SEPARATION PROCESS

CRYSTALLISATION
Part 1

by
Zulkifly bin Jemaat
Faculty of Chemical and Natural Resources Engineering
email: zulkifly@ump.edu.my

Introduction

- **Crystallisation is solid-liquid separation process, in which mass transfer of a solute from the liquid solution to a pure solid crystalline phase occurs.**
- Can occurs in
  - the freezing of water to form ice
  - the formation of snow particles from a vapour
  - the formation of solid particles from a liquid melt
  - the formation of solid crystals from a liquid solution

- Commercial crystallization (i.e. production of sugar, MSG, NaOH-home salt)
  - Yield and purity
  - Shape and size – uniform
    - Avoid caking
    - Ease of pouring
    - Ease in washing and filtering

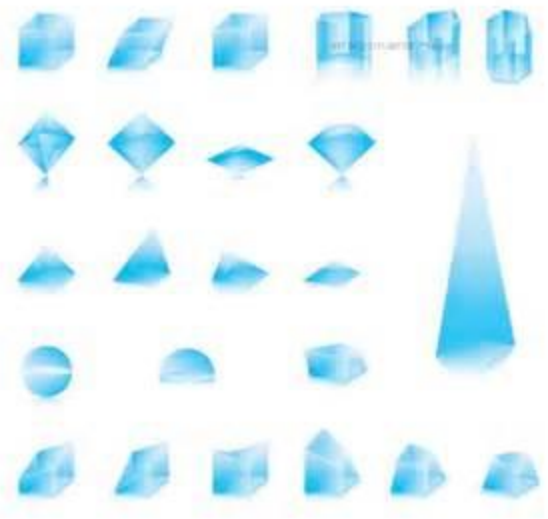
Types of Crystal Geometry

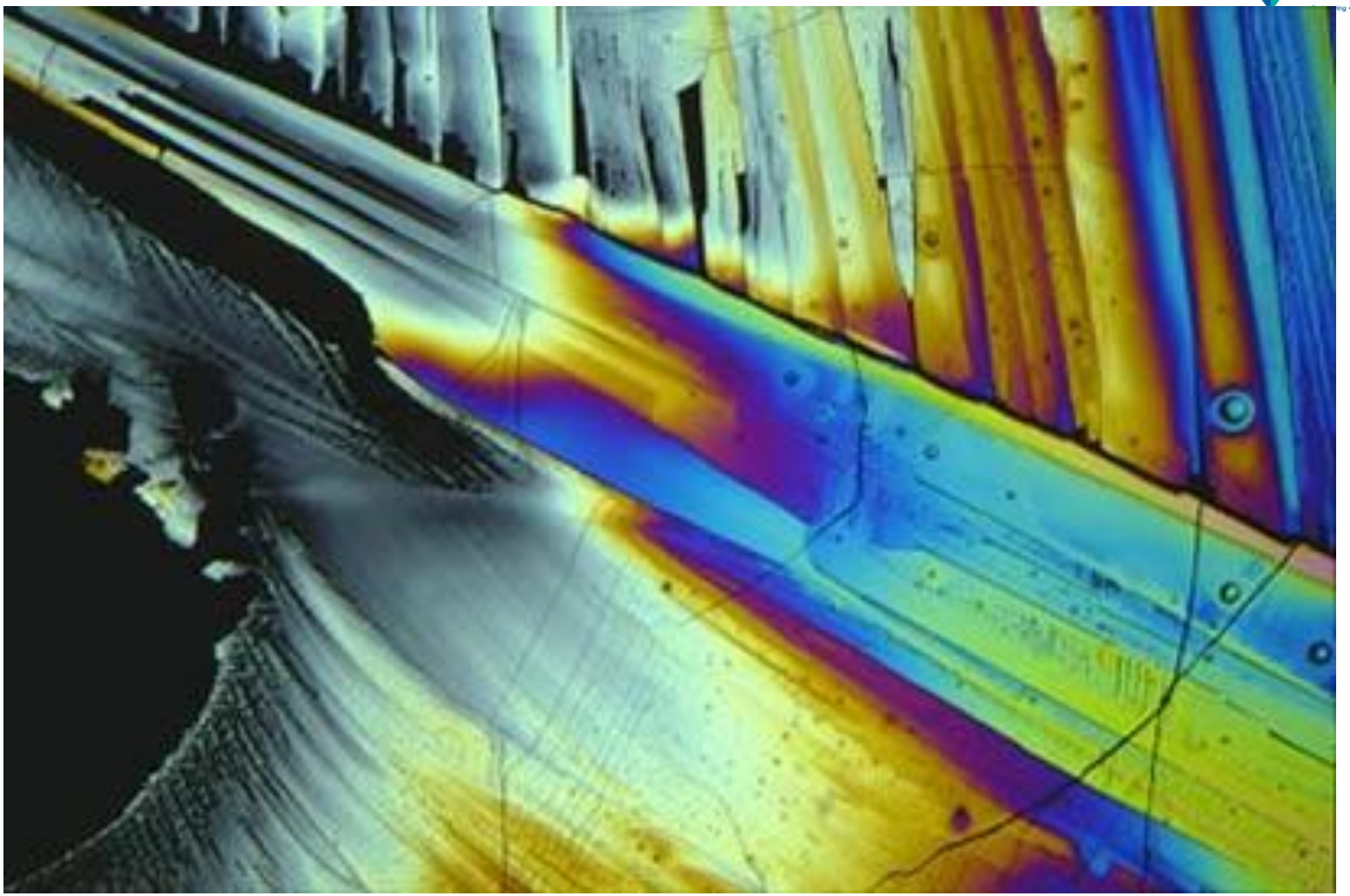
Crystal is a solid composed of atoms, ions, or molecules which are ***arranged in an orderly and repetitive manner***. It is a ***highly organised*** type of matter. The atoms, ions or molecules are located in 3D arrays or space lattices.

