asset, investment, jewellery, medical implications and technological components (World Gold Council, 2024). Because of the concern that paper money may lose value, gold investing has recently emerged as one of the finest alternative investments to safeguard personal wealth (Syukor, 2009).

As the demand for genuine, high-purity gold products rises both domestically and internationally, it is essential to ensure the accuracy of gold purity testing and assessment procedures. Numerous claims of fake gold bars and gold-plated jewellery misrepresented as pure gold have become increasingly prevalent. This situation highlights a growing concern among consumers and investors regarding the authenticity and quality of gold products. Gold scam syndicates frequently target the general public who lack in-depth knowledge and technical skills to verify gold purity, leaving them vulnerable to fraudulent transactions (Norizuan, 2016).

Malaysia is significantly impacted by the growing issue of gold scams. Due to its similar density, tungsten is often mixed with other materials such as tungsten, to create fake gold bars (Sihar et al, 2015). The underlying factor why tungsten is often used in gold bar adulteration is due to its significantly lower cost compared to other metals (Lee and Sun, 2016). Thin gold coating was discovered on tungsten in modern times (Arbutine et al, 2015). According to Mercer, (1992) it is challenging to distinguish between gold coated with other materials, especially when the densities were identical to gold. Tungsten density 19.3 g/cm³ while gold 19.25 g/cm³ thereby making it hard to detect without precise testing (Rahim & Manaf,2022).

On average, jewellery retailers, pawnbrokers, and banks organizations in Malaysia employ non-destructive testing methods like densimeters, scales, XRF, needles, chemical solutions, electronic pens, magnets, and touchstone to ascertain the gold's purity since they are low-cost, easy to use, and do not harm the sample (Nor, 2021). However, X-ray fluorescence (XRF), touchstones, electronic pens, and needles can only be used to measure gold's exterior surface (Jalas et al., 2002). It is complicated to detect fake gold jewellery using the material covered by gold, due to the complex shape and thin material (Ismail et al., 2018).

During the pilot study, out of all Malaysia small and medium scale gold industry (SMEs) still using the touchstone method to identify gold purity. According to (Zedelius,1981) In order to evaluate gold purity, a worker requires expertise when dealing with touchstone. Touchstone technique is also not very effective especially for soft high-carat gold and white gold (Corti, 2011). The reliance of SMEs on inexpensive and simple non-destructive verification methods, driven by limited method selection, has significantly contributed to the prevalence of gold fraud.

International studies have emphasized the importance of assessing gold purity. "With billions of dollars' worth of gold traded globally across various applications, the valid and reliable determination of gold purity is important for hallmarking, regulatory compliance, and facilitating trust in international trade". In several nations, the law demands that each piece of jewellery must be inspected prior to receiving a hallmark stamp (Nahar, 2012). Nevertheless, there is little research on how these standards are implemented in the Malaysian gold manufacturing industry, particularly among SMEs.

Gold scam, had led to significant impacts for people, businesses, and economies in the aspect of financial losses and trust in the gold market. Analyses of gold jewelry purity must be carried out with the highest level of accuracy and precision because the level of gold quality influences its price, as even small errors can result in significant financial losses (Bardi et al., 2008). Additionally, prior research has not sufficiently addressed important difficulties such as inconsistent values, non-standardized testing protocols, and the absence of comprehensive regulatory frameworks. By analyzing the difficulties small and medium-sized businesses face in ensuring that the purity of gold satisfies industry standards, assessing the techniques used to determine gold purity within the SME sector, and identifying the reasons for inaccurate gold valuation, such as technological factors, industry standards, or expertise, this study seeks to close these gaps (Kaspin, et al; 2021).

