

Reinhold Environmental Ltd.



2010 NO_x-Combustion Round Table & Expo Presentation

February 8 & 9, 2010

Chattanooga, TN

All presentations posted on this website are copyrighted by Reinhold Environmental, Ltd (RE). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or obtain copies for any other uses than the training of attendees to RE's Conferences is expressly prohibited, unless approved in writing by RE or the original presenter. RE does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of RE.



Evonik Energy Services



Ammonia Delivery systems and advancements

by Marilyn Martin

