FUNDAMENTALS OF AIR POLLUTION CONTROL

Air pollution control methods & equipment

- The industrial growth had made our life more comfortable
- The world has became smaller because of rapid transportation
- The growth of industries has another side of coin i.e. pollution
- We have to use same control methods to minimize the pollution

Dilution

- Accomplished by the use of tall stack
- It's Short term control & may cause highly considerable effects.
- For effective dilution

  $H = 74\ Q^{0.27}$

  H = Stack height

  Q = Particulate emission rate
- $H_{SO2} = 14\ Q^{1/3}$

  H = Stack height, m

  Q = SO_2 rate, kg/hr

Gravity settling

Absorption

- Natural Absorption process
  - Particulate or Gaseous
- Below cloud level
- Falling rain drops absorbs pollutants called as Washout or scavenging
- Does not remove particles less than 1µm in size.
- Gaseous pollutants removed in dissolved state with moisture with or without chemical changes.

Rain

Adsorption

- Prevention is Better than cure…..
- Try to minimize the WASTE at SOURCE
- It can be done by
  - Investigation of various approaches at early stage of process design & Development
  - Selection of method which do not contribute pollution
  - This methods are called as source correction methods….
  - Application of this methods are difficult in the existing plant, but still could be applied without severely upsetting the economy of the operation

Control of pollution at SOURCE

- Raw material changes
- Operational changes
- Modification or replacement of process equipment
- By more effective operation of existing equipment

Raw material changes

- If raw material is responsible for causing air pollution
  - Use of a purer grade of raw material
    - Reduce undesirable impurities & by-product
    - Eliminate treatment of effluent gas
  - Use of low sulfur fuel in place of higher ones
    - Limited availability of low sulfur fuel for wholesale use
    - Fuel desufurisation is an attractive alternative
  - Ore handling operation usually result in emission of large quantities of dust into atmosphere.

- In steel industries replacement of raw ore with pelleted ore has gradually reduced dust emission

Process change

- It involves new or modified techniques to lowering atmospheric pollutant emissions
- Radical changes in chemical & petroleum refining had minimized the material emission to atmosphere.
  - The volatile substance are recovered by condensation & the non-condensable gases are recycled for additional reaction

- Rotary kiln are major source of dust generation in cement plant.
- Some dust is controlled by adjusting operating conditions such as
  - reduction of gas velocities
  - modification of the rate
  - location of feed introduction

- Smelting & paper industries are major source of emission of sulphourous material
- It can be reduced by major process changes such as
  - hydro-metallurgical separation of ore
  - Avoiding use of sulphide in paper making

- Formation of nitric oxide in combustion chamber reduce by low excess air combustion by flue gas recirculation & water injection
- The fly ash emission from coal pulverization reduce by washing of coal before pulverization

Equipment modification or replacement

- In petroleum industries hydrocarbon vapors are released into atmosphere from storage tanks due to temperature changes, direct evaporation and displacement during filling.
- These can be minimized by designing tank with floating roof covers or by pressurizing the tanks.

- Replacement of open hearth furnace with oxygen furnace in steel industries
- Use of alternative power source for automobiles in place of internal combustion Engine.
- In addition to above three methods, air pollutant emission can be reduced by
  - proper equipment maintenance
  - housekeeping
  - changes in the design of local exhaust hood & proper installation

- Chemical plants have excessive leakage around ducts, piping, valves & pumps. Checking the seals routinely can prevent such leaks
- Floor, storage bins, loading areas & material transmitter conveyors must be kept clean to reduce dust pollution.