## OXIDES:

- VI group elements form two types of oxides, dioxides of the type $MO_2$ and trioxides of the type $MO_3$.

  **Dioxides :**

- $O_3$ may be treated as **Oxygen dioxide ($OO_2$).**
- Dioxides can be prepared directly by burning the elements in air

  Ex . $S + O_2 \rightarrow SO_2$
- $SO_2$ can also be prepared by heating metal sulphides (sulphide ores) in air.

  $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

  $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
- $SO_2$ is highly soluble in water and forms hydrated $SO_2$
- $SO_2$ can be condensed to liquid which is used as a solvent.
- $SO_2$ acts as a **lewis base** due to presence of lone pairs of electrons.
- $SO_2$ acts as a **reducing agent** in both in acid and in alkaline medium.
- $SO_2$ reduces $K_2Cr_2O_7$ in to chromium sulphate

  $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow K_2SO_4 + Cr_2(SO_4) + H_2O$
- $SO_2$ acts as a **bleaching agent** in the presence of moisture.
- The bleaching action of $SO_2$ is due to **reduction.**

  $SO_2 + 2\,H_2O \rightarrow H_2SO_4 + 2\,(H)$
- During bleaching $SO_2$ will be oxidised to $H_2SO_4$
- Coloured matter + 2(H) $\rightarrow$ Colourless product
- $SO_2$ bleaching is temporary bleaching
- Acidic nature decreases from $SO_2$ to $PoO_2$.
- Trioxides are more acidic than corresponding dioxides.

  **Trioxides :**
- Sulphur trioxide can be prepared by reacting $SO_2$ and $O_2$ in the presence of catalyst like Pt or $V_2O_5$ or $NOSO_3$.

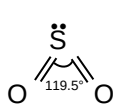
  $2SO_2 + O_2 \xrightarrow{\text{Catalyst}} 2SO_3$ ?H = –196 kJ
- $SO_3$ is the anhydride of $H_2SO_4$

  $SO_3 + H_2O \rightarrow H_2SO_4$.
- It is called **Sulphuric anhydride.**
- $SO_2$ is angular in shape.
- Sulphur in $SO_2$ is in $sp^2$ hybridisation .
- Number of pairs = $\frac{6+0}{2}$ =3 (2BP + 1LP)
- Sulphur atom is in double bonds with oxygen atoms.
- One oxygen of $SO_2$ form a **pπ - pπ bond** and another oxygen atom form pπ - dπ bond

with sulphur atom.

- The structure of $SO_2$ is a resonance hybride of two structures

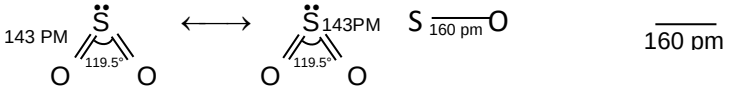
  Shape : Angular ; Hybridisation : $sp^2$ ; bond angle is less than 120° (119.5°) ≠0. (dipole moment is not zero)




$2\sigma$, 2bonds $\begin{bmatrix} 1\pi - p\pi - d\pi \\ 1\pi - p\pi - p\pi \end{bmatrix}$

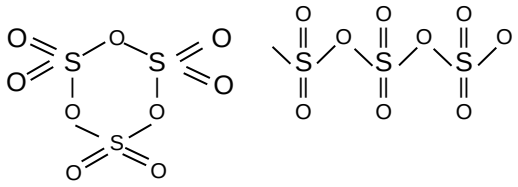
excited :$3s^2\ 3p^4$

$3s^2\ 3p^3\ 3d^1$




- $SO_3$ has planar triangular structure

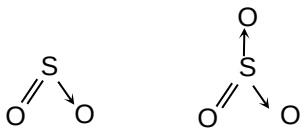
  In solid state : (polymeric structure) cyclic () or chain(or )




Cyclic form Chain form( - form)

In aqueous state $SO_3$ exists as [$SO_4^{2-}$ - tetrahedral]

**$SO_2$ :** **$SO_3$ :**




**Oxyacids**

| 'Ous' acids | 'ic' acids |
|---|---|
| $MO_2 + H_2O \rightarrow$ ous acids | $MO_3 + H_2O \rightarrow$ ic acids |
| $H_2SO_3$ | $H_2SO_4$ |
| $H_2SeO_3$ | $H_2SeO_4$ |
| $H_2TeO_3$ | $H_2TeO_4$ |

- Acidic nature – decreases for sulphur oxyacids to tellurium oxyacids

- – ic acids > – ous acids
- – ous acids and their salts act as reducing agents
- – ic acids and their salts act as oxidising agents

**Acidic nature :**

$H_2SO_3 > H_2SeO_3 > H_2TeO_3$

$H_2SO_4 > H_2SeO_4 > H_2TeO_4$