REINHOLD ENVIRONMENTAL Ltd.

2011 APC Round Table
& Expo Presentation

July 11-12, 2011, in Cleveland, OH / Hosted by FirstEnergy

Air Pollution Control Panel

Round Table Panel Discussion:

This panel will discuss the impact of the newly proposed HAPS rule on unit operation, condensable (SO_3/HCl) mitigation strategies, and the potential challenges to existing environmental equipment.

APC Reinhold Environmental Round Table

Panel Members

- Douglas Ritzenthaler – AEP
- Robert Bryne – FMC Corporation
- Joe McCain – Southern Research, Sr. Staff Physicist
- Mike Theil – Nol-Tec
- Mark Thomas - Consultant
- Ron Triscori – Consultant

Key HAPS rule Emission Targets

- Table 2 to Subpart UUUUU of Part 63 (p. 25126)
  - Emission Limits for Existing Utility Steam Generating Units
- Coal-fired unit designed for: Coal>8,300 Btu/lb.
  - HCl: 0.0020 lb / MWh
    - SO_2 As a surrogate for HCl - SO_2 limit: 0.20 lb/MMBtu
  - Total Particulate (PM): 0.030 lb/MMBtu or 0.30 lb/MWh
  - Hg 1.0 lb/TBtu or 0.008 lb/GWh

Proposed HAPS Rule

- Impact on existing equipment
  - FGD upgrades for SO_2 capture when used as a surrogate for HCl
  - ESP / Baghouse upgrades for PM
- Addition of New Equipment
  - SDA, NID, Wet FGD
  - Replace existing ESP with baghouse?
- CEMS
  - HCl monitors

Portable DSI System by Nol Tec

Chemistry/ NSR Calculation for Trona Reacting with SO_3

Chemistry*: $2\ Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O + 3\ SO_3 \rightarrow 3\ Na_2SO_4 + 4\ CO_2 + 5\ H_2O$

Molecular Weight of Trona = 226 lb/lb mole

Molecular Weight of SO_3 = 80 lb/lb mole

Equation Weight of Trona = 2 lb moles x 226 = 452 lb

Equation Weight of SO_3 = 3 lb moles x 80 = 240 lb

*Assumes no insolubles

$$NSR = \frac{\text{Moles of } Na_2O \text{ injected}}{\text{Moles of } SO_3 \text{ inlet}}$$

FMC Corporation

Handling Trona Before Injection

1) **Use a Dehumidification system for loading/transloading** preferably at 100 F to avoid moisture pickup and obtain good flowability characteristics.

2) Keep Trona Well Below 130 Deg F

Trona calcination mechanism has been proven to occur in stages:

