



**Topic :-
FGD System Optimization
for enhanced SO₂ capture efficiency**



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FGD System Optimization

for enhanced SO₂ capture efficiency

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Participants: Sr Executives from business, environment, and the thermal power sector.

Venue: Radisson Blu Hotel, Paschim Vihar, New

Date: 26/06/24 to 27/06/2024.

Optimization of consumption of limestone

- 1. SO₂ capture efficiency is improved by reducing Limestone particle size through mill.** A finely ground limestone dissolves faster than a coarse ground limestone. Ensure mill output passes 90% through 325 mesh (44 micron) screen.
2. Ensure proper atomization of limestone slurry so that it is distributed evenly around the tower.
3. A lower pH is beneficial for limestone dissolution.
 - pH value low: Lower SO₂ removal η since SO₂ is acidic in nature.
 - pH value high: Higher SO₂ removal η , **Reduced Gypsum purity.**
 - Hence optimize pH.

4. A reactive limestone dissolves faster than an unreactive limestone. Limestone reactivity is a measure of the rate at which it provides alkalinity to react with acid created during SO₂ dissolution.

- **Factors for the estimation of lime reactivity:**

- The specific surface area
- Porosity.
- The temperature during the calcination process.
- Hydration rate (T-60) of the lime.
- **Lime reactivity is measured in terms of the R DIN values**, where the lime grains are mixed with distilled water (1 lime: 4 water) in a calorimeter. **The time elapsed to attain a temperature of 60°C (T60 sec.) is measured** and the R DIN is calculated from the equation: $R\text{ DIN} = 2400/T60$.

R_{DIN} value > 30 – highly reactive lime

$10 < R_{\text{DIN}}$ value < 30 - reactive lime

R_{DIN} value < 10 - unreactive lime

Limestone binding

5. Presence of fly ash because of poor ESP efficiency & unburnt carbon in ash due to poor combustion of coal also impacts reactivity.

LIMESTONE BINDING – CAUSE

- Poor ESP performance sends high levels of fly ash to FGD
- Aluminum from fly ash dissolves and reacts with fluoride ions to form AlFx (**Aluminum fluoride**) complexes which forms a “thin candy shell” on the limestone preventing dissolution.

LIMESTONE BLINDING – RESULT

- pH drops despite increased reagent feed.
- SO₂ removal suffers – low pH and no reagent
- Byproduct gypsum doesn't meet spec – high unreacted CaCO₃ content and low CaSO₄·2H₂O content.

LIMESTONE BLINDING – SOLUTION

- Resolve the ESP problem
- AlFx is more soluble at lower pH. But reducing pH below 5.3 is not advisable to safeguard Absorber internals.
- Gypsum filter cake temporarily may have to be wasted.

6. “Perforated tray” below absorber spray level

- Use of “Perforated tray” located directly above the flue gas inlet (below absorber spray level) in absorber shell
- Stream lines flue gas distribution/ makes the flue gas uniformly distributed through the absorber spray zones.
- The flue gas and the limestone slurry form a very intense turbulence flow field above the tray. This increases the contact between the gas and the slurry due to the vigorous frothing action that occurs on the tray, resulting in greater SO₂ removal.
- A Dp Transmitter is provided across the absorber perforated tray to measure the DP and send this value to DDCMIS for continuous monitoring.

