



ONE SOURCE ○ ONE PURPOSE ○ MANY SOLUTIONS



Dry Sorbent Injection and Material Handling for APC **Delta DSI Static Mixers**

for

Mcllvaine Hot Topic Hour

June 20, 2013

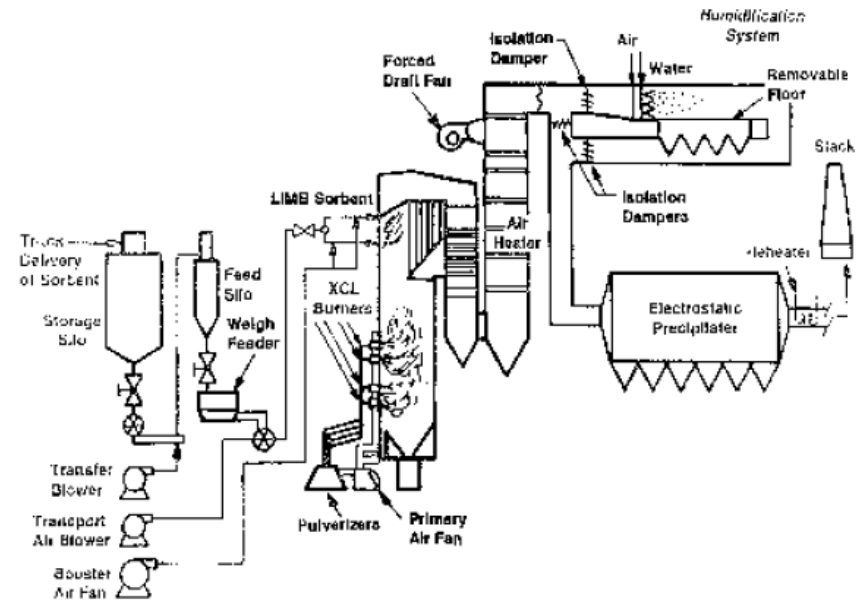
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What Can We Learn From The Past

LIMB (Limestone Injection Multistage Burner) program 1984 to 1987

- The chemistry works, different sorbents work in different temperature zones and are predictable
- “Proper mixing and dispersion of the injected sorbent into the temperature window required for maximum removal are ***more important*** than finding the optimum injection level or temperature”



Mixing is *critical* to Dry Sorbent Injection



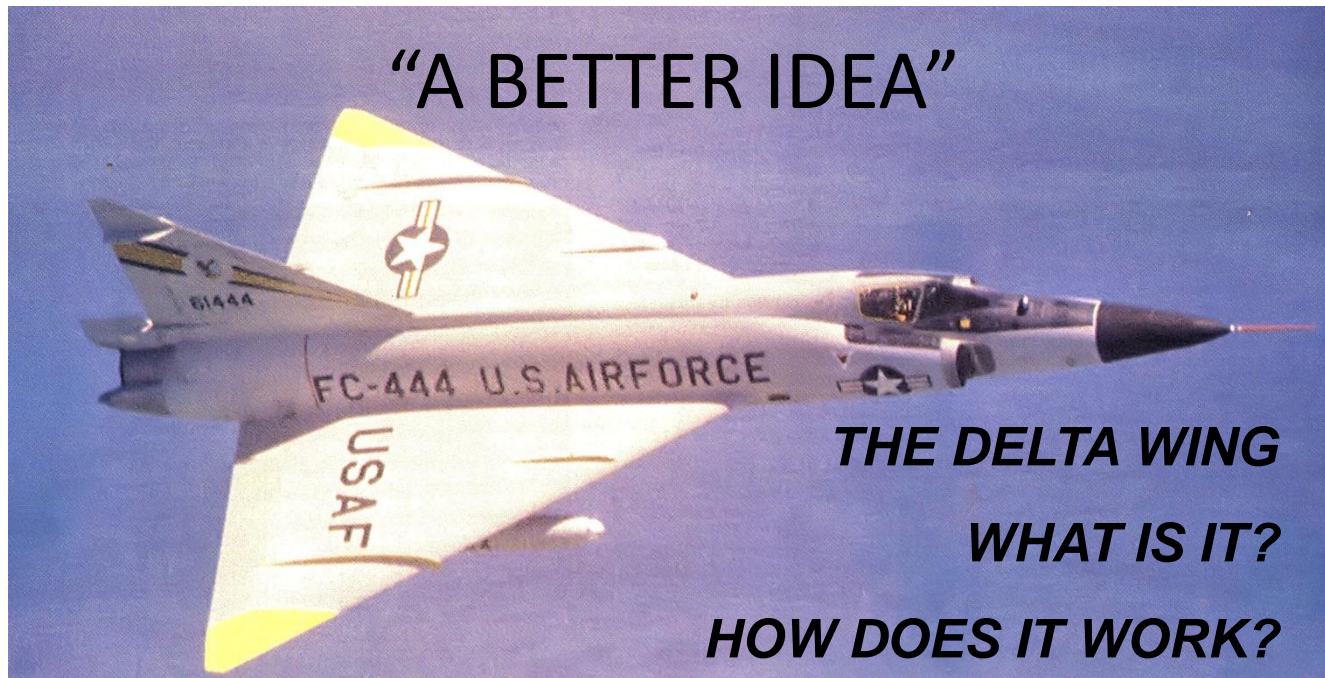
Why Use Static Mixing?

