



# SO<sub>3</sub> Injector Fouling Causes and Solutions

Michael Vukmir  
Regional Manager, Environmental Field Services  
Chemithon Corporation

# Presentation Topics

---

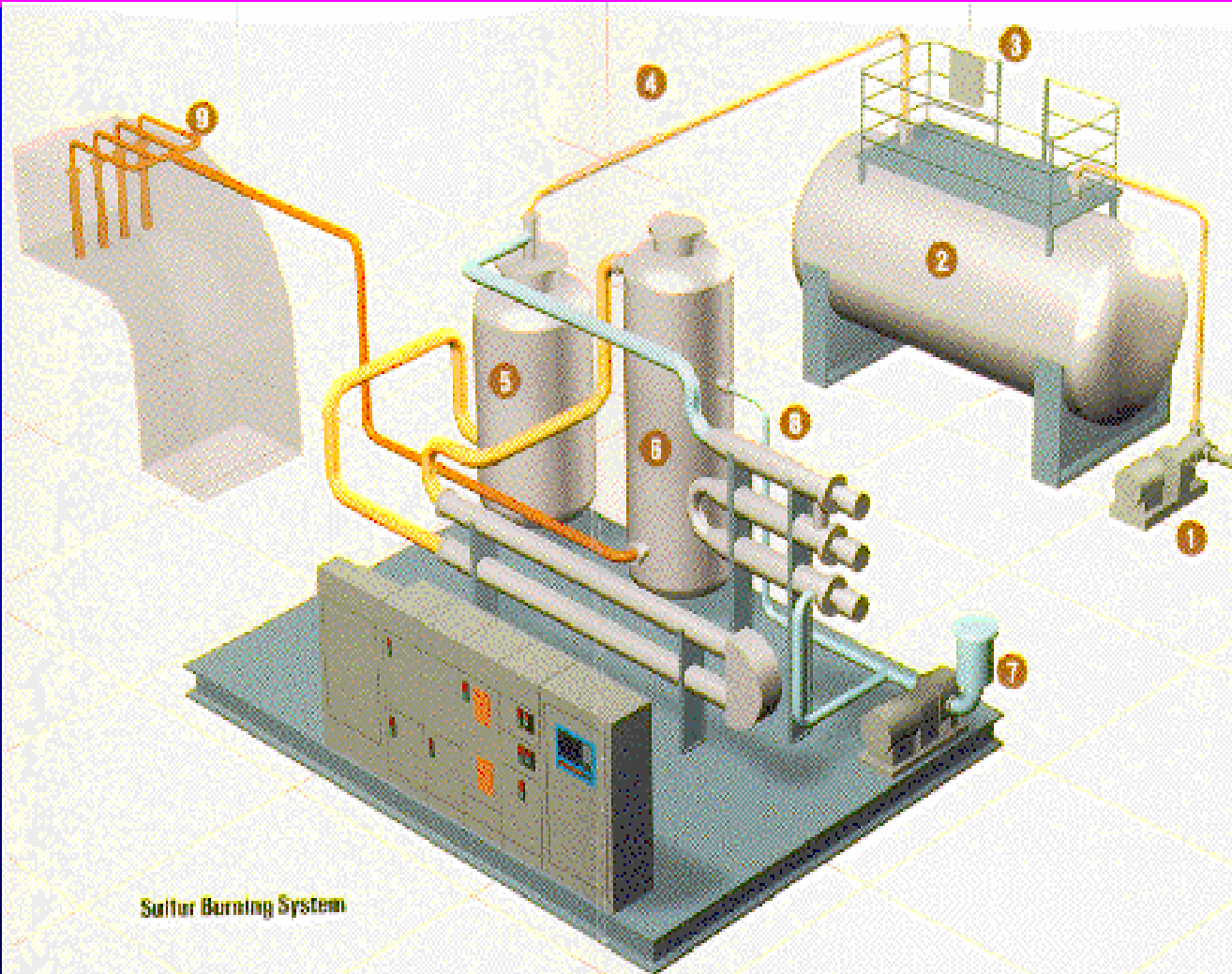
- ◆ SO<sub>3</sub> overview
- ◆ Typical SO<sub>3</sub> system
- ◆ Preventing SO<sub>3</sub> injector fouling

