# TECHNICAL WHITE PAPER

## DISCUSSING GOLD RECOVERY RATE

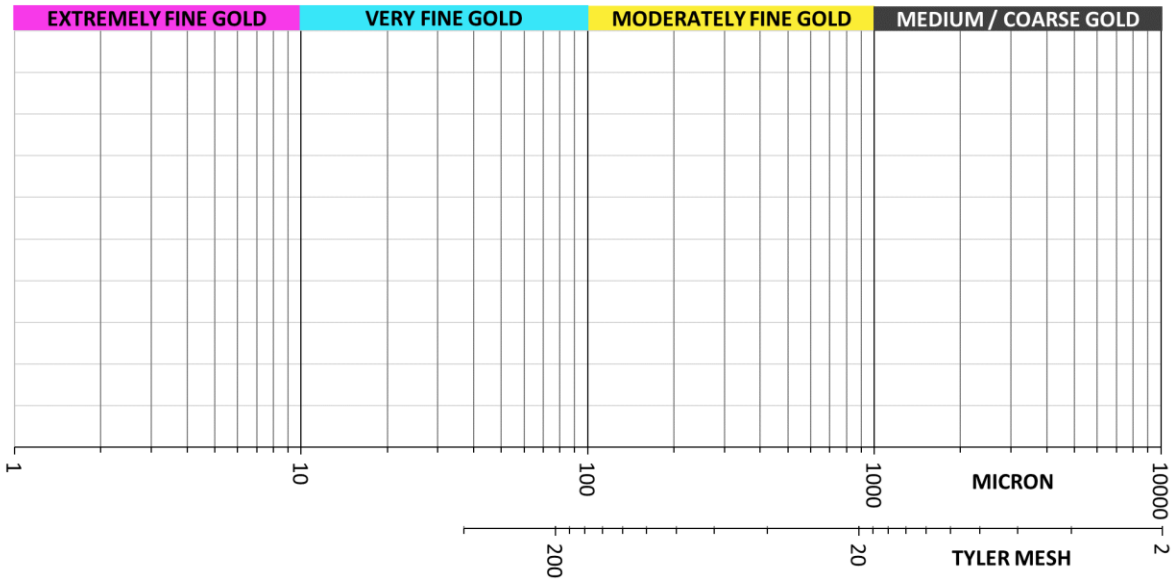
This whitepaper discusses various aspects of gold recovery and specific methods to predict the potential recovery and production rate from state-of-the-art washplant designs.

The gold recovery rate from alluvial / placer deposits is difficult to measure in practice, since it requires knowing both the amount of gold recovered and the amount of gold lost. The latter requires analyzing a representative sample of the tailings by analytical methods, such as fire assays, whereby the challenge lies in obtaining a representative sample and preparing it for fire assays without bias. Panning a random sample of sluice tailings for a visual indication of gold is a practical approach, but not meaningful for the determination of recovery rate.

$$Gold\ Recovery\ Rate\ [\%] = \frac{Mass\ of\ Recovered\ Gold}{Mass\ of\ Recovered\ Gold + Mass\ of\ Lost\ Gold}$$

Gold recovery by means of gravity (sluices, jigs, etc) is considered the only ecologically and economically viable method. Other methods, such as mercury amalgamation, cyanide leaching or froth flotation are not considered for technical and environmental reasons.

All gravity recovery methods are highly dependent on particle size and shape. Robin Grayson's paper on "Fine Gold Recovery – Alternatives to Mercury and Cyanide" (World Placer Journal, 2007) provides a relevant nomenclature for gold by particle size. Particles finer than 10 micron are considered "extremely fine gold", 10-100 micron "very fine gold", 100-1000 micron "moderately fine gold" and 1mm – 10mm "medium/coarse gold". The following table and color coding adopted from Grayson's definition displays the gold size distribution graphically on a logarithmic scale.



**GOLD RECOVERY RATE MUST REFERENCE GOLD PARTICLE SIZE**

Besides operational variables, such as feed presentation (screen aperture, feed rate, solids/water ratio) and sluicebox design (i.e. length, width, slope, riffle pattern), the gold particle size distribution and shape are inherent factors determining the gold recovery rate.