- Mixing is important for emissions performance and sorbent usage
 - Reduce emissions and/or
 - Reduce sorbent usage
 - Lowers loading on particulate removal equipment and lower disposal costs from sorbents
- Simplicity of DSI System Design
 - Minimize injection points
 - Reduce system maintenance
- Reliable
 - Proven Delta Wing[®] technology in use at many operating plants
- Operability
 - Better mixing equals better control over varying loads



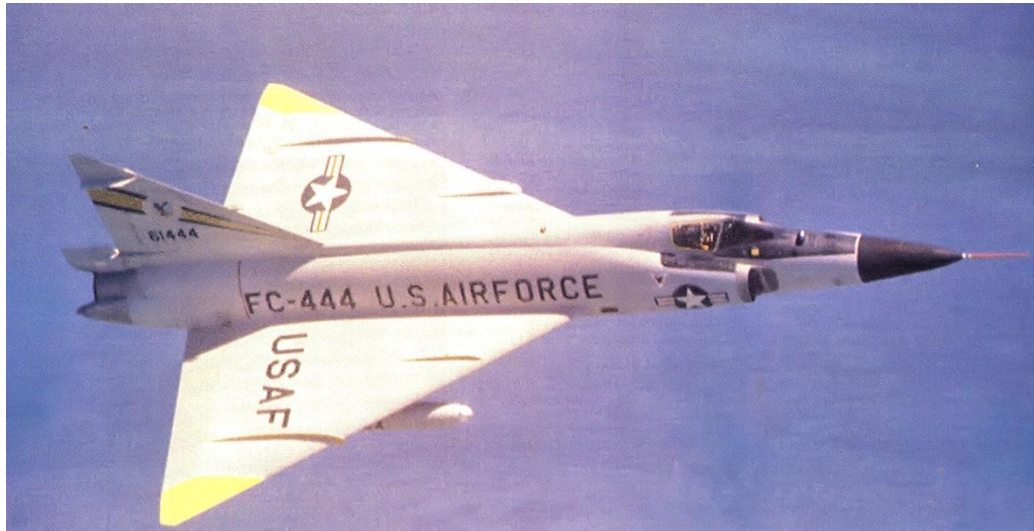
How Do We Do It - Delta Wing[®] Technology

- Proven Delta Wing[®] Mixing System -- the Art and Science of Mixing
- Proven Application of Mixing to Emissions Control System
 - Can be added as a retrofit