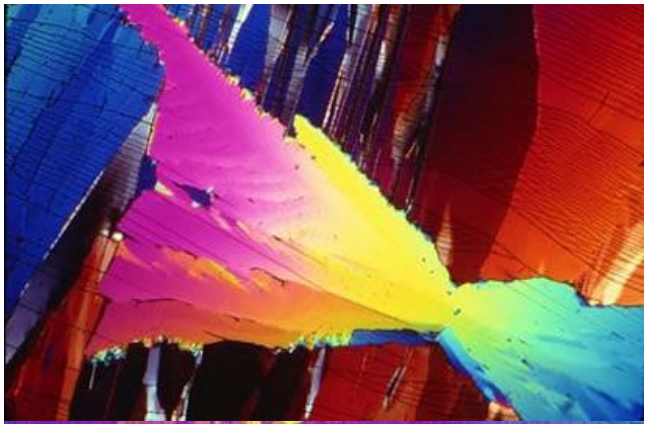
Crystals appear as ***polyhedrons*** having flat faces and sharp corners. The relative sizes of the faces and edges of different crystals of the same material may different greatly. However, the ***angles*** between the corresponding faces of all crystals of the same material are equal and are characteristic of that particular material. Therefore, crystals are classified on the basis of these interfacial angles.

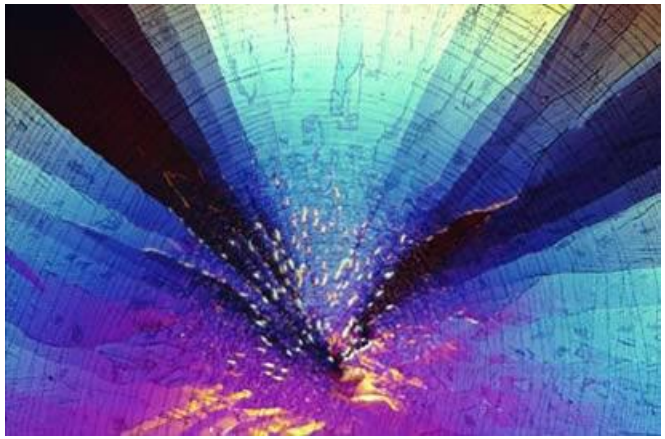
7 classes of crystals,

- Cubical system
- Tetragonal system
- Orthorhombic system
- Hexagonal system
- Monoclinic system
- Triclinic system
- Trigonal system

