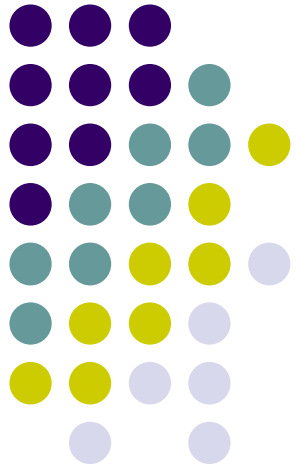
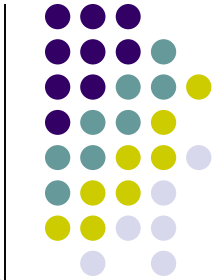
Atmospheric Analysis -Particulate-



• Introduction



– The types of particulate

1) Condensation products from natural combustion (forest fires, volcanoes)

2) Products of reaction of trace gases (NH_4Cl, sulphate and nitrate salts)

3) Material dispersed from earth's surface (salt spray from oceans, mineral dust)

4) Particulate material introduced by man (combustion and incineration etc)

-Many atmospheric rxn occur either on the surface of pm or in the liquid phase in water adsorbed on the surface of the pm

– Major transportation route ; dispersal of pollutants in the form of particulate

- Measurement ; total particulate concentration
  analytical composition (ex; metal
  particle size (transport, difference in physiological properties,
  distribution of chemical species)

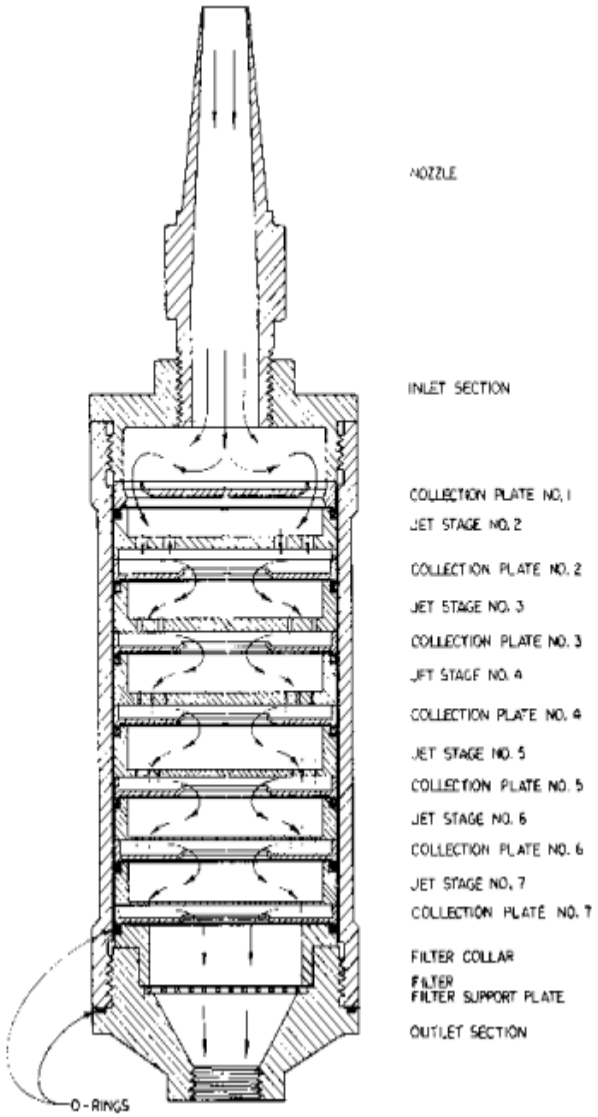
• Sampling methods

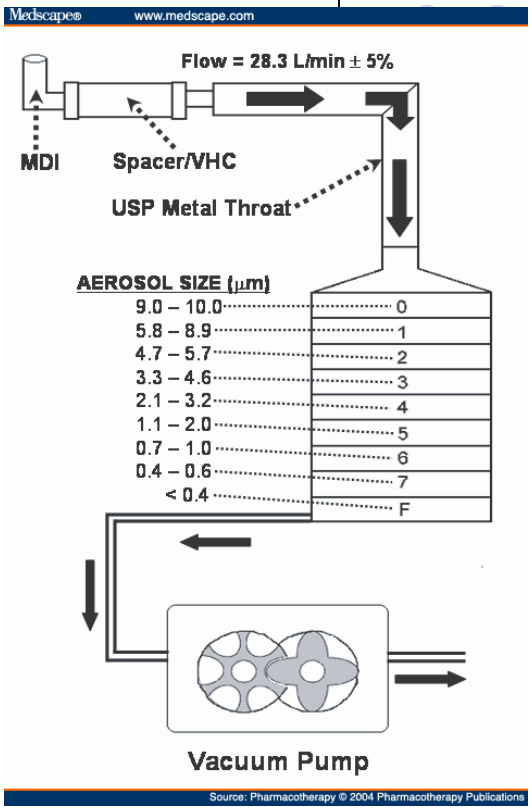
-High volume sampler ;
cellulose filter for metals and inorganics, glass-fibre filter for organics