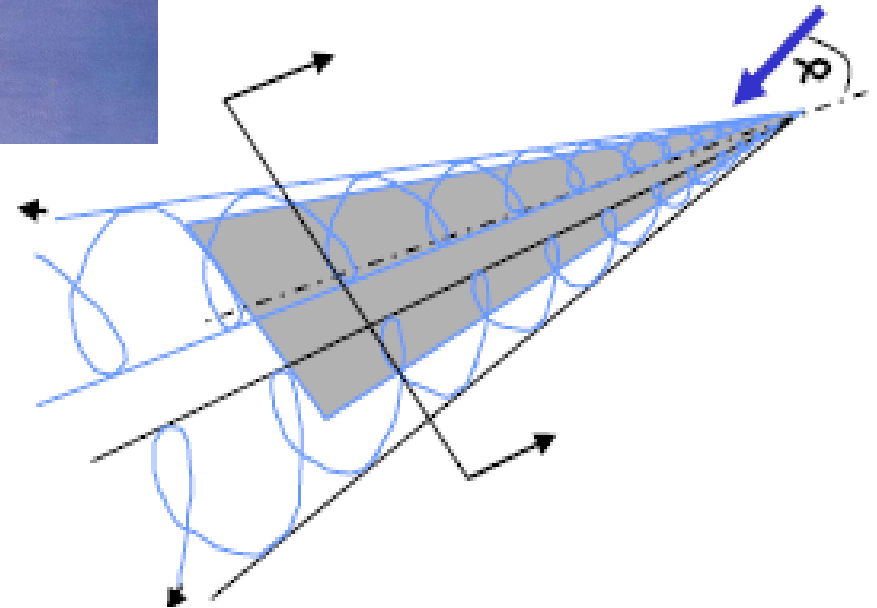


Delta Wing[®] Technology



WIND TUNNEL WORK ON
DELTA WING FIGHTER JETS

OBSERVATION OF STRONG
STABLE VORTICES AT LEADING
WING EDGE



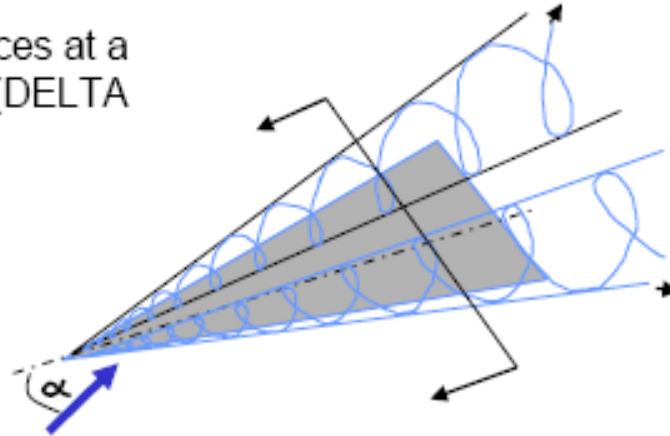
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Delta Wing[®] Technology

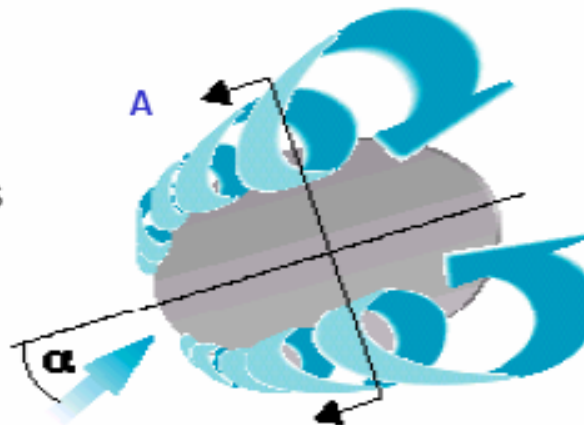
The principle of **DELTA WING**[®]

Leading -edge vortices at a delta-shaped plate (DELTA WING)



TRIANGLE OR DELTA SHAPE RESULTS IN NARROW FIELD OF VORTICES

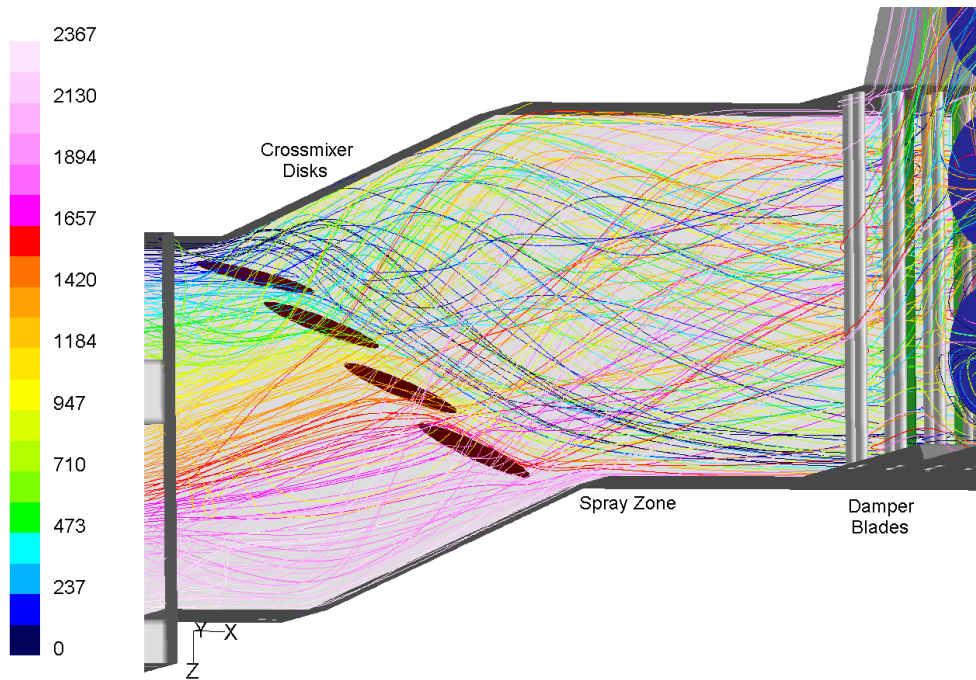
Leading-edge vortices at a circular shaped plate



