Chemical separation

Uses the chemical separation method depended on differences of minerals chemical properties. When physical separation failed in liberate mineral from gangue the chemical separation will be used. Failed of the physical separation are returned to inefficient liberate of mineral process from the cementation material or gangue when the physical process confront fine mineral particles or similar in physical properties in this case go to use the chemical process that depended on different in chemical properties.

Most minerals form ionic crystals material do have a positive or negative charge bonded together by an electrostatic attraction. The chemical of crystal that formed from unit cell that have regular frequent in the space this is caused chemical properties of mineral particles.

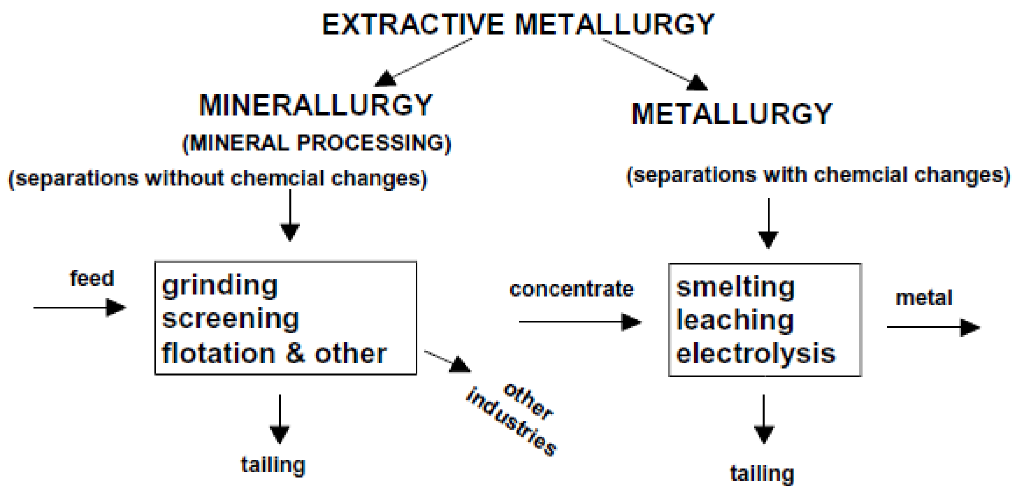

Fig. 2. Mineral processing is a part of extractive metallurgy

The surface of the particles charged in positive or negative charge causes it to adhere to air bubbles inside the liquid and to float upward. The chemical dealt with particle surface is easier , quick and cheap because of using few amount of chemical material that change the chemical properties of minerals.

When the previous processing fail we go o used treatment and separation by chemical such as dissolve one of mineral to separated it from another continent . this process is very expensive so that it using to separate the valuable mineral if it found in few amount inside sterile (dead) rock.

Chemical processing divided in to tow method:

1- flotation method (depending on chemical of mineral surface)

2- leaching method (depended on chemical reaction of minerals)

1-flotation method

This method use while there is different on the surface of mineral particles uses this method doesn't need to large amount of reagent because of the reaction targeted just the surface of mineral particles. This method depended on put the mineral particles or the ore in intensity water solution inside tank and passed air bubbles from bottom of tank this deal to adhere targeted particle in bubbles. If this bubbles that linked with particles have lowest intensity from the water solution then the particles floated at top of tank and accumulated them as froth from top of tank surface. The heavier particles are plunged at the bottom of tank and extracted out by specified pipe fig (12-1) . the tank that use for floated is call (flotation cell) this method is called also forth flotation.

(12-1)

This method used widely in separated sulphide minerals from the silicate wile extracted the mineral content of copper, zinc, lead. Nickel, cobalt, molybdenum, from the ore and dead rocks that carrying them, also in modern they are used to treated the iron ore, coal and phosphate rocks.

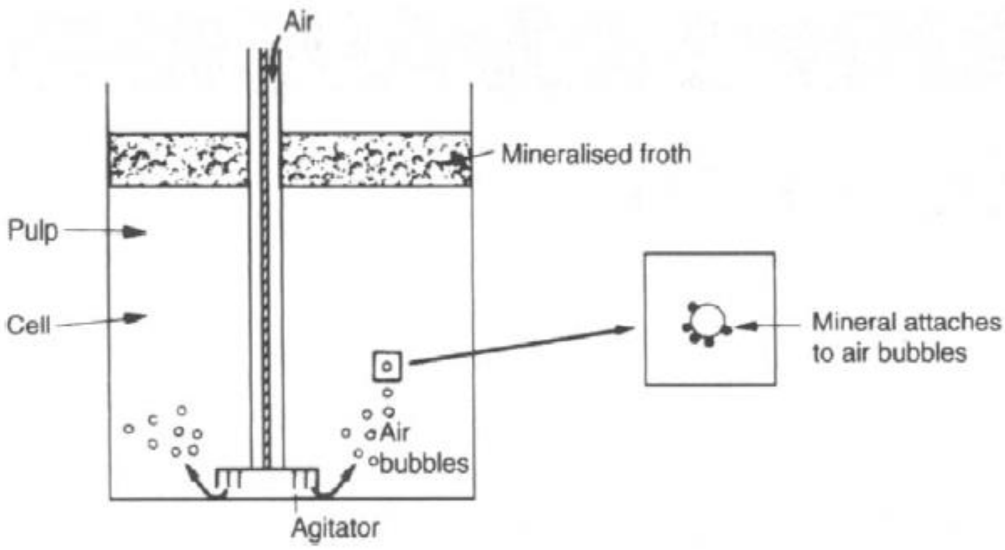

Figure 12.1 Principle of froth flotation

Flotation is one of many methods of separation it can be used for separation of phases, for instance to remove solid particles or oil drops from water. More frequently flotation is used for separation of particles having different hydrophobicities.