6. “Perforated tray” below absorber spray level

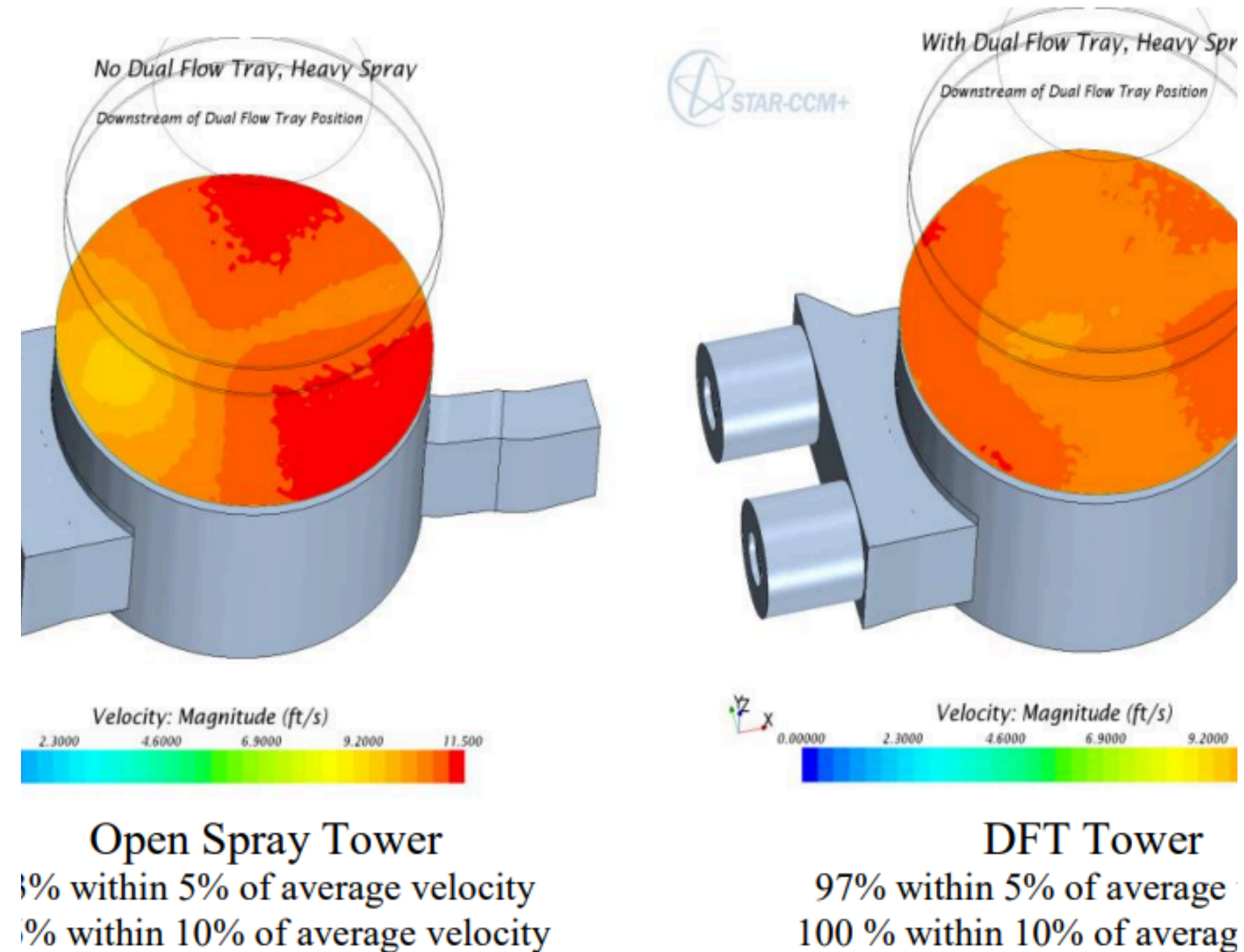
Improving SO₂ removal performance for open tower designs is generally limited to the following factors:

- Increasing L/G ratio
or
- Creating smaller droplet sizes via higher pressure drop nozzles.
Either of these will increase APC.
- Additionally, smaller spray droplet sizes are only marginally effective due to significant droplet coalescence within the spray zone of the tower.
- Flue gas/slurry contact can be significantly enhanced with the use of internal contacting devices.
- Use of Dual Flow Tray (DFT) technology which consists of one or more levels of perforated plates that span the entire absorber cross-section.
- The DFT's SO₂ removal efficiency is improved due to its increased and more effective gas-to-liquid contact area compared to a typical open tower design that relies only on spray droplet surface area.

