

# SHIBAYAMA LAB.

## [Mineral Processing and Recycling]

International Research Centre for Sustainable Materials

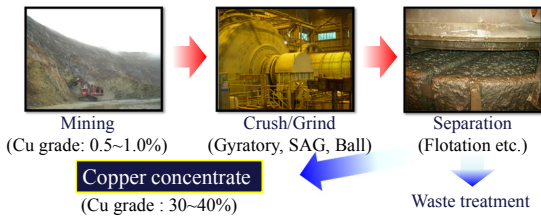
**Akita University**  
Graduate school of  
Engineering and  
Resource Science

<http://susmat.iis.u-tokyo.ac.jp/>

### Mineral Processing and Recycling Engineering

#### Thema1: Development of impurity removal method from Cu-ore by mineral processing technology

##### Mineral processing flow in copper mine



##### Problem of impurity in Cu mine

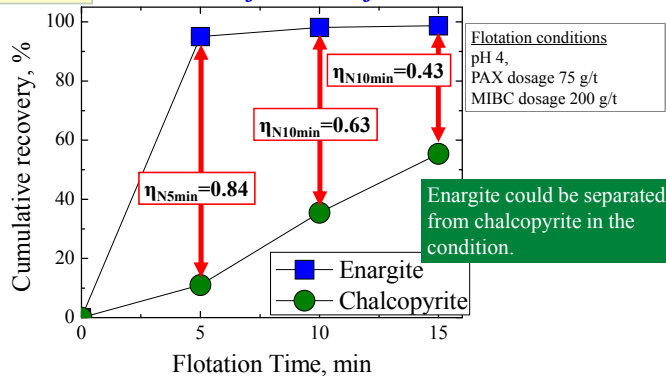
- Increasing of As/Sb grade in Cu-ore
- Environmental treatment is required in copper smelting process.



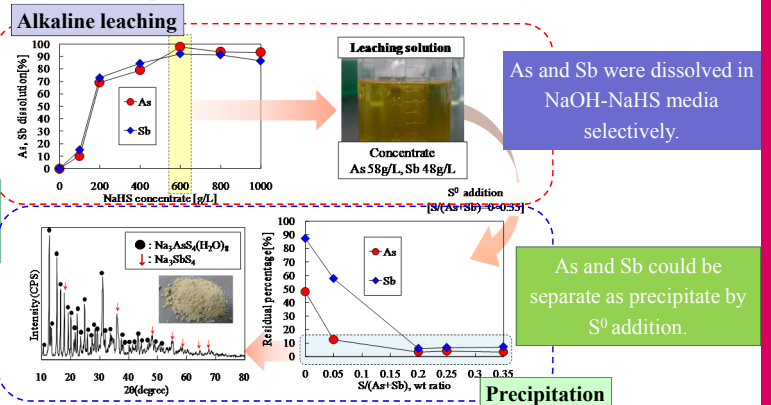
**Enargite ( $\text{Cu}_3\text{As}_2\text{S}_4$ )**  
(As bearing mineral)  
**Chalcopyrite ( $\text{CuFeS}_2$ )**  
(Typical Cu mineral)

Development of impurity removal technology by using combination process of flotation and hydrometallurgical separation.

##### Results Selective flotation of As minerals



##### Impurity removal by hydrometallurgical treatment



#### Thema2: Recovery of valuable metals by chlorination-volatilization and high pressure leaching



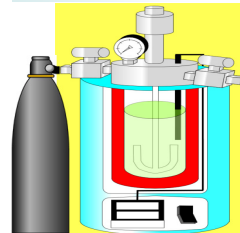
##### Metals in e-wastes

Na, Mg, Al, Si, S, K, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Br, Sr, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, Ba, Ta, W, Ir, Pt, Au, Pb, Bi

Recovery of several metals (minor element) are difficult.  
Investigation of recovery of valuable metals by pyro-hydrometallurgical process

##### Leaching of metals by high pressure leaching process

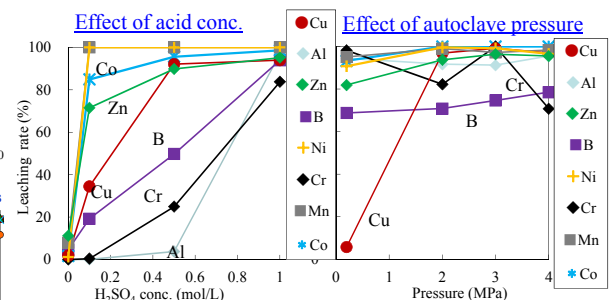
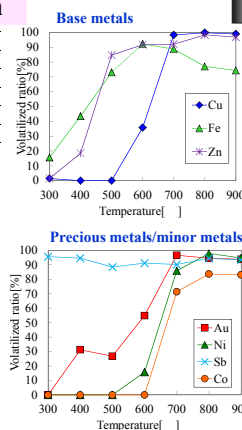
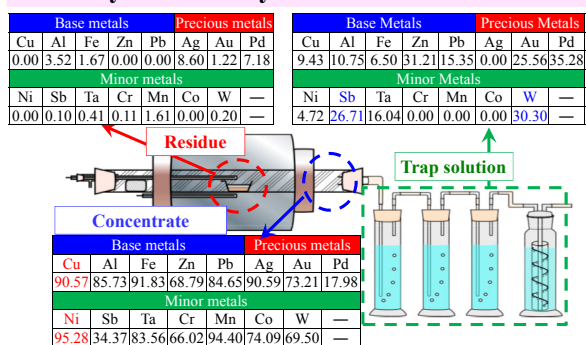
###### Auto-clave system



###### Advantage point

- ◆ This reactor temperature over 200
- ◆ Leaching high pressure with  $\text{O}_2$  gas
- ◆ Improvement of oxidation reaction rate by  $\text{O}_2$  gas supply.
- ◆ Reagent dosage, reaction time etc. can be decrease compare with normal condition.

##### Recovery of metals by chlorination-volatilization



###### Leaching conditions

Temperature : 180 , Leaching time : 1h,  
Pressure : 2MPa, Pulp density : 100g/L