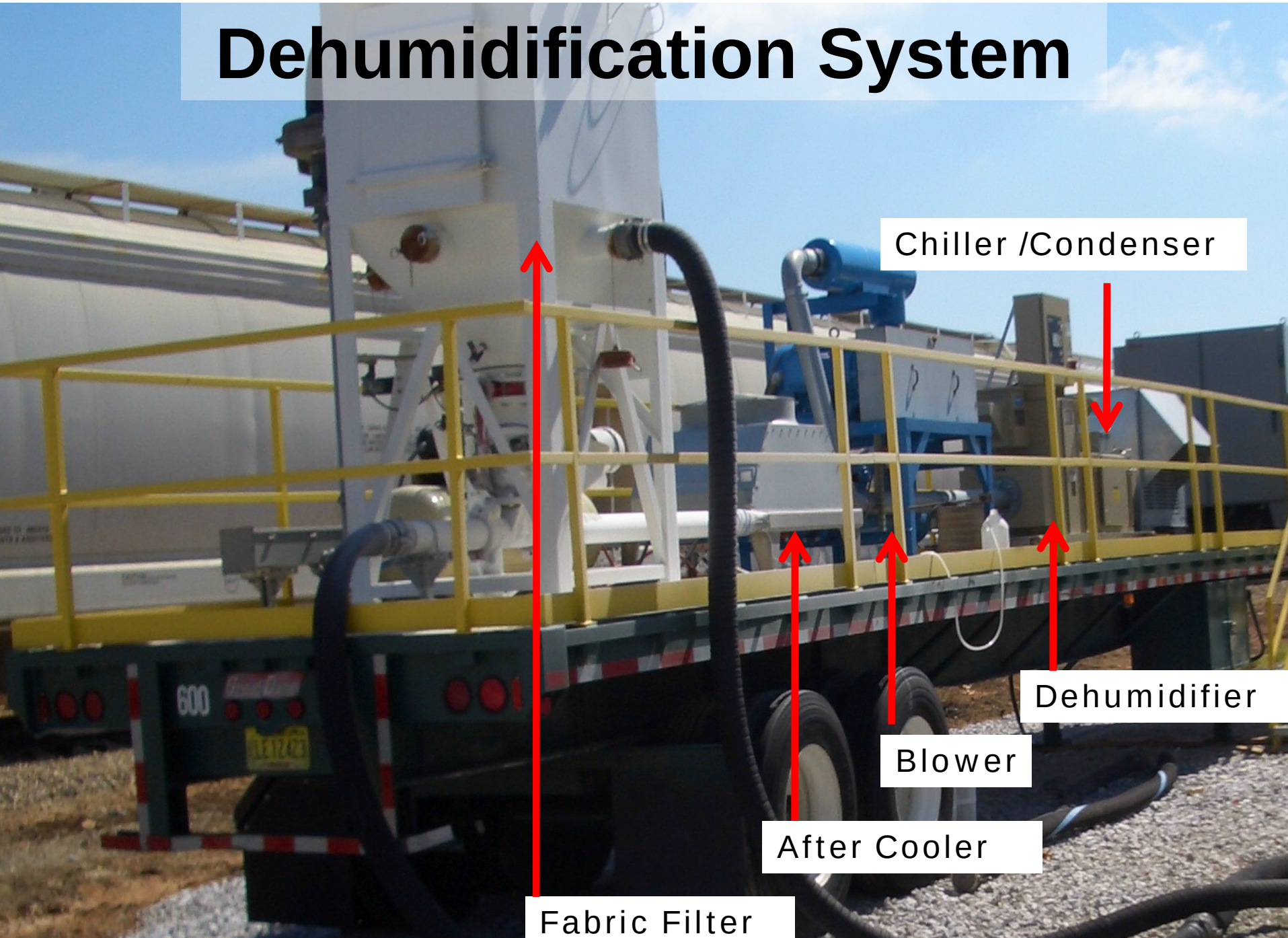
$Na_2CO_3.NaHCO_3.2H_2O \rightarrow \frac{1}{3}(3NaHCO_3.Na2CO3) + \frac{2}{3}Na_2CO_3 + \mathbf{2H_2O}$

$\frac{1}{3}(\underline{3NaHCO_3.Na_2CO_3}) + \frac{2}{3}Na_2CO_3 \rightarrow \mathbf{^3/_2}\ Na_2CO_3 + \mathbf{\frac{1}{2}}\ CO_2 + \mathbf{\frac{1}{2}}\ H_2O$

No CO_2 and most of the H_2O is removed forming Wegschideirite (First stage of the reaction), which begins forming at 130 F Therefore avoid handling trona in a manner which raises the temperature to 130 Deg F