# SO<sub>3</sub> Conditioning Overview

---

- ◆ Sulfur is burned to form SO<sub>2</sub> which is then converted to SO<sub>3</sub> and injected into the flue gas stream
- ◆ H<sub>2</sub>O in flue gas stream combines with SO<sub>3</sub> to form H<sub>2</sub>SO<sub>4</sub> (sulfuric acid) mist in flue gas
- ◆ Sulfuric acid condenses on fly ash reducing resistivity
- ◆ Increasing collection efficiency of the ESP

# Typical SO<sub>3</sub> System



- 1 Unloading Pump
- 2 Storage Tank
- 3 Metering Pump
- 4 Liquid Sulfur at 135°C
- 5 Sulfur Burner
- 6 Multi-Stage Converter
- 7 Air Blower
- 8 Air Heater
- 9 SO<sub>3</sub>/Air at 475°C

Sulfur Burning System

# Prevention of Fouling

---

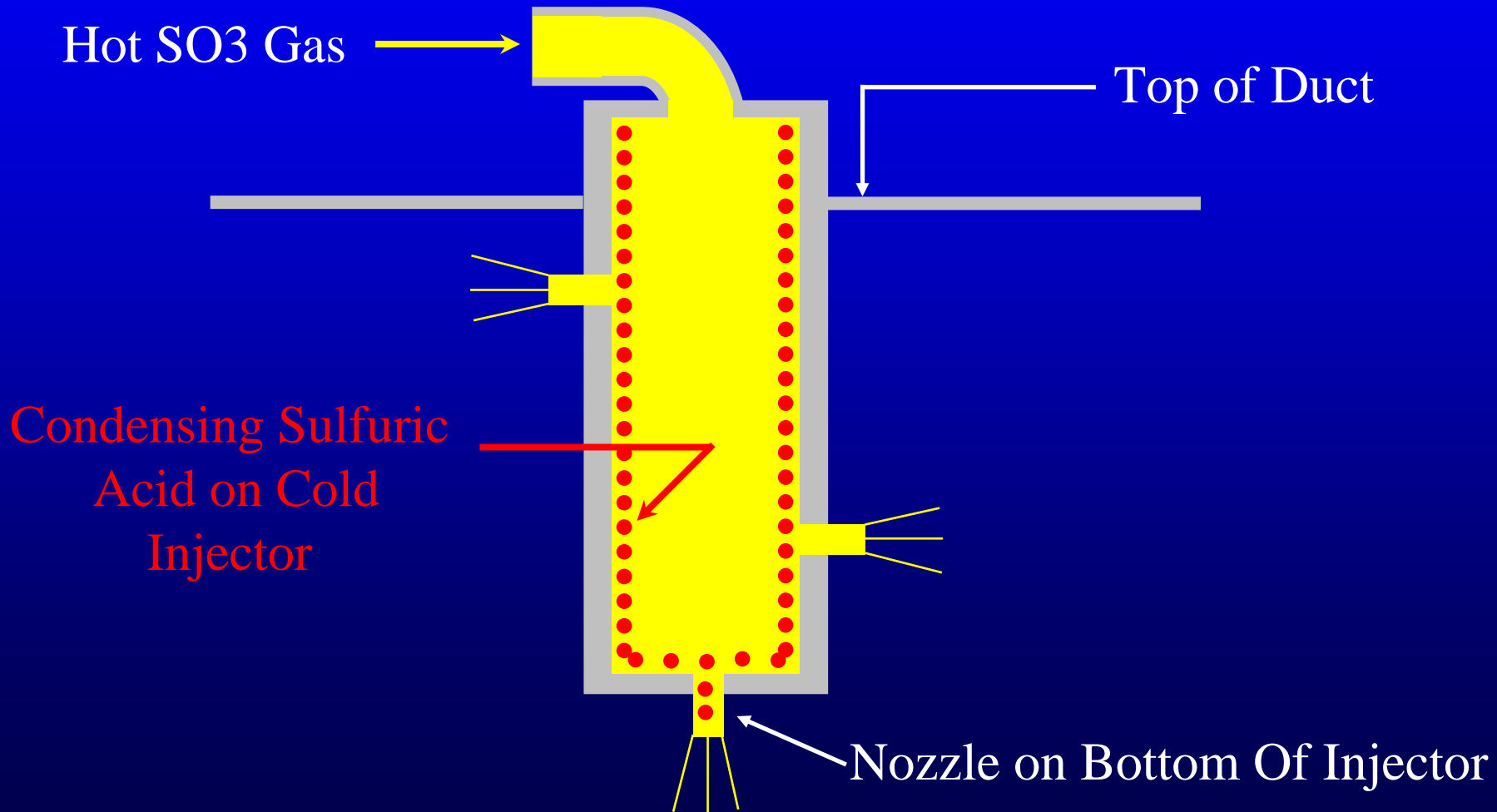
- ◆ Orientation of probes in duct work
- ◆ Operational methods
- ◆ Equipment tuning
- ◆ Maintenance