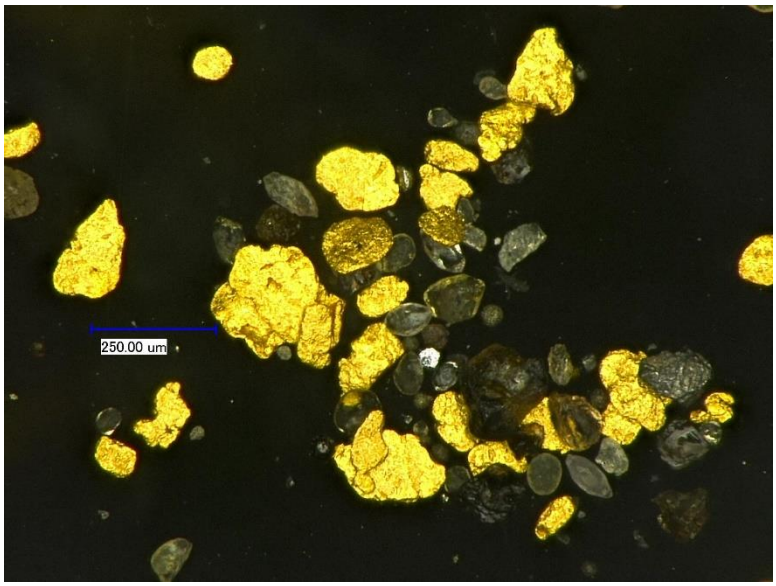



Fig. 1 – Moderately Fine Gold (200X Magnification)

Figures 1 and 2 illustrate microscope images of relatively fine and coarse alluvial gold, respectively. Fine and flat shapes are more difficult to recover than coarse and bulky shapes. State-of-the-art sluicebox designs therefor utilize a combination of riffle patterns, including Hungarian riffles, expanded metal mesh over woven Nomad matting and hydraulic riffles.

MACON washplants are designed with state-of-the-art features to maximize gold recovery.

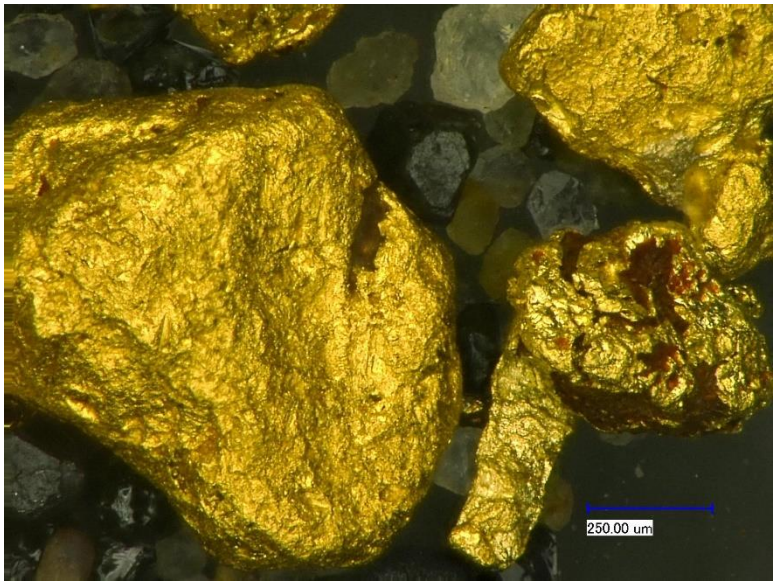



Fig. 2 – Medium / Coarse Gold (200X Magnification)

### 1. WASH AND CLASSIFY

Efficient material breakup, washing and classification are key feed preparation steps. Gold's high density and settling velocity naturally deposits it in proximity of coarser rocks, resulting in fines adhering to oversize rocks being of elevated gold grade. Aggressive impact/shear forces combined with high pressure directional spraybars facilitate material washing and classification on shaker deck or trommel screen type plants.

## 2. SCREEN PANEL SELECTION

SD and T series wash plants are equipped with modular screen panels, available in various aperture shapes and sizes. Considering the required feed tonnage, ground composition and target gold particle size, the correct screen panels are selected accordingly. The durability of the top (scalping deck) allows for larger top feed material to be fed into the plant that would otherwise be discarded by a grizzly feeder. This allows for this oversize material to be washed thoroughly while scrubbing smaller material as it transitions down the length of the screen.

## 3. SLURRY DISTRIBUTION ACROSS THE WIDTH OF SLUICERUNS

Large wash plants with wide sluice runs require careful attention to distributing the slurry evenly across the sluice runs for even loading and velocity profiles. MACON wash plants are equipped with engineered slurry distributors, guiding the slurry from under the screen deck or trommel to the sluice runs via center and wing distributors. As a result, the outside and inside material loading of all sluice runs is equal. Rubber lining of the distributors maximizes wear life and prevents short-circuiting.

## 4. SLUICE DESIGN FEATURES

a) SD series wash plants are equipped with primary and secondary sluice runs, where the primary runs are integral to the screen underpan and secondary sluice runs are external runs fed via slurry distributors. This design maximizes the effective sluice area and provides rapid access to the primary sluice run, in which up to 95% of the total production is recovered. The primary sluice runs are lowered hydraulically and designed for daily cleanouts.

b) A combination of various established riffle profiles is selected for the recovery of a wide range of gold particle sizes. The selection of profiles ranges from conventional boil boxes, Hungarian riffles and expanded metal riffles to MACON's proven hydraulic riffle design.