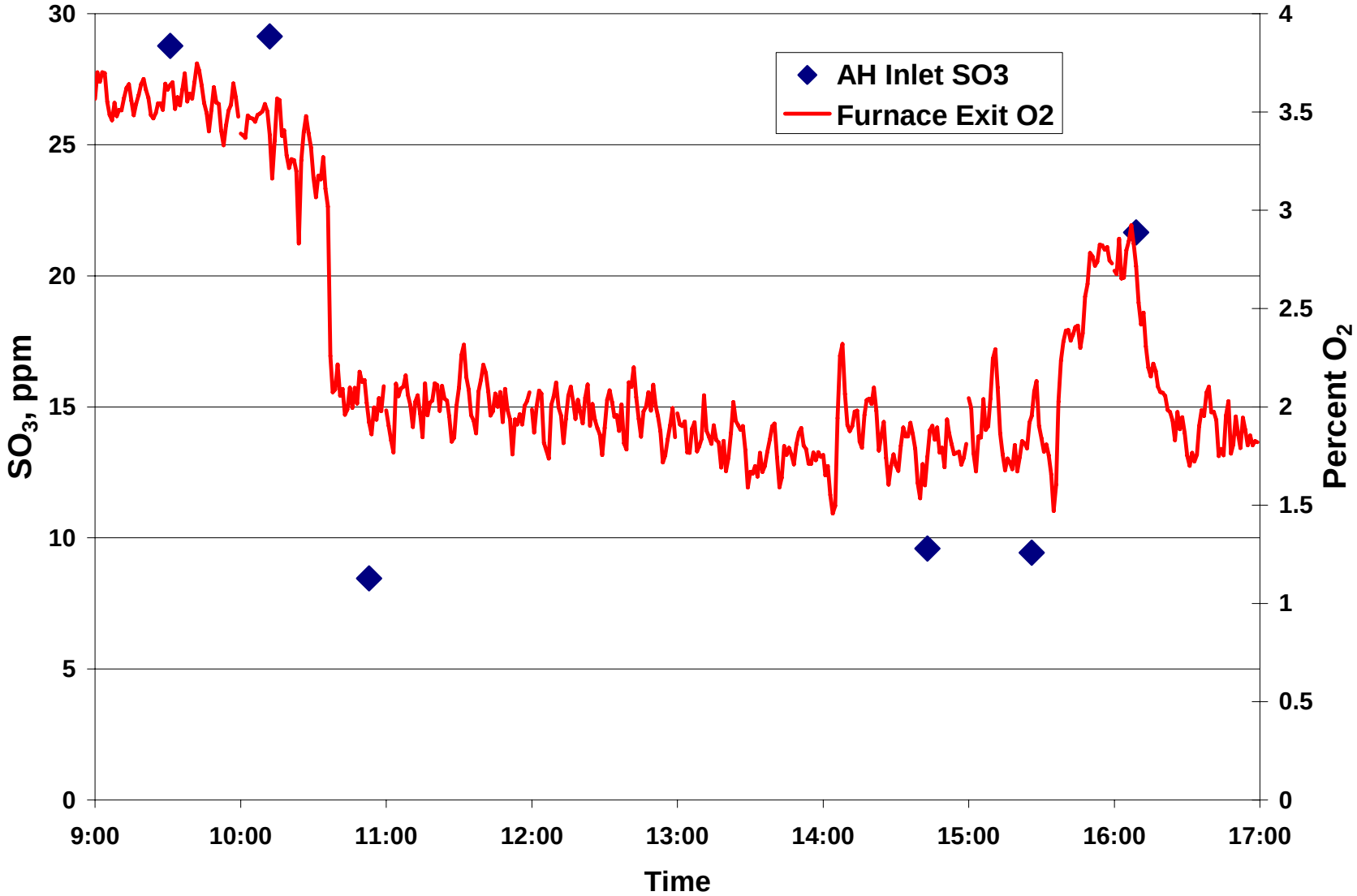
FMC Corporation

Dehumidification System



Compliance with emission regulations are to be based on total particulate ***including condensables***. In the case of fossil-fuel fired utility boilers, H_2SO_4 is the dominant condensable and, in many cases, may dominate the total particulate emissions.

- The Chemkin Homogeneous reaction model can be used to predict the SO_3 concentration at the inlet to the convective section of the boiler.
- Catalytic SO_3 formation with iron as the catalyst begins in the convective pass adding to its concentration.
- Uptake by ash reduces the SO_3 concentration and can proceed concurrently with formation.
- The final SO_3 concentration exiting the boiler is strongly influenced by the oxygen concentration in the convective pass.



Measured boiler exit O_2 and SO_3 concentrations. The boiler was firing a 3.8 % sulfur Eastern bituminous coal.

Southern Research