This study aims to evaluate the methods used for verifying gold purity, identify approaches for assessing gold quality, and uncover the underlying causes of inaccuracies in gold valuation that lead to fraudulent practices within the jewellery industry. An accurate evaluation of gold purity is vital to ensure that you receive the true value of your purchase plus to help protect against overvaluation and safeguard long-term investment returns. The lack of documentation concerning the jeweler's techniques for evaluating the purity of jewels during the trade-in process constitutes a significant gap in this research. To confirm the major cause that leads to the primary concerns of this study, which is fake gold, the procedures and processes performed by the establishment or jewelers' home should be investigated and documented. The data's findings should benefit the development and enhancement of a standard process that many jewelers can use to enhance the assurance when assessing the composition of gold purity.

1.1 Gold Properties and Demand Worldwide

Gold is a chemical element listed in the periodic table under the chemical symbol Au, derived from the Latin word "aurum," signifies the yellow metallic element, which has an atomic number of 79. In its purest form, also referred to as "native gold,". It is considered as a mineral since frequently found embedded in geological formations and regarded as a metal due of its remarkable electrical conductivity and consistent brilliance, It can melt at "1943 °F = 1062 °C," pure gold is soft and pliable and may be formed into a wide range of items, such as jewellery, coins, and gold bars (Edwards, 2004).

According to the (World Gold Council, 2023) above ground approximately 216,265 tons of gold are found and served in multiple sectors according to its uses.

Table 1. Gold demand in multiple sectors, Source: (World Gold Council,2023)

Demand	Percentage
Jewellery	37%
Technology	7%
Investment	38%
Central banks	18%

The jewellery industry is one of the main sectors with the highest demand for gold compared to other sectors (World Gold Council, 2019). Jewellery became the most popular option due to its beautiful, glossy appearance and robust resistance to corrosion (Raw, 1997). The largest markets for purer and higher-carat gold are Asia and the Middle East (World Gold Council, 2023).

According to the Malaysian Investment Development Authority (MIDA), Malaysia is the fourth-largest jewellery manufacturer in ASEAN. With over 100 active producers and a strong domestic market, Malaysian artisans are renowned for their proficiency with 22K gold (916) and foreign goods, the majority of which come from China, Italy, and Turkey. On the global scene, Malaysia is rapidly becoming a significant hub for upscale gold jewellery. Penang, the nation's jewellery manufacturing hub, is home to a concentration of talented craftsmen, designers, and artisans who produce more than 70% of Malaysia's gold jewellery that complies with international standards. The industry's masterpiece for complex filigree work and craftsmanship meets both domestic and international standards.

1.2 Gold Alloying and Karat

According to Cambridge dictionary, "alloy" refers to a material formed by combining two or more metals, or a metal with another element. While "karat" is a unit to determine the purity of gold.

Karatage is commonly represented by the symbol K or kt (Stankiewicz et al, 2012). This term is used in documenting standards for instance the standards established in Malaysia and India "MS1247 2005; IS 2790 1999" (Fazrulhisyam, 2020; Kaspin, 2008). Alloying gold will create a variety of gold purity and quality levels depending on gold content. Gold is categorized according to its purity using several carat grades, including 24K, 22K, 18K, 14K, 12K, and 10K are between several grades of gold purity that are available on the market (Corti, 1999; Ning, 2005; Singh, 2012; Stankiewicz et al., 1998). The percentage of gold content increases with increasing carat numbers (Dutton,1982; Bache,1987). On jewellery, karatage is commonly stamped without including the decimal point (World Gold Council,2021)

Alloying gold is crucial, especially for jewellery because tougher materials are more resilient to wear and stretch. For instance, it will have an impact on the jewelry's resistance to dents, distortion, and scratching as well as its ability to hold its claw

setting. If alloy jewelry is more durable, polishing it is also less complicated. If the jewellery alloy is too soft, it will be harder to work with as items like hollow bangles are prone to denting and soft springs or earring posts may bend easily, such issues often lead to customer dissatisfaction. Pomellato, a jewellery company in Italy, reported receiving several customer complaints related to these problems. This matter was discussed by Valerio Faccenda in a presentation at the 2005 Santa Fe Symposium (Corti, 2019).