-Personal sampler ; to measure total inhalable dust, clip to the lapel and pump around the waist

-Cascade impactor; to collect different size of dust (0.5 ~ 200 um)

- Organics ; filter for particulate, adsorbent for vapour phase components





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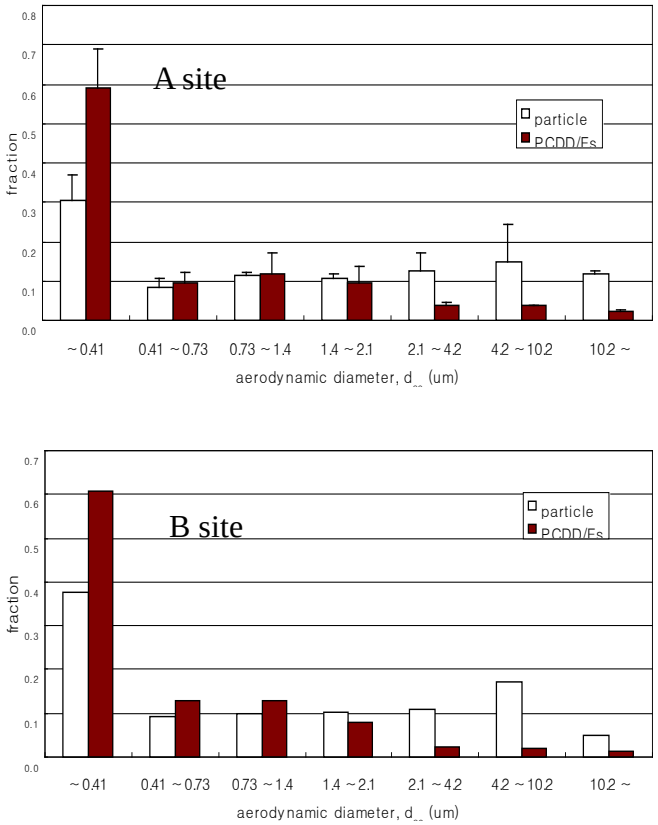
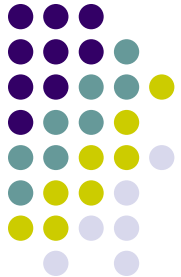


Figure 1. Distribution of particles (■) and PCDD/Fs (□) with respect to particle size

• Analytical methods involving sample dissolution



-Metals ; dissolution step is necessary

· normally used HF to dissolve silicates for unknown sample composition

· dilute acid, mild oxidising agents or even water can be used for dissolution

- SCOPE procedure (HF, HNO3)
- UK methods (nitric acid/hydrogen peroxide)

· Atomic Absorption spectrometry, UV/VIS spectrometry for instrumental analysis

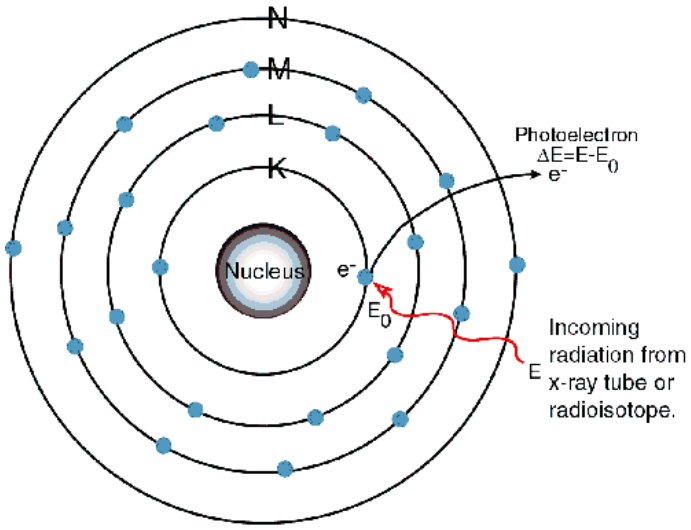
-Organic compounds ;

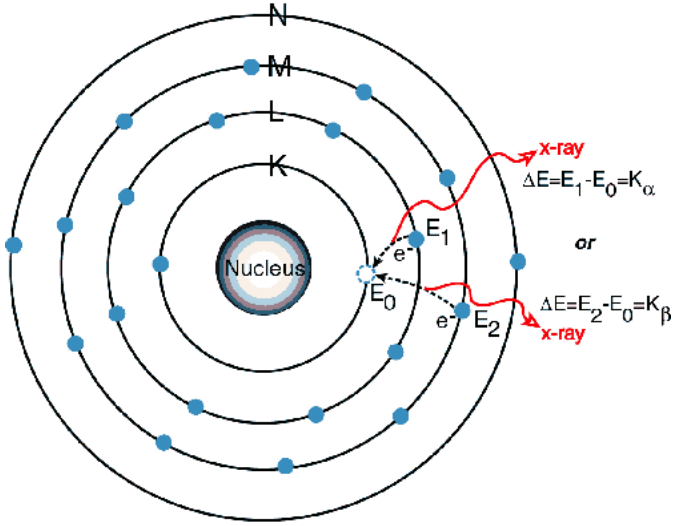
analysis of total organic carbon
or mass loss after extraction with an organic solvent
extract ; use various instruments in part 4

