

Extraction of Gold

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Characteristics and uses of gold

- ***Density*** : 19.3 g/cm^3 , $T_m:1064^\circ\text{C}$
- ***Shinny***: for Jewelry
- ***Durable***: does not tarnish or corrode easily, sometimes used in dentistry to make the crowns for teeth.
- ***Malleable and ductile***: can be bent & flattened . For this reason it is used to make fine wires and thin, flat sheets
- ***Good conductor for heat & electricity***: used in transistors, computer circuits & firefighting cloths.

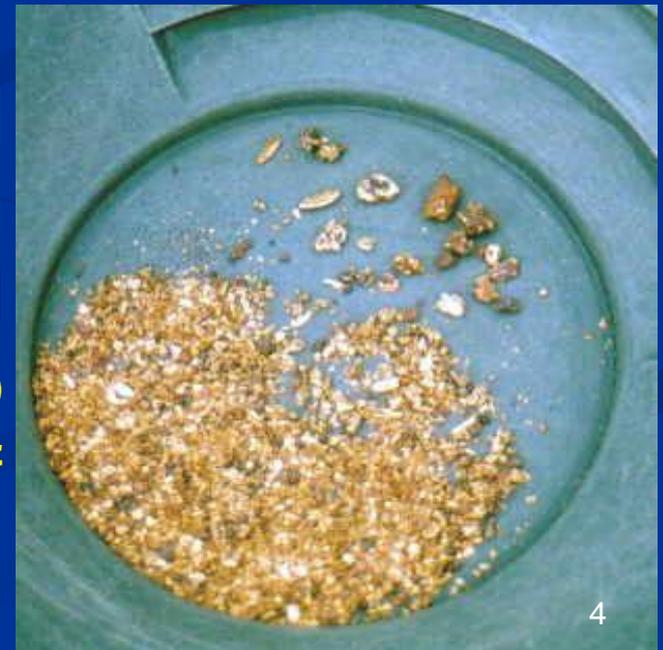
Types of ores

- Gold occurs principally as a Native metal, usually alloyed with silver (as Electrum), or with mercury (as an Amalgam). Native gold can occur as sizeable nuggets, flakes, grains or microscopic particles embedded in other rocks.
- Ores in which gold occurs in chemical composition with other elements are comparatively rare. They include calaverite, sylvanite, nagyagite, petzite and krennerite

Gold extraction

Gold mining

- Hard rock mining – used to extract gold encased in rock. Either open pit mining or underground mining.
- Panning (الفصل) – sand and gravel (حصى) containing gold is shaken around with water in a pan. Gold is much denser than rock, so quickly settles to the bottom of the pan.



Gold extraction

Gold mining

- Sluicing – water is channelled to flow through a sluice-box with riffles (تموجات) at the bottom which create dead-zones in the water current which allows gold to drop out of suspension.
- Sluicing and panning results in the direct recovery of small gold nuggets (خامات الذهب) and flakes.



Gold extraction

Gold ore processing

Gold cyanidation:

- The most commonly used process for gold extraction.
- Used to extract gold from low-grade ore.
- Gold is oxidised to a water-soluble aurocyanide metallic complex $\text{Au}(\text{CN})_2$.
- In this dissolution process, the milled ore is agitated with dilute alkaline cyanide solution, and air is introduced:



Gold extraction

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Gold cyanidation:

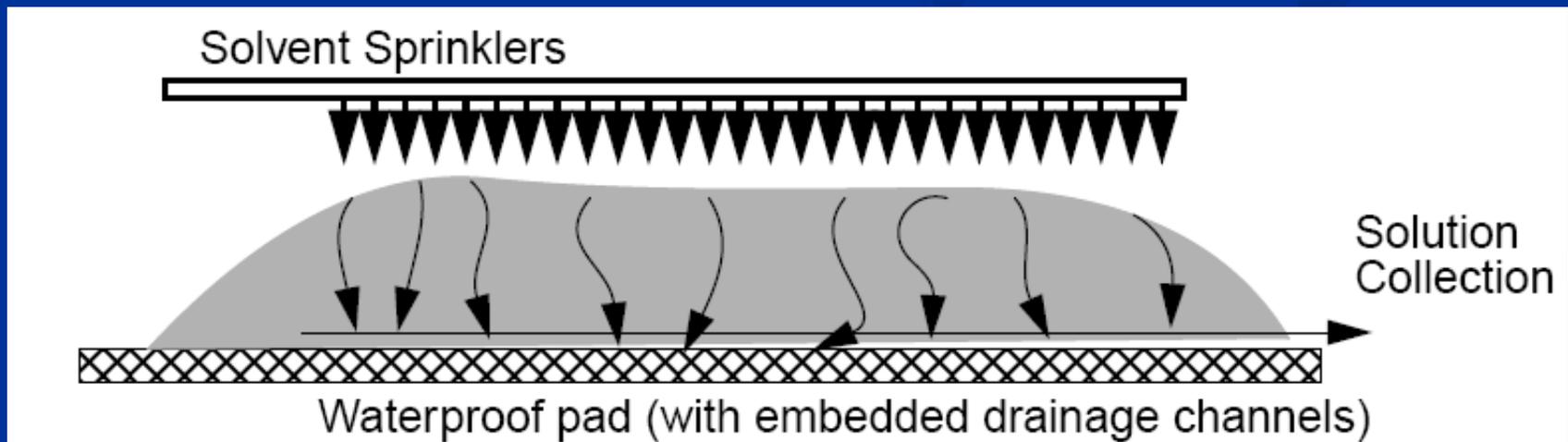
- At a slurry concentration of around 50% solids, the slurry passes through a series of agitated mixing tanks with a residence time of 24 hrs.
- The gold-bearing liquid is then separated from the leached solids in thickener tanks or vacuum filters & the tailings (مخلفات المعالجة) are washed to remove Au and CN^- prior to disposal.

Gold extraction

Gold ore processing

Heap Leaching

- Is an alternative to the agitated leaching process.
- Drastically reduced gold recovery costs of low grade ore.
- Ore grades as low as 0.3 g per ton can be economically processed by heap leaching.



Gold extraction

Gold ore processing

Heap Leaching

- Generally requires 60 to 90 days for processing ore that could be leached in 24 hrs in a conventional agitated leach process.
- Au recovery is around 70% as compared with 90% in an agitated leach plant.
- BUT, has gained wide favour due to vastly reduced processing costs.
- Frequently, mines will use agitated leaching for high-grade ore & heap leaching for low grade ores that would otherwise be considered waste rock.

Gold extraction

Gold ore processing

Gold cyanidation:

Merrill-Crowe process

- Traditional method for Au recovery from pregnant cyanide solutions.
- Once dissolution of Au is complete, the remaining rock pulp is filtered off through various filters to produce a sparkling (لامع) clear solution.
- O_2 is removed from the clarified solution by passing the solution through a vacuum deaeration column.

Gold extraction

Gold ore processing

Gold cyanidation:

Merrill-Crowe process

- Zinc dust is then added to the cyanide solution to chemically reduce the gold to the metal.



- The metallic gold is then filtered out & refined.

Smelting of resultant powder (rich Au) into steel molds and the slug is remove from the top furnace.

Electrolysis is done to get high gold grade 99.999% purity.

Cyanide process of gold production