1.3 Gold Purity Testing Methods

Based on current patterns, the best-selling items for trade and investment are gold in all of its forms, including gold bars, coins, and jewelry (World Gold Council, 2023). In order to verify the validity of gold bars, they usually come with a certificate that includes the weight of the gold and its serial number. In contrast, a hallmark will be imprinted on jewellery, as for quality assurance to assist customers in confirming the purity of the items they buy. However, what if the hallmark is not what it claims to be, and the purity is not what it appears to be? Analysis of gold purity needs to be done carefully and accurately, considering gold's price currently depends on its purity (Bardi et al., 2008; Kaspin, 2021).

The destructive test method and the non-destructive test method are essentially the two methods used to identify the gold's purity, the destructive approach will demolish the gold sample, consisting of inductively coupled plasma (ICP) and fire assay. On the other hand, the non-destructive method measures the purity of gold on its surface or throughout the sample without damaging it such as XRF, touchstone and densimeter (Battaini et al., 2014).

1.3.1 Fire Assay (Cupellation)

Fire assay is known as a destructive method, the history of fire assay began around 2600 B.C. In the first part of the third millennium B.C., "cupellation," often referred to as fire assaying, was established in Asia Minor. Not long after it was discovered that lead could be produced from galena (Forbes, 1950). In spite of its exceptional analytical reliability, the most popular used technique for determining the amount of gold in jewelry is fire assay (Ronlad 1980; Peter 1997; UNI EN ISO 11426 2000). It is an old technique that separates and identifies the metals in ores and metallurgical products using heat and dry reagents (Geological Survey Bulletin, 1445).

1.3.2 X-ray fluorescence (XRF)

X-ray fluorescence, or "XRF," is a non-destructive technique for determining how pure gold actually is (Nor et al., 2021). This technique is employed in both assaying and jewelry production facilities. This approach entails subjecting the surface of the jewelry to radiation, usually from an X-ray tube source. This radiation affects atoms, causing electrons to change their orbital shells or levels and release X-rays. Each component of a sample produces a distinct collection of distinctive signals that are referred to as "fluorescent." Later, a spectrometer is used to gather and measure these. The amount of metal present can be ascertained by counting the energy. Then the results will automatically be displayed on a computer interface (Corti, 2011).

1.3.3 Densimeter

The foundational principle for solving gold-testing challenges was discovered via the Greek scientist Archimedes in (c. 287–212 B.C.) (Van den Warden & Heath, 1983). A densimeter is a device used to measure the density of gold that is composed of a liquid-filled container and an analytical balance, the operation of this machine based on the “Archimedes” principle or also known as “hydrostatic weighing method” (Rahim & Manaf, 2022). This method is normally used in pawn shops, bank agencies and jewelry shops in Malaysia due to its economical and simple. The hydrostatic weighing might be cheap, simple and non-destructive. Nevertheless, it is unable to produce a precise assessment (Corti,2001).

1.3.4 Acid Testing (Touch Stone Method)

Touchstone is a non-destructive gold purity testing method that has been used for over 2,500 years (Nor et al., 2021). This approach is known as a reliable and quick tool (Ježek, 2013). However, A worker needs competence to perform this testing (Zedelius,1981). The Greeks managed to achieve this by rubbing an alloy onto a smooth black stone. Touchstone is a chunk of black stone with fine grains, black agate, radiolarite, basalt, and lydite are some of the stones that can be used in this technique. Nevertheless, basalts are the most often utilized stone in this process. (Oddy, 1986).

2. METHODOLOGY

This study thoroughly gathers data in two phases using an explanatory mixed-methods methodology. During the questioning procedure, the researcher thoroughly evaluated the questionnaires along with in-person interviews. A questionnaire survey was conducted to record respondent background, explore the usual procedure for assessing the gold's purity, awareness of standards and regulations while interview intended to comprehend the rationale for the usage of specific methods, to investigate practical problems and to enhance the discussion and conclusion.