• Direct analysis of solid

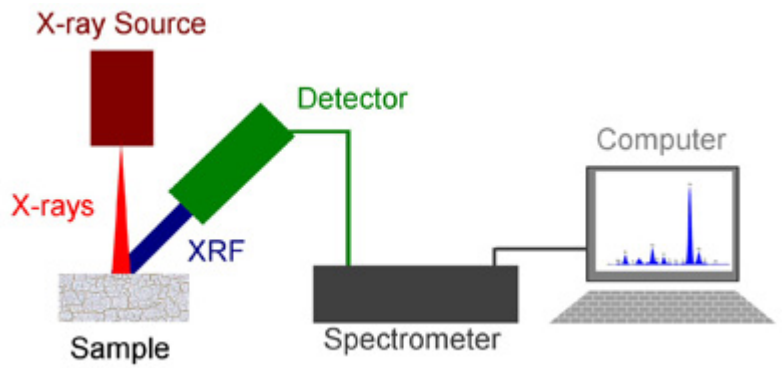
1) X-ray fluorescence

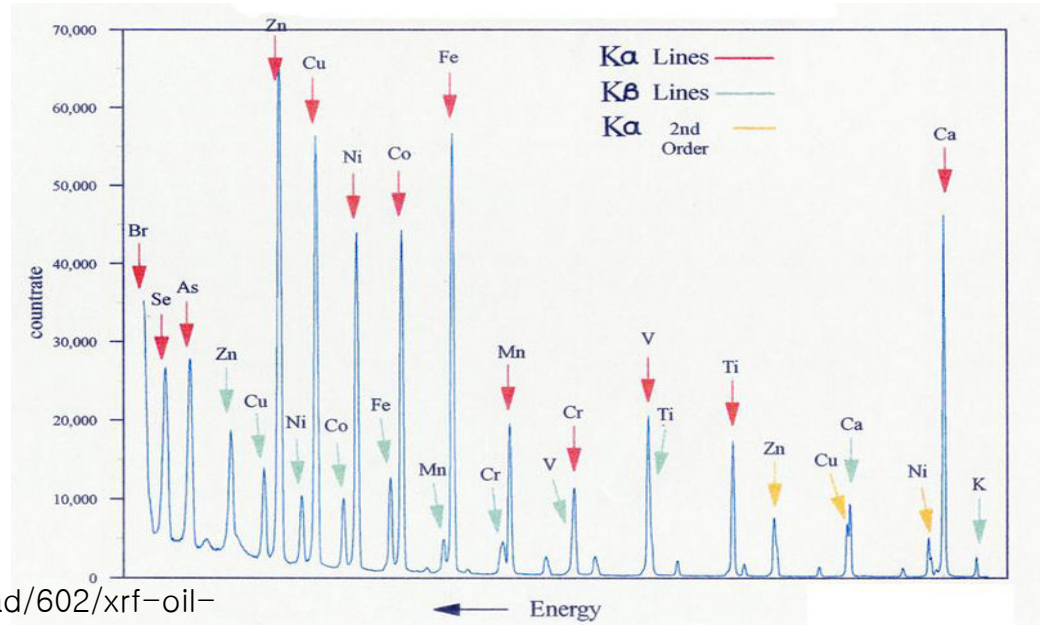
-Based on irradiation of an atom with x-ray leads to the ejection of an electron from inner shell→ outer shell electrons cascade to the inner shell to fill the vacancy, emitting x-rays. → wavelength of this radiation is related with atomic number (1/λ = kz)
intensity is proportional to the concentration of elements





http://www.amptek.com/xrf.html





http://www.machinerylubrication.com/Read/602/xrf-oil-analysis

http://www.horiba.com/scientific/products/x-ray-fluorescence-analysis/tutorial/xrf-spectroscopy/

2) X-ray Emission

- The bombardment of sample with fast electrons causes excitation of inner shell electron → decay back to the ground state → X-ray emission

3) Neutron Activation Analysis

- Irradiation with neutrons → produce radionuclides of the elements of interest → emits gamma rays from radioactive nucleus decay → intensity is related with concentration

• Asbestos analysis

-Asbestos ; any one of group of fibrous silicate minerals

- Microscopic analysis ; collect PM by filtration → preparation of microscope slide → count fibres (number of fibres per millilitre of air)

• Disadvantage of solid state analytical techniques

1) Difficult to prepare sample and calibration sample

2) Small amounts has to be representative of the whole

3) Some methods only respond to the first few layers of atoms (ex ; XRF)
X-ray ; matrix effect

4) Need highly specialized spectrometers