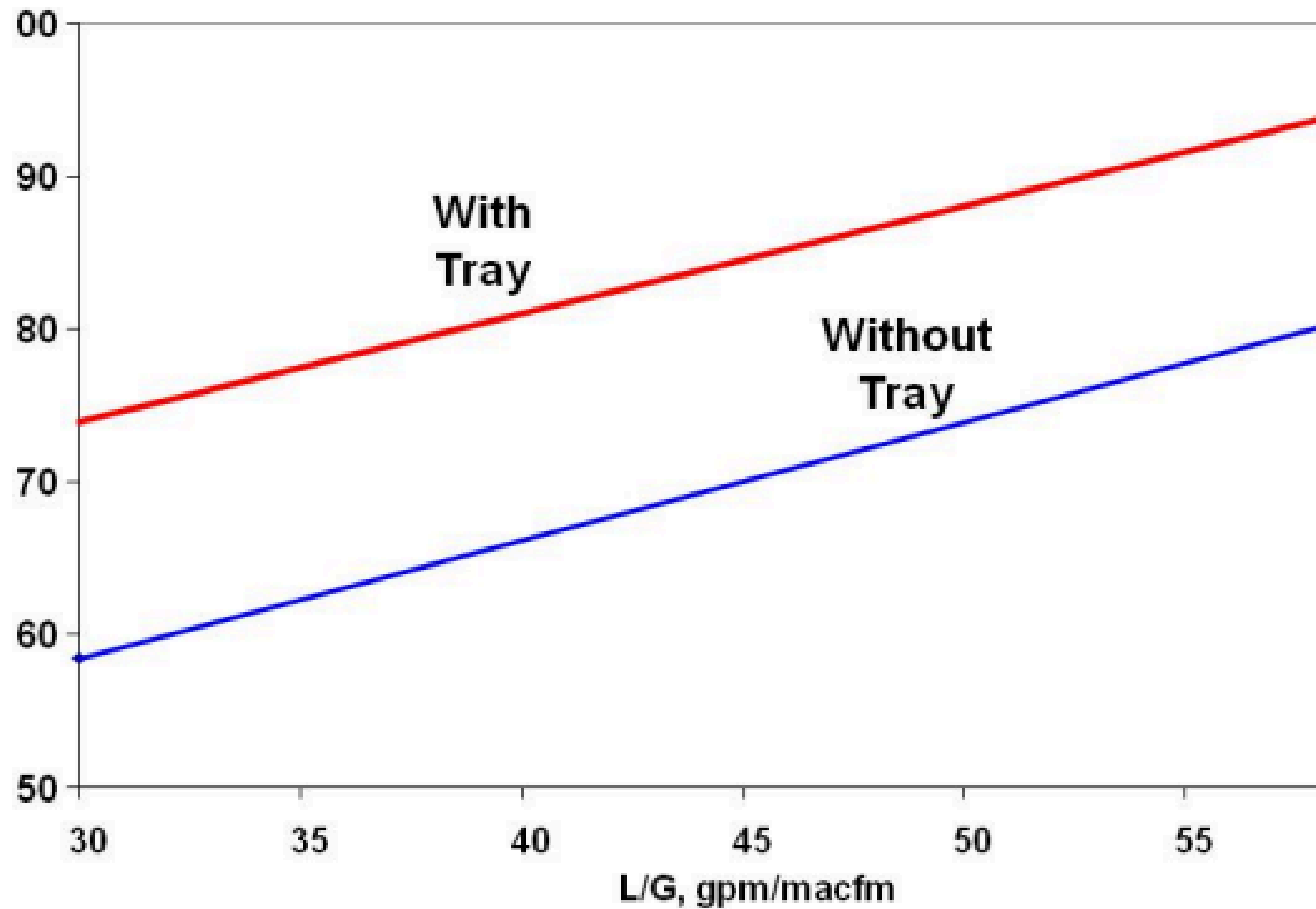
CFD flow model from an existing DFT installation

- Flue gas entry is from the side which is typical of most absorber systems.
- For comparison, the same CFD model was run without the DFT included.
- The expected gas flow distribution for both cases is displayed.
- DFTs provide additional and **very effective gas to liquid contact**. Flue gas flowing upward is intimately mixed with the falling absorber slurry.
- The flue gas velocity travelling through the holes in the DFT causes a liquid resistance, thus forming a froth layer to occur on the tray.
- The froth layer, typically 150mm – 300mm deep, provides additional mass transfer surface area and contact time in the absorption zone. According to estimates each tray level provides an additional one to two seconds of contact time in the absorption zone.

CFD: Computational Fluid Dynamics. DFT: Dual Flow Trays



S02 removal efficiency with and without tray



S02 removal efficiency increase in the same absorber tower with and without an absorber tray

Thanks

Any question?

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**Thanking You
on Behalf of !**



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