The survey's analysis results serve as the basis for sampling and respondent selection. The term "explanatory" is employed because the qualitative insights clarify the quantitative analysis's findings. In the explanatory sequential design, the quantitative phase is given priority, followed by the qualitative phase (Creswell, 2011). Explaining the results of the first quantitative phase and providing an explanation for outliers that never fully reflect the collected data are common goals of the second qualitative phase (Clark, 2017).

The questionnaires were sent randomly to 100 Jeweler's House located in Selangor, Pulau Pinang, and Kelantan. These three major states were selected because they have the largest gold jewelry industries. The target demographic, which included goldsmiths, sales person, owners, and managers in charge of gold verification and

sales activities, was chosen from jeweler's houses engaged in the production and selling of gold. While quantitative data were examined using cross-tabulation and descriptive statistics in SPSS, qualitative data were examined thematically to identify significant patterns and insights. Because of their disparities in size and years of operation, the participating SMEs provided a range of perspectives on the present verification processes.

3. FINDINGS

In order to evaluate the survey instrument's usefulness, dependability, and comprehensibility, three respondents from three distinct jewellery companies were chosen for an initial pilot research. The pilot study offered first insights into gold purity testing procedures. Based on the analysis, the respondent implied that they prefer a non-destructive gold verification method. The goldsmiths noted that they mostly use non-destructive methods since they are quick and affordable, "but we are conscious that they might not detect all types of adulteration".

These preliminary results suggest that a company's selection of verification methods may be impacted by practical constraints, such as cost and tool availability. These results align with earlier studies showing that SMEs frequently use non-destructive testing due to its low cost, ease of use, and lack of sample damage (Nor et al., 2021). In order to facilitate analysis and discussion, Table 3 displays the groups of respondents from three companies along with their approach for determining the purity of gold.

Table 2. Preliminary results of the method assessing gold purity in three companies

Company	Method of Assessing Gold Purity	Person in Charge (Jewellery House)
A	Touchstone and magnet	Sales Person
B	Touchstone	Goldsmith
C	Touchstone and Densimeter	Manager

In summary, the preliminary survey's findings indicate that the majority of small and medium-sized businesses continue to use the traditional technique of acid testing (touchstone). The benefit of employing this technique is that it can detect the purity of jewellery in nearly any shape, size, or finishing, including stone-setting jewellery (Mercer, 1992). This technique, which is also referred to as the quickest and least costly sorting test, is essentially a preliminary test prior to a fire assay, nevertheless this technique is not very efficient for soft high-carat gold and white gold, nor is it precise enough for hallmarking (Corti, 2011). The detection of hidden interior compositions, such as those containing tungsten or other material, can be particularly difficult because touchstone only measures gold purity from the exterior (Jalas et al., 2002; Piorek et al., 2013; Rastrelli et al., 2009; Schaffer, 2003).

4. CONCLUSION AND RECOMMENDATIONS

The intention of this study is to examine the methods used in the SME sector to determine the purity of gold, with an emphasis on the methods employed and the factors influencing their selection. According to preliminary empirical findings from the pilot study, SMEs mostly choose non-destructive testing techniques since they are inexpensive, simple to use, and not damaging the sample. However, according to past research densimeters have no ability to identify the presence of tungsten owing to the fact that tungsten has a similar density to pure gold (Rahim & Manaf,2022). Moreover, according to (Corti ,2001) the test findings will be less accurate if procedures that can increase accuracy are ignored.

Despite being aware of the risks involved, respondents acknowledged limitations in correctly recognizing fake gold, which is consistent with the pilot findings. These findings point to the need of improving gold verification procedures within the SME level from an industry standpoint. SMEs are advised to use a gradual verification approach, whereby initial non-destructive testing is complemented by periodic advanced analytical techniques, especially for high-value or high-risk transactions, although non-destructive methods remain practical for routine verification.

Any uncertainty or mistake in determining the quality of gold could erode market confidence. It is essential to comprehend how this impacts price, transparency, and fraud prevention. By addressing these issues, Malaysia's gold sector will be able to create more dependable and uniform gold verification techniques, finally building a stronger, more transparent, and reliable global gold market.

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