# Injector Installations

---

- ◆ Vertical from top of duct
- ◆ Horizontal from sides of duct
- ◆ Vertical from bottom of duct

# Vertical From Top



# Vertical From Top

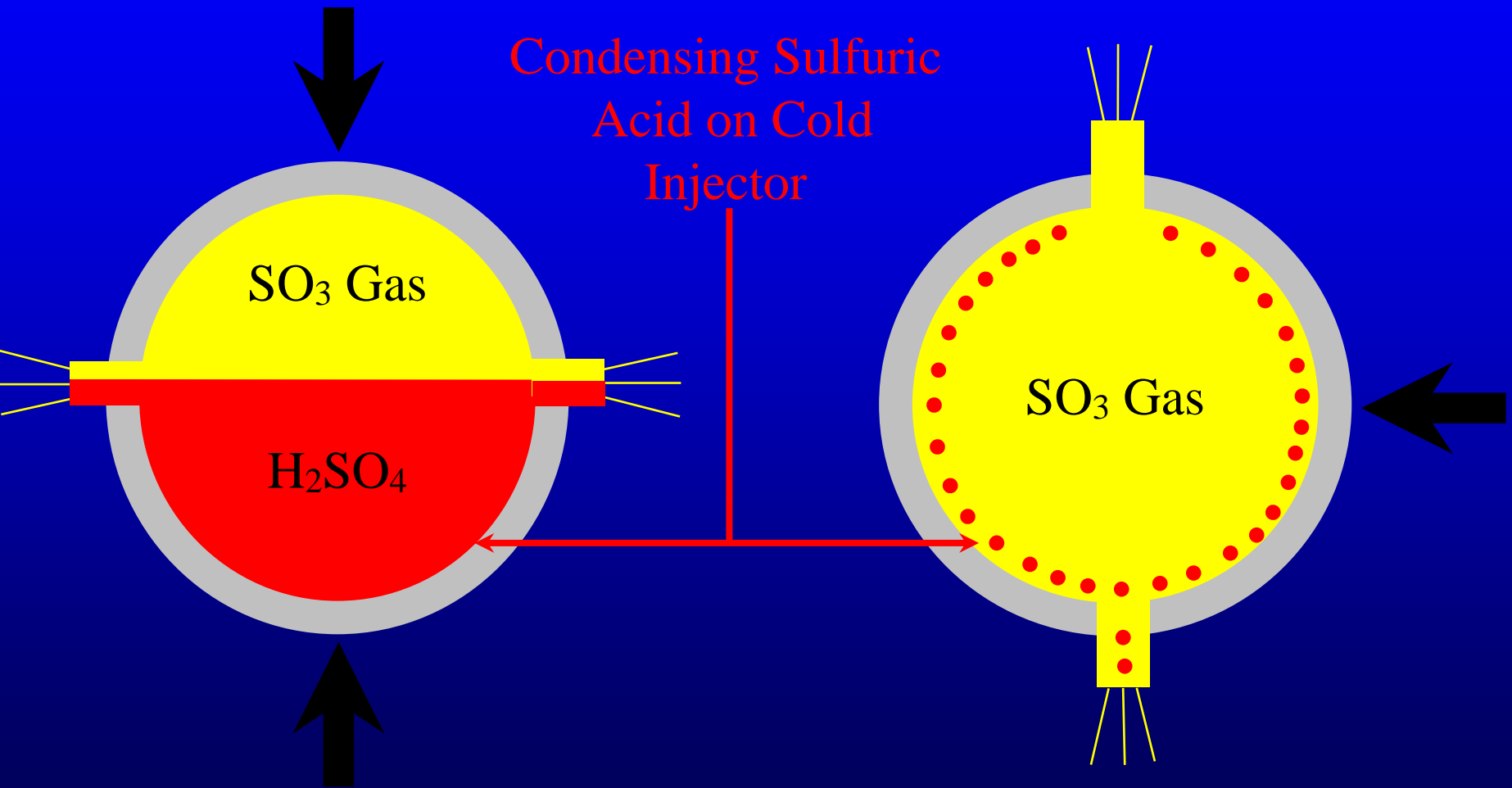
---

- ◆ Clean and well drained