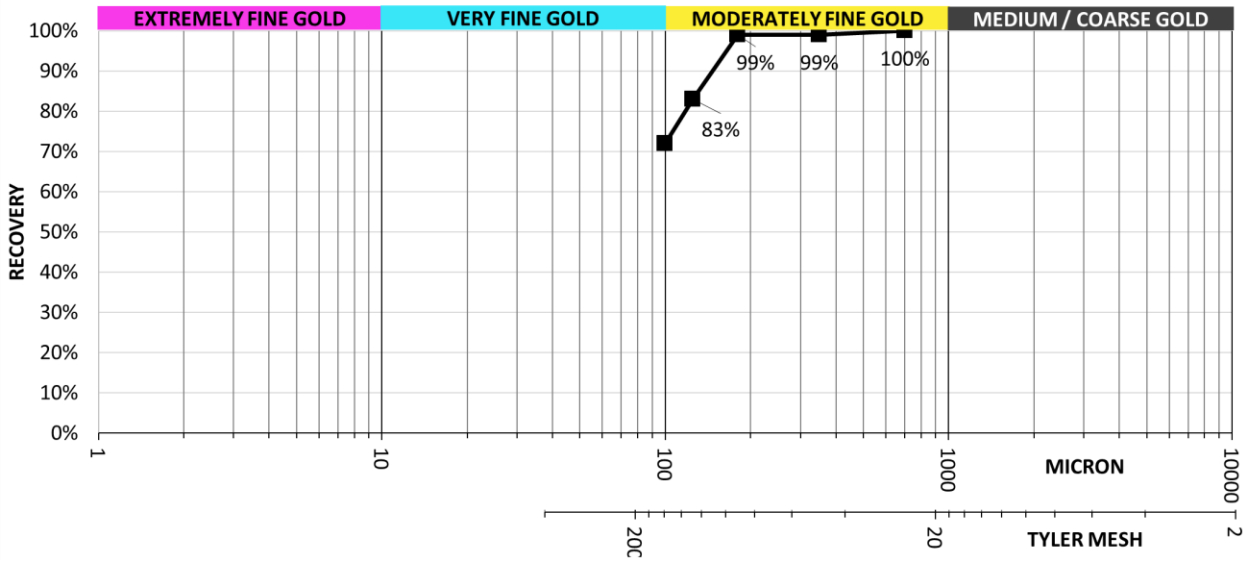
c) Secondary sluice runs are supported off powered cable lines, allowing for precise side-to-side levelling and slope adjustment. The correct slope is confirmed via measurement of the slurry velocity and easily re-adjusted from the washplant's control station, even while the plant is operational.

d) Water supply lines are equipped with by-pass valves, which are opened immediately if feed to the plant is interrupted. This feature is important to avoid "white watering" conditions, where the sluices

operate without feed but water. Under such conditions the water velocity increases, resulting in gold loss from conventional, shallow riffle sections. Hydraulic riffles are not affected due to their deep and secure gold retention zones.

### 5. ROBUST PLANT DESIGN

Washplants are operated in demanding environments. Gold production rates are the result of gold grade of the ground, tonnage processed, recovery rate and plant utilization. MACON washplants incorporate a heavy-duty design, built for longevity and thereby minimizing downtime for maintenance during short mining seasons.




Industry experts (Poling, Hamilton, Clarkson, Wotruba) suggest that state-of-the-art sluice box wash plants yield high recovery rates for gold particles down to 100 micron (0.1 mm).

The recovery curve above is based on work at the University of British Columbia (UBC) and illustrates the gold recovery as a function of particle size for feed screened at 19mm and processed over expanded metal mesh over Nomad matting. It is reasonable to expect that medium and coarse gold can be recovered fully even under aggressive production conditions. Fine gold loss can be minimized with low and consistent feed rates and short cleanout intervals.

MACON customizes screen aperture and sluice configuration to the respective ground conditions.

Predicting the gold recovery rate for a specific deposit may be considered in a two-stage approach:

### 1. DETERMINATION OF THE GOLD CONTENT BY PARTICLE SIZE.

Concentrates derived from carefully panning drill or trench samples are submitted for microscopy and size-by-size fire assay. Those methods are relatively inexpensive and considered indicative while not representative due to the small sample volume and the dependency on the skill of the pan operator. Rather it is a practical approach that can justify processing a larger bulk sample.

## 2. BULK SAMPLING USING A TEST PLANT

Placer / alluvial gold deposition can be highly irregular and the nugget effect inherent with coarse gold can have a major impact on gold recoveries and economics. Processing large bulk samples using a state-of-the-art test plant increases the confidence in the sample being representative and proves up the proposed equipment selection. The equipment must be configured correctly for the respective duty, i.e. in regards to screen aperture and sluice configuration. Areas with moderately coarse gold and with the presence of occasional nuggets can justify coarser screening (i.e. 12mm aperture).

Fig. 3 – Macon T150 Test Plant

Areas with very fine gold (< 0.1mm) require finer feed preparation (i.e. 6 mm aperture or less) and lower feed rates. Gold recovered from the bulk test is considered the benchmark “practically recoverable gold”.