



*Controlling Emissions of SO<sub>x</sub>  
and NO<sub>x</sub> from power plants*

*By: Ben Bernardo*

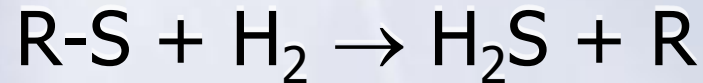


## *Main Control Technologies for SO<sub>x</sub>*

- ❖ Remove the sulfur from the fuel before it is burned
- ❖ Remove the SO<sub>2</sub> from the exhaust gases

# *Sulfur Removal*

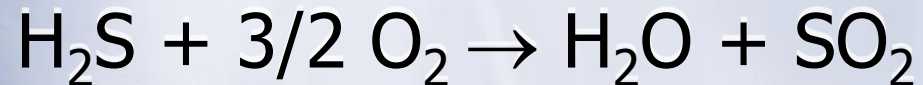
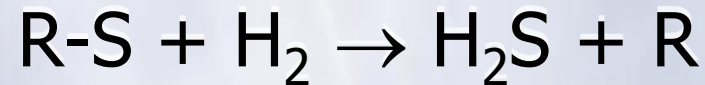
- ✧ Sulfur is removed from crude oil by the catalytic reaction:



- ✧ Until the mid 1970's the H<sub>2</sub>S was mixed back into the fuel gas.
- ✧ The problem with this is that the H<sub>2</sub>S is burned in fuel producing SO<sub>2</sub>, but at a different stage



# *Claus Process*



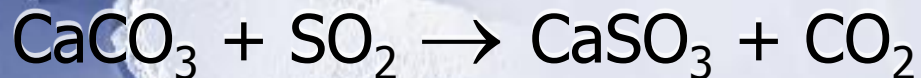
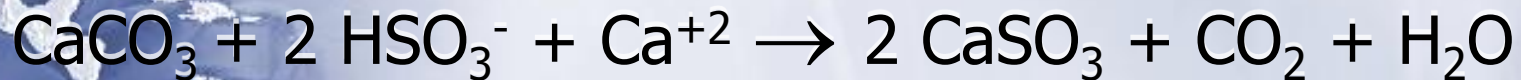
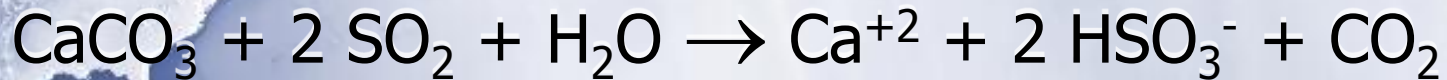
✧ The elemental sulfur is then sold and the emissions of  $\text{SO}_2$  and  $\text{H}_2\text{S}$  are reduced drastically



