Group 16 (6) called "**chalcogens**" ("brass giver ")

O $O_2(g)$ – Colourless, tasteless, odourless gas. Mp -183°C – paramagnetic .

$O_{3(g)}$ – ozone, blue gas, fresh smell. Mp -111°C

S :Yellow powder

- tasteless and odourless. Commonest allotrope is rhombic sulphur .

Takes form of S_8 rings in rhombic sulfur.

Allotropes depend on ring stacking.

- Example of catenation in polysulfanes $HS\text{-}S_x\text{-}SH$ where x =0 to 6.

Se: Grey non-metallic solid, poor electrical conductor, several allotropes consisting of chains. Se_8 red solid .

Te : Silver –white metalloid .

Po : Grey metalloid which is obtained from U and Th .

Sulfur :

Source from sulfide ores e.g. FeS_2 (fool's gold), mined by the "Frasch process" but also obtained from H_2S which occurs in oil by "Claus process".

Claus Process :

$H_2S_{(g)} + O_{2(g)} \rightarrow SO_{2(g)} + 2H_2O_{(g)}$

$2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(l)}$

Use : To strengthen rubber, a process called "vulcanisation". Also to produce H_2SO_4 by the "**Contact Process**" which has 3 steps

1) $2SO_2(g) + O_{2(g)} \rightarrow 2SO_{3(g)}$

2) $2SO_{3(g)} + H_2O_{(l)} \rightarrow H_2S_2O_{7(l)}$ (Oleum).

3) $H_2S_2O_{7(l)} + H_2O_{(l)} \rightarrow 2\ H_2SO_{4(l)}$.

Dihydrogen sulfate is an oily liquid with boiling point 300°C.

Bronsted acid : - almost completely dissociated in water .

Good oxidising agent :

$Cu_{(s)} + H_2SO_{4\ (aq)}$ (conc.) $\rightarrow$ $CuSO_{4(aq)} + SO_{2(g)} + H_2O$.

Dehydration agent: $C_{12}H_{22}O_{11(s)} \rightarrow$ conc. $H_2SO_4 \rightarrow 12C_{(s)} + 11H_2O_{(l)}$

Uses include the manufacture of ammonium sulfate – for use as a fertiliser, petrochemicals, dyestuffs, detergents .

Sulfur compounds containing oxygen :

$SO_{2(g)}$ odourless poisonous gas, 84% occurs naturally – volcanic combustion, oxidation of $H_2S_{(g)}$ – vegetation.

16% from industry – oil and coal combustion.

SO_2 is the acid anhydride of H_2SO_3 "sulfurous acid". Actually "H_2SO_3" on cooling exists as $SO_2.xH_2O$ (x = 7), this is an example of a *clathrate*

H_2SO_3 is a source of SO_3^{2-} .

These ions can act as oxidising agents e.g $SO_3^{2-}{}_{(aq)} + S_{(s)} \rightarrow S_2O_3^{2-}{}_{(aq)}$

(thiosulfate)

Group 17 (7)

Halogens ("salt making "):

F (fluorine), Cl (chlorine), Br (bromine), I(Iodine), At (astatine).

Properties

Decreasing going down the group:

electronegativity, electron affinity (diatomic molecules), oxidising ability

Increasing down the group:

Mp/Bp (London forces depend on number of electrons), atomic /ionic radii, metallic character .

They have an electron configuration ns^2np^5 - all require one electron for a complete stable octet.

The normal form of these elements is as diatomic molecules.

Interhalogen compounds occur when the gases react with each other. The stiochiometry depends on the relative sizes of the components e.g IF_7 , IBr

(note that IF_7 disobeys octet rule).