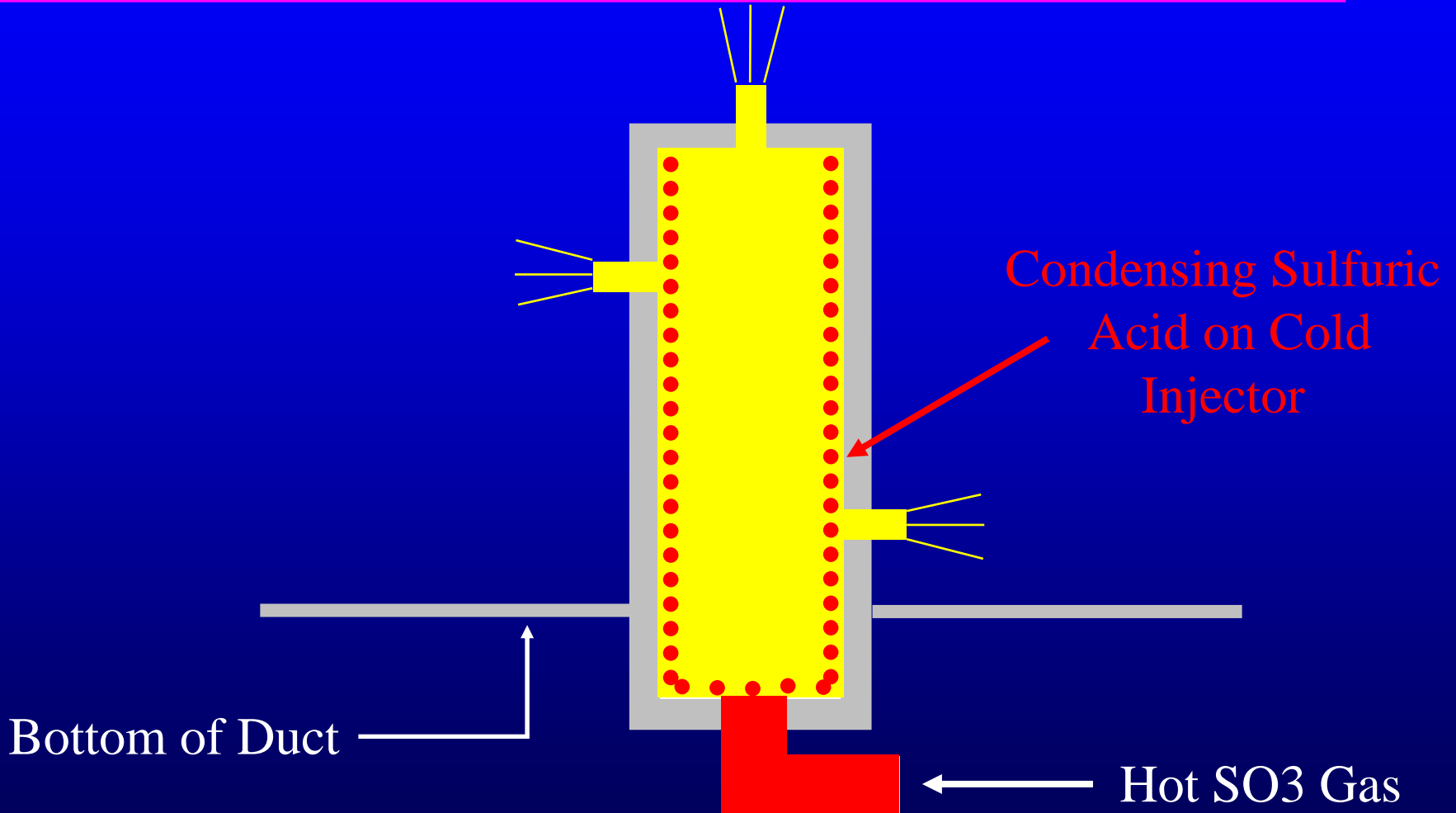




# Horizontal Injectors



# Bottom Injectors



# Bottom Injector Installation Piping

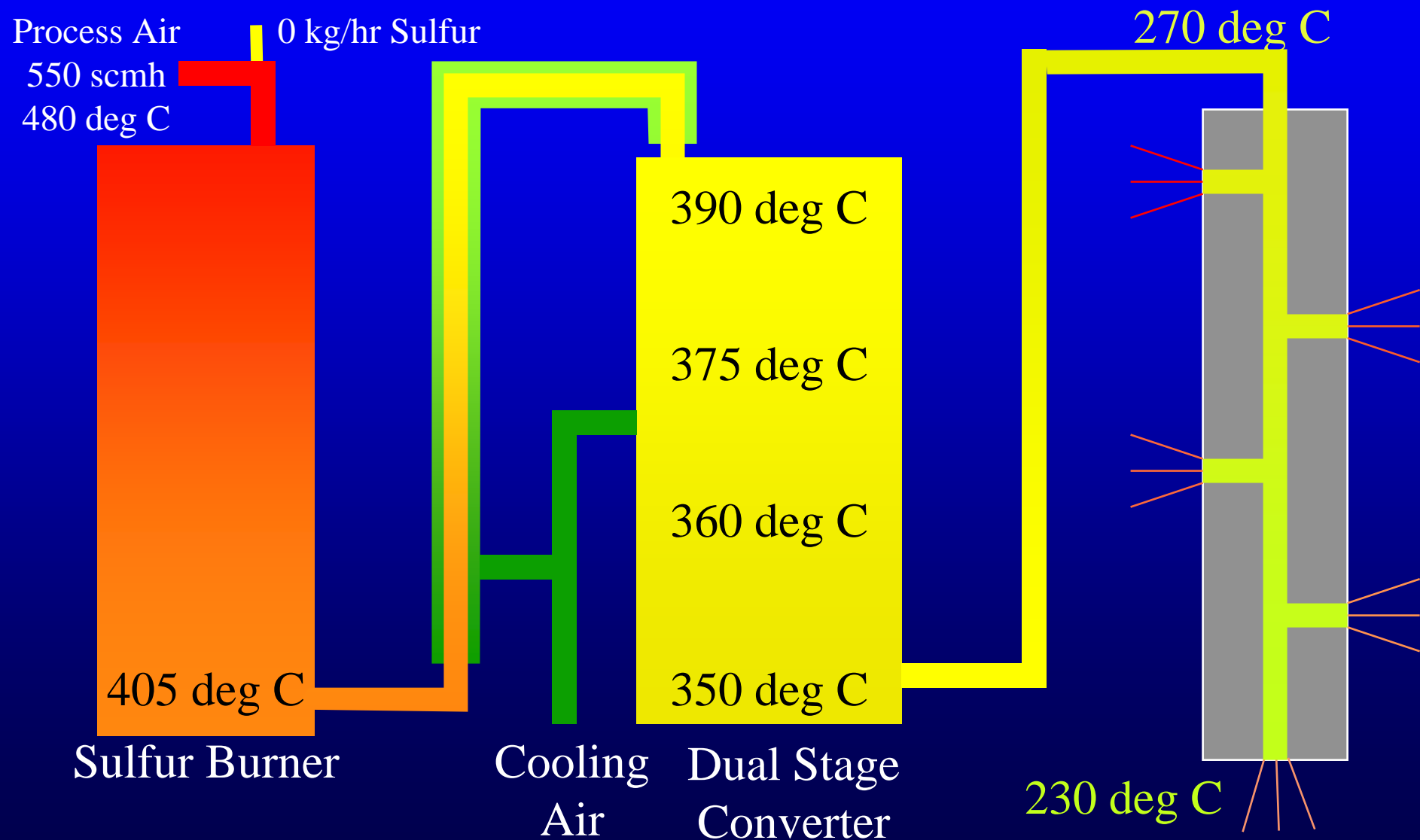
---



# Bottom Injector Installation in Duct



# Start-up Temperature Profile



# Low Treat Rate