Hydrophobicity is a feature of material characterizing its ability to be wetted with a liquid in the presence of a gas phase. In mineral processing, solids which can be easily wetted with water are called hydrophilic, while solids with limited affinity for wetting are called hydrophobic.

As a result of hydrophobicity, particles adhere to a gas bubble forming a particle-air aggregate which is lighter than water, and travels upwards to the surface of water (Fig. 12.1). Hydrophilic particles do not adhere to the bubbles and fall down to the bottom of a flotation tank.

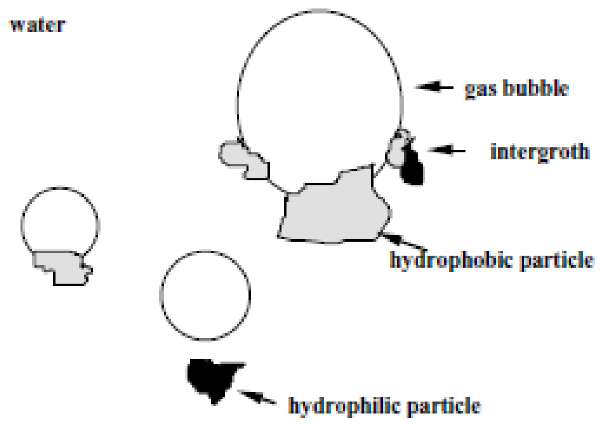

Fig. 12.1. Flotation

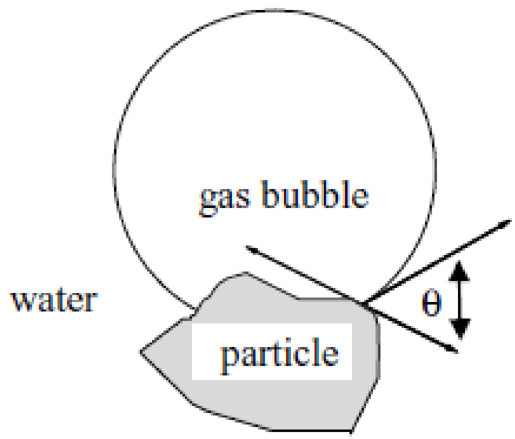

Fig. 12.2. Contact angle in flotation

Substances can be hydrophobic to a different degree and the measure of their hydrophobicity is contact angle. The contact angle (Fig. 12.2) is determined by straight lines drawn from the point of contact between a particle, gas and water which are tangent to the solid–gas, gas–water, and solid–water interfaces.

Commonly, contact angle is expressed and measured as an angle between gas and solid phases, through the water phase. The contact angle can be also defined as the angle between solid and water phases, through the gas phase.

Both ways of expressing contact angle are equally valid, since the sum of contact angle measured through the water phase, as well as the angle expressed through a gas phase is 180^0. To avoid misunderstanding, information which phase contact angle is expressed through should be clearly stated.

The contact angle for hydrophilic materials is zero, while for hydrophobic substances is more than zero. Maximum value of contact angle for materials in contact with water and air is about 110^0 (paraffin, Teflon). Table 12.1 presents contact angles for selected materials measured by flotometry (Drzymała and Lekki 1989a, 1989b).

Table 12.1. Hydrophobicity of materials. Contact angle is based on flotometric measurements expressed in degrees

Strongly hydrophobic*		hydrophobic		weakly hydrophobic		hydrophilic** $\theta = 0$
Material	θ	Material	θ	Material	θ	Material
Paraffin C_nH_{2n+2}	90+	sulfides	44–0	fluorite, CaF_2	10–13	gypsum $CaSO_4 \cdot 2H_2O$
Teflon, C_2F_4	90+	silicon carbide SiC	27.6	arsenic, As_2O_3	9.3	ferrosilicon
Sulfur, S	63.2	coal	26–0	perovskite, $CaTiO_3$	9	dolomite $CaMg(CO_3)_2$
Mercury, Hg	45.6	indium, In	25	scheelite, $CaWO_4$	9	magnetite Fe_3O_4
Germanium, Ge	39.7	iodargyrite, AgI	23.5	diamond, C	7.9	halite, NaCl
Silicon, Si	35.4	cassiterite, SnO_2	22–	tin, Sn	7.5	brawn coal
Talc	35.2	silver, Ag	14	boric acid, H_3BO_3	64	kaolinite
		ilmenite, Fe	14	graphite, C	6.2+	hematite, Fe_2O_3
		molybdenite, MoS_2	5.9+	PbJ_2	6	quartz, SiO_2
				gold, Au	5	calcite, $CaCO_3$
				barite, $BaSO_4$	5	anhydrite, $CaSO_4$
				corundum, Al_2O_3	4	bones
				HgO	3,3	tourmaline
				HgJ_2	3	vegetables
				copper, Cu	3	iron, Fe
						amber
						ice, D_2O

* Flotometric method is able to measure contact angles smaller than 90°.
** Other hydrophilic materials: chromite, malachite, smithsonite, azurite, rutile, zircon, mica.