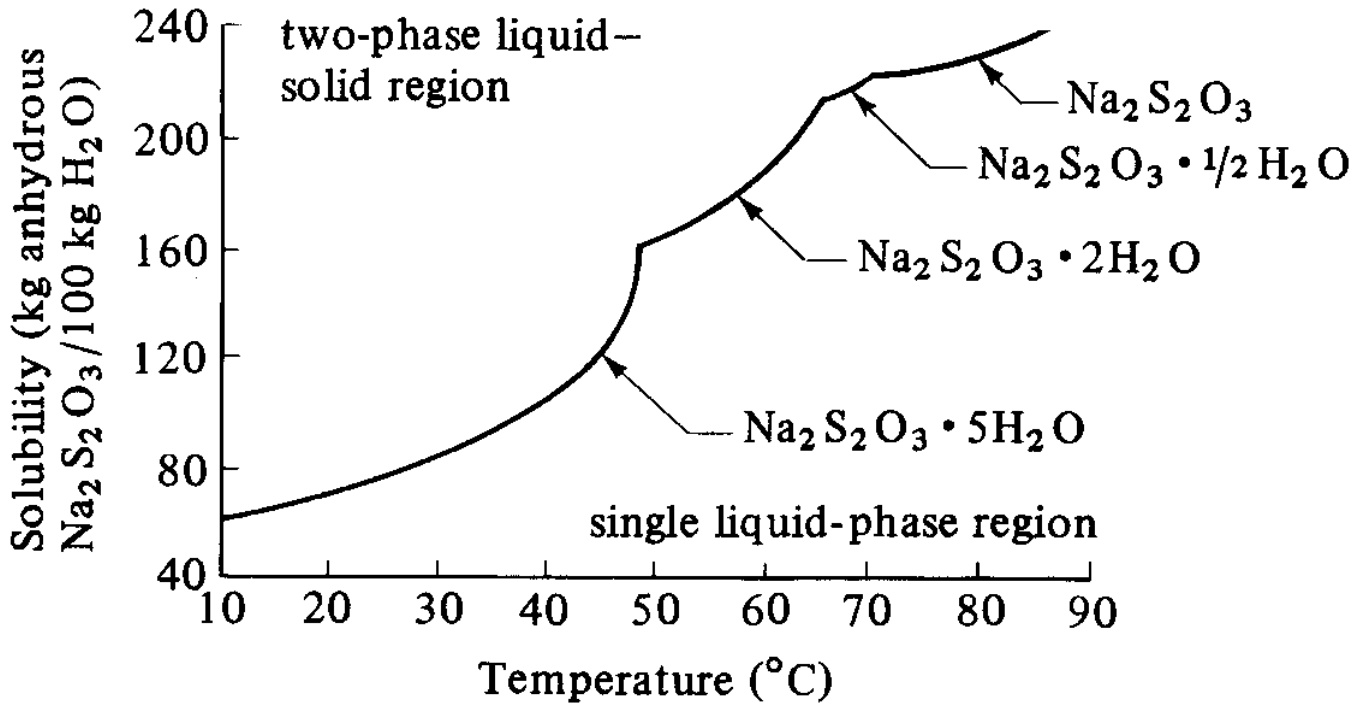








Yield and Heat and Material Balance in Crystallization



What happen to the solubility if temperature increases?

HEAT EFFECTS AND HEAT BALANCES IN CRYSTALLIZATION

❖When a compound whose solubility increases as the temperature increases dissolves , there is an absorption of heat , called the heat of solution.

❖ An evaluation of heat accurse when the compound dissolves whose solubility does not change with temperature , there is no heat evolution on dissolution .

❖In crystallization the opposite of dissolution occurs . At equilibrium the heat of crystallization is equal to the negative of the heat of solution at the same concentration in solution .

❖With many materials this heat of dilution is small compared with the heat of solution , and this approximation is reasonably accurate.

❖The most satisfactory method for the calculating heat effects during a crystallization process is to use the enthalpy-concentration chart for the solution and various solid phases which are present for the system.

❖Few charts are available for some materials and systems

❖The enthalpy H1 is kJ for the total feed , the enthalpy H2 of the final mixture of crystals and another liquor at the final temperature is also read off the chart.

❖If some evaporation accurse , the enthalpy Hv of the water vapor is obtained from the steam tables. Then the total heat absorbed q in kJ is

$$q = (H2 + Hv) - H1$$

If q is positive ……. Heat must be added to the system
If q is negative ……. Heat must be given off the system

Credit to the authors:
Syed Mohd Saufi, Assoc. Prof
Ahmad Ziad Sulaiman, Prof
Azilah Ajit
Hayder Bari, Prof
Rosli Mohd Yunus, Prof