Temperature Profile

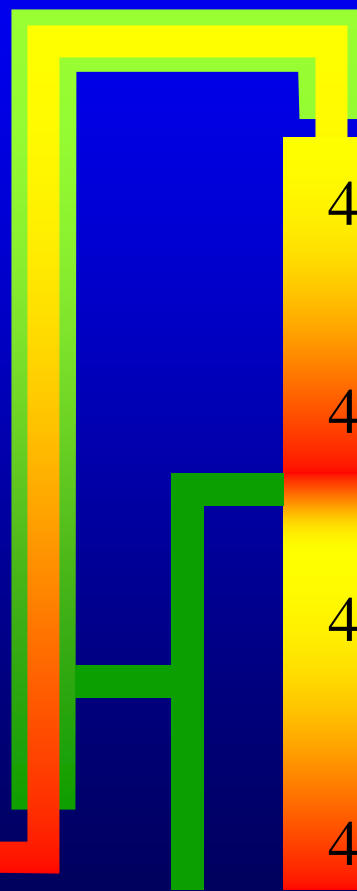


Process Air  
550 scmh  
400 deg C

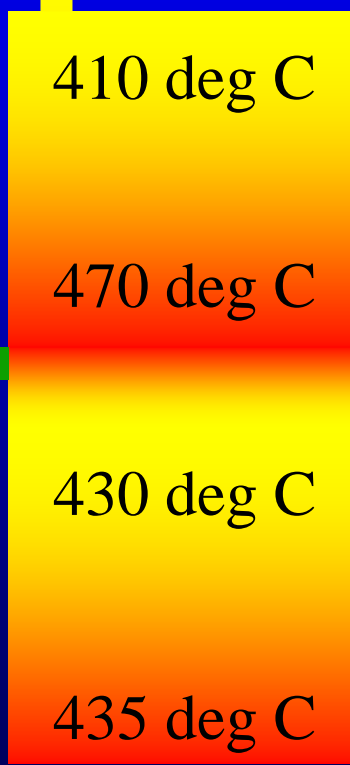
10 kg/hr Sulfur



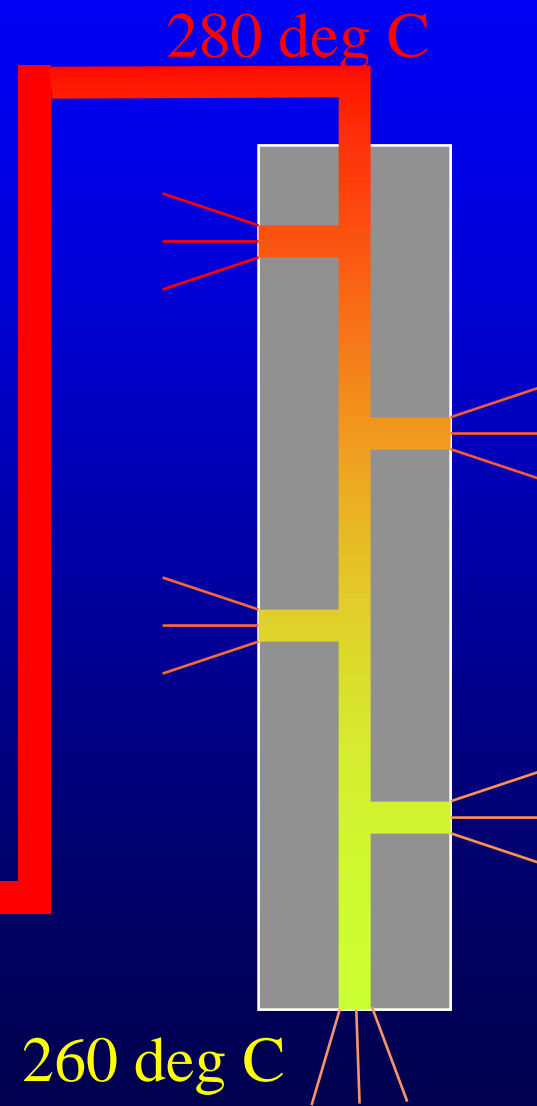
Sulfur Burner



Cooling  
Air



Dual Stage  
Converter



260 deg C

280 deg C

410 deg C

470 deg C

430 deg C

435 deg C

# Low Temperature Problems

---

- ◆ A sulfur burn rate of 40 kg/hr together with the moisture in atmospheric air has the capacity to form 82 kg/hr of sulfuric acid at injectors if dew point is reached