ROUND OR ELLIPTICAL SHAPE RESULTS IN WIDER FIELD TO SPREAD VORTICES TO ACCOMMODATE DUCTWORK GEOMETRY



Delta Wing[®] In Duct Mixer

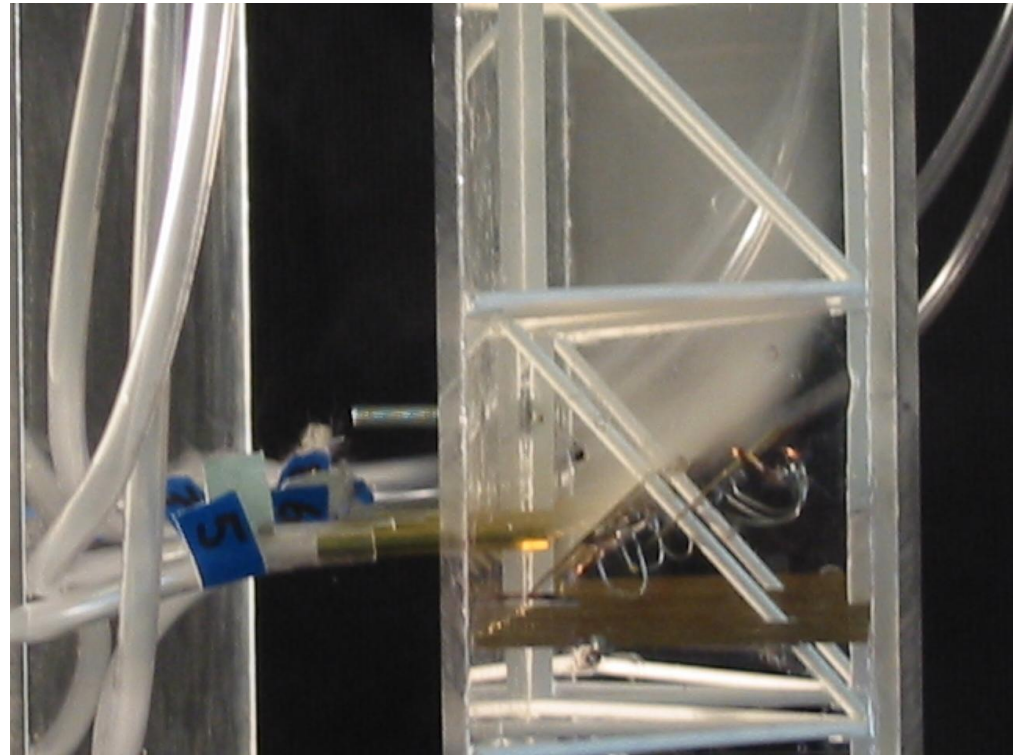


- Able to mix gases, temperature, velocity, concentration before injectors
- Use after injectors to mix entire duct cross section



Modeling

- Scope includes detailed flow and dust models
- Measurement of velocity and mixing at multiple plane locations
- Sorbent injection model based on extensive dust model experience





Modeling (con't)



- Similarity Conditions for Sorbent/Dust Model the Barth Number
- Ratio of Particle Drag to Particle inertia forces
- Similarity of Velocity with Reynolds Number



BPEI Approach To DSI





Delta Wings® Installed at Shawnee Station





Conclusions

- Mixing and Dispersion Critical to DSI Process
- Delta Wing[®] Mixers assure good Mixing and Dispersion
- In Duct Mixing reduces number of injectors thereby reducing or eliminating several current DSI O&M issues
- Delta Wing[®] Mixers and Model Studies Successfully Applied to other Emissions Control Technologies
- Delta Wing[®] Mixers are operating successfully in DSI applications



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