33: Oleophilic adhesion – 1980s research in Alberta

Oleophilic adhesion is the selective adhesion of a mineral to a surface coated in oil, grease or wax. Gold is ideal being oleophilic, and proven to be naturally hydrophobic [84,85]. Conversely magnetite and quartz are oleophobic and hydrophilic. Yet gold recovery by oleophilic adhesion failed to challenge froth floatation, in spite of requiring less water and less grinding, ease of regenerating oils/greases/waxes and general simplicity. In contrast, oleophilic adhesion became the standard means of recovering diamonds on grease tables and grease belts.

Oleophilic adhesion was formerly known as the 'contact method of ore concentration', for which Royer Luckenbach of New York was awarded two patents in 1923 and a third in 1931 (US #1,448,928, US #1,478,237 and US 1,792,544). The patents propose a sticky coating of oil, grease or wax being smeared on an endless belt (e.g. a Frue vanner) to which gold particles would be attracted and remain attached even when the belt inverts over an end roller where black sand and quartz are shed as tailings. The gold is removed from the moving inverted belt by a scraper, and a roller reapplies a sticky smear of oil, grease or wax. Luckenbach added sodium silicate to the smear as a wetting agent to deter settling of magnetite and other gangue minerals, and his patents mention an extraordinary range of suitable oils, greases and waxes – including candle wax, candle tar, coal tar, horse grease, bitumen and lard.

The Lurgi method was invented by Ernst Bierbrauer of Germany and patented in 1940 and 1942 (US #2,189,698 and US #2,291,447) but not for gold recovery.

The Kruyer method was invented by Jan Kruyer of Alberta and patented in 1983 (US #4,511,461) and rather than using a sticky solid belt uses a sticky mesh belt. Rather than scraping the belt to collect the adhering oleophilic particles, the belt is squeezed between rollers or alternatively be blown or shaken off.

Operation

The text is adapted from the account of the greasy belt described by Royer Luckenbach in his patents.

Hardrock ore is milled to 2.5mm – a major advantage over froth floatation that requires much finer milling.

Placer ore is screened at 2.5mm. Gold in the oversize is separated in a simple device such as sluice. The <2.5mm fraction is subjected to oleophilic adhesion.

Water is added to the <2.5mm feed to create a slurry of about 25% solids by volume. Hydrophilic particles are wetted by adding a trace of wetting agent such as sodium silicate (see patents) or liquid non-frothing detergent. This weakens surface tension and sinks 'float gold'.

The 'greasy belt' is an endless rubber belt moving between rollers, one of which is a drive roller. The belt is coated in a thin sticky ('tacky') coating of oil, grease or wax but not so liquid that it might drip free when the moving belt inverts on passing over the end roller.

Luckenbach suggests a flexible resin binder such as rubber is added to the coating to make it waterproof.

The slurry issues as a thin stream onto the moving endless belt and the gold adheres to the sticky coating by oleophilic adhesion. At the end, the water and gangue minerals are shed as tailings whereas the gold and other oleophilic particles remain stuck to the inverted belt from which they are removed by a scraper. The scraper also removes some or all of the sticky coating.

The inverted belt passes across a roller that applies a fresh sticky coating and then turns 'right-way-up' over its end roller to again capture oleophilic particles from slurry.

Adoption by placer gold miners

Oleophilic adhesion does not appear to be being used by placer gold mining companies, artisanal miners or recreational miners in spite of its apparent simplicity.

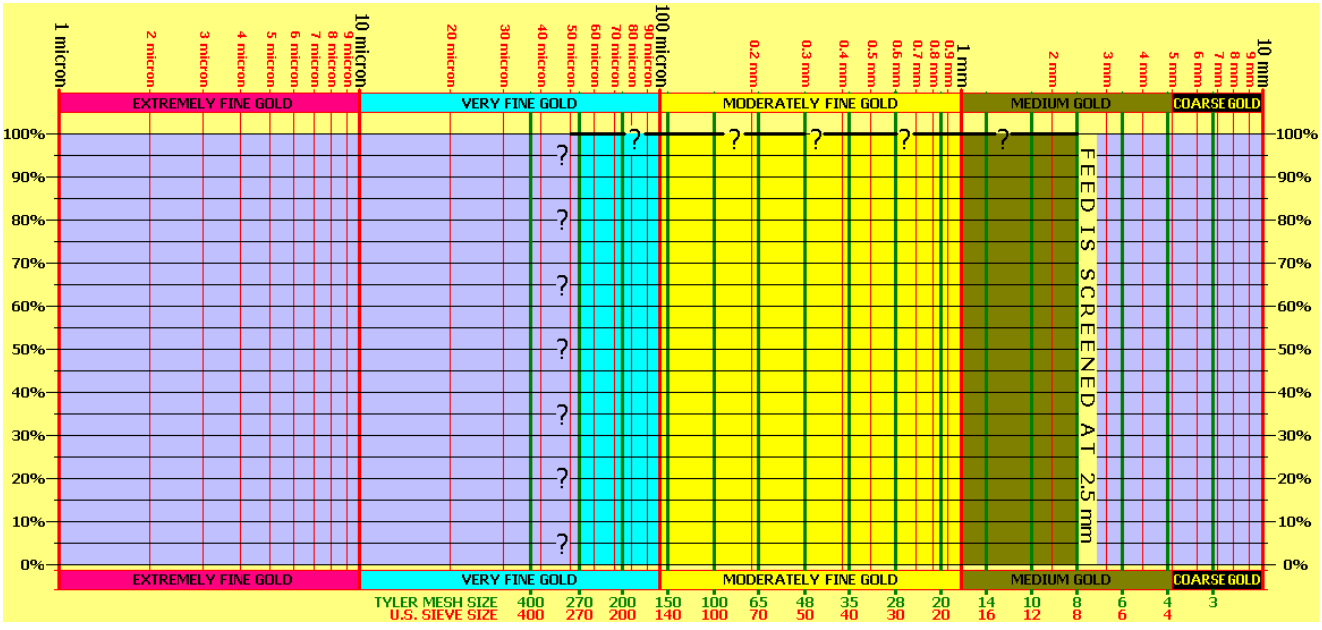

Figure 70. GOLD RECOVERY BY OLEOPHILIC ADHESION - generalised

Recovery of placer gold by the oleophilic adhesion is unclear and the graph is highly conjectural. (compiler: Robin Grayson)