# Low Temperature Operation

---

- ◆ Sulfuric acid formation on injector





# Low Temperature Operation

---

- ◆ Destruction of nozzle



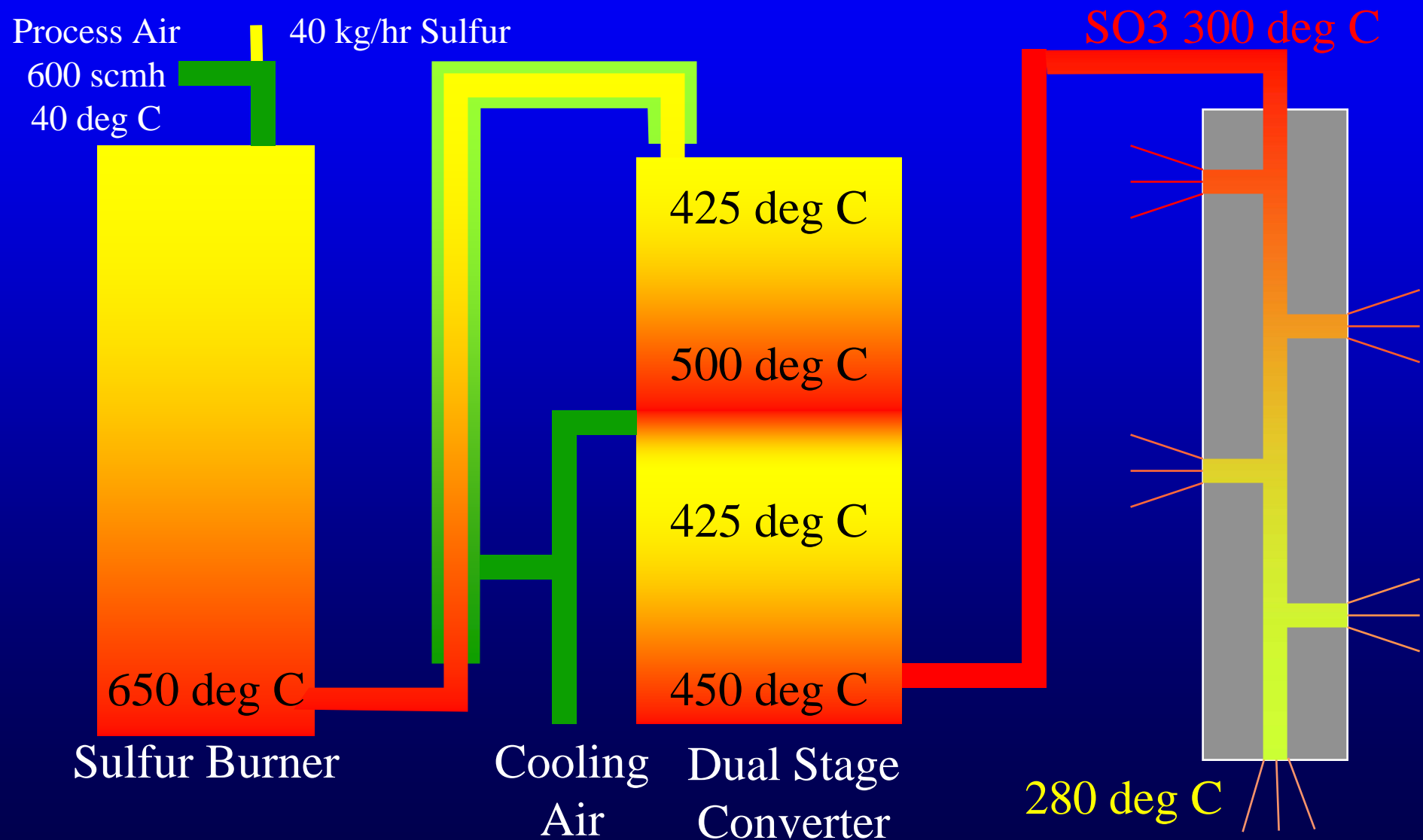
# Low Temperature Operation

---

- ◆ Plugging of nozzle



# Ideal Temperature Profile



# Ideal Temperature

---

- ◆ Clean open nozzles



# Power Plant Operation

---

- ◆ Start  $\text{SO}_3$  system as soon as FD or ID fans are put in operation
  - Prevents dust from entering injector
  - Allows  $\text{SO}_3$  system time to reach operating temperature prior to ESP requiring  $\text{SO}_3$  treatment to reduce opacity
- ◆ If two shifting leave  $\text{SO}_3$  system in hold at 480 deg C to keep injectors hot

# Shutting Down System

---

- ◆ Stop burning sulfur and allow ample time to purge gases from system
  - Most systems have purge mode
    - » Keeps system hot to prevent formation of acid
    - » Keeps air flowing to purge residual SO<sub>3</sub> from system
- ◆ Keep system in standby mode if ID or FD fans are operational
  - Prevents dust from entering injectors

# Maintenance

---

- ◆ SO<sub>3</sub> gas generating skid
  - Heater operation
  - Insulation of converter vessel
- ◆ Sulfur storage and piping
  - Steam leaks into sulfur
    - » Sulfur Tank
    - » Sulfur Piping



# Maintenance

---

- ◆ SO<sub>3</sub> gas piping insulation





# Conclusions

---

- ◆ Fouling of injectors can be minimized or prevented by
  - Proper installation of system
  - Operation guidelines
  - System tuning
  - Maintenance