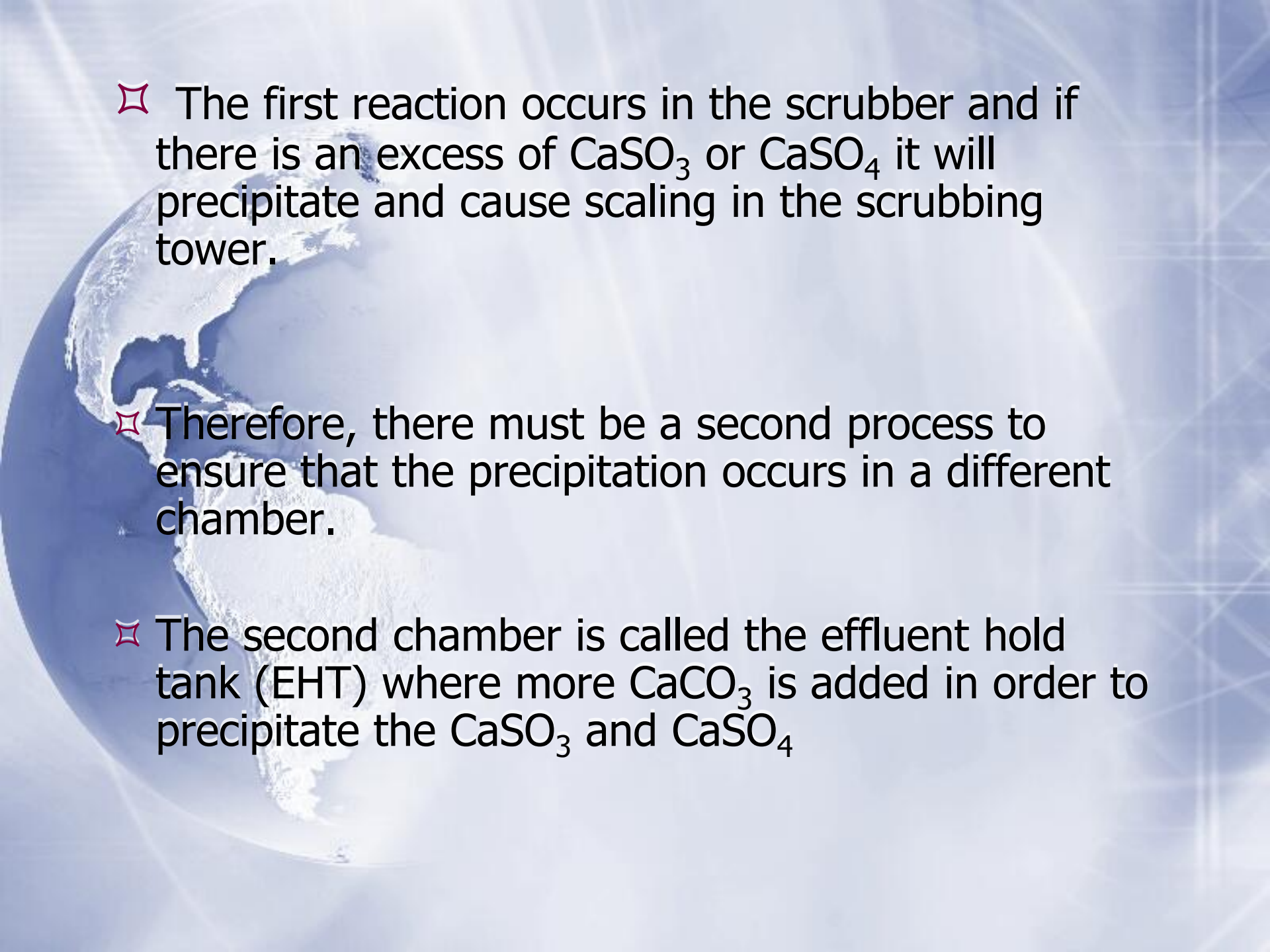
# *Limestone Scrubbing*

- ✧ Most widely used because it is very cost effective
- ✧ Current efficiency of 98 - 99% removal of SO<sub>2</sub> compared to 88 - 90% in the 1980's

# *Limestone Scrubbing Chem*

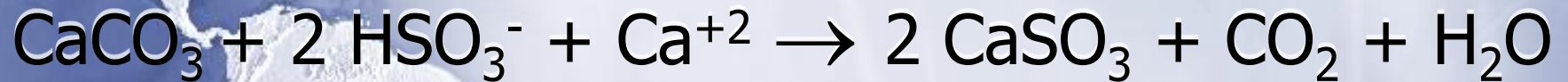


- ✧ This is a two step process including the scrubber and the effluent hold tank.
- ✧  $\text{CaSO}_4$  (gypsum) is also formed by the oxidation of  $\text{CaSO}_3$

- 
- ✧ The first reaction occurs in the scrubber and if there is an excess of  $\text{CaSO}_3$  or  $\text{CaSO}_4$  it will precipitate and cause scaling in the scrubbing tower.
  - ✧ Therefore, there must be a second process to ensure that the precipitation occurs in a different chamber.
  - ✧ The second chamber is called the effluent hold tank (EHT) where more  $\text{CaCO}_3$  is added in order to precipitate the  $\text{CaSO}_3$  and  $\text{CaSO}_4$



# *Limestone Scrubbing Chem*



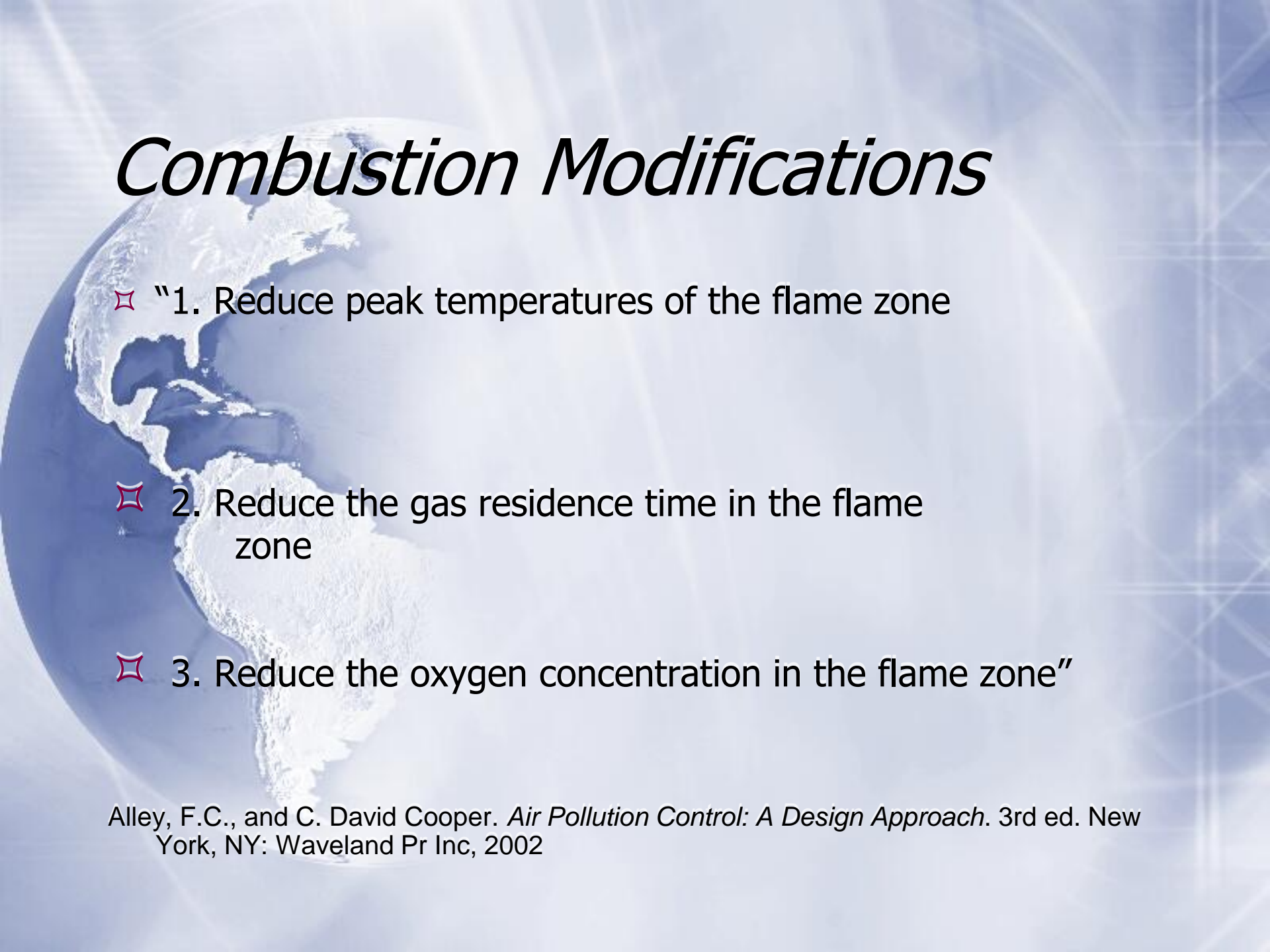




# *Main Control Technologies for NO<sub>x</sub>*

✧ Combustion Modification

✧ Flue Gas treatment



# *Combustion Modifications*

- ✧ "1. Reduce peak temperatures of the flame zone
  
- ✧ 2. Reduce the gas residence time in the flame zone
  
- ✧ 3. Reduce the oxygen concentration in the flame zone"

# *Flue Gas Treatment*

## ✧ Selective Catalytic Reduction (SCR)



✧ SCR's are usually 80% efficient in reducing NO<sub>x</sub>

✧ Operates at temperatures from 300 to 400 C

# *Flue Gas Treatment Contd.*

## Selective Noncatalytic Reduction (SNR)

- ✧ Operates at 900 to 1000 C
- ✧  $\text{NH}_3$  at this high temperature will reduce the  $\text{NO}_x$  into  $\text{N}_2$  without a catalyst
- ✧ Only around 40 - 60% reduction in  $\text{NO}_x$
- ✧ More cost effective than SCR's if only 40 to 60% reduction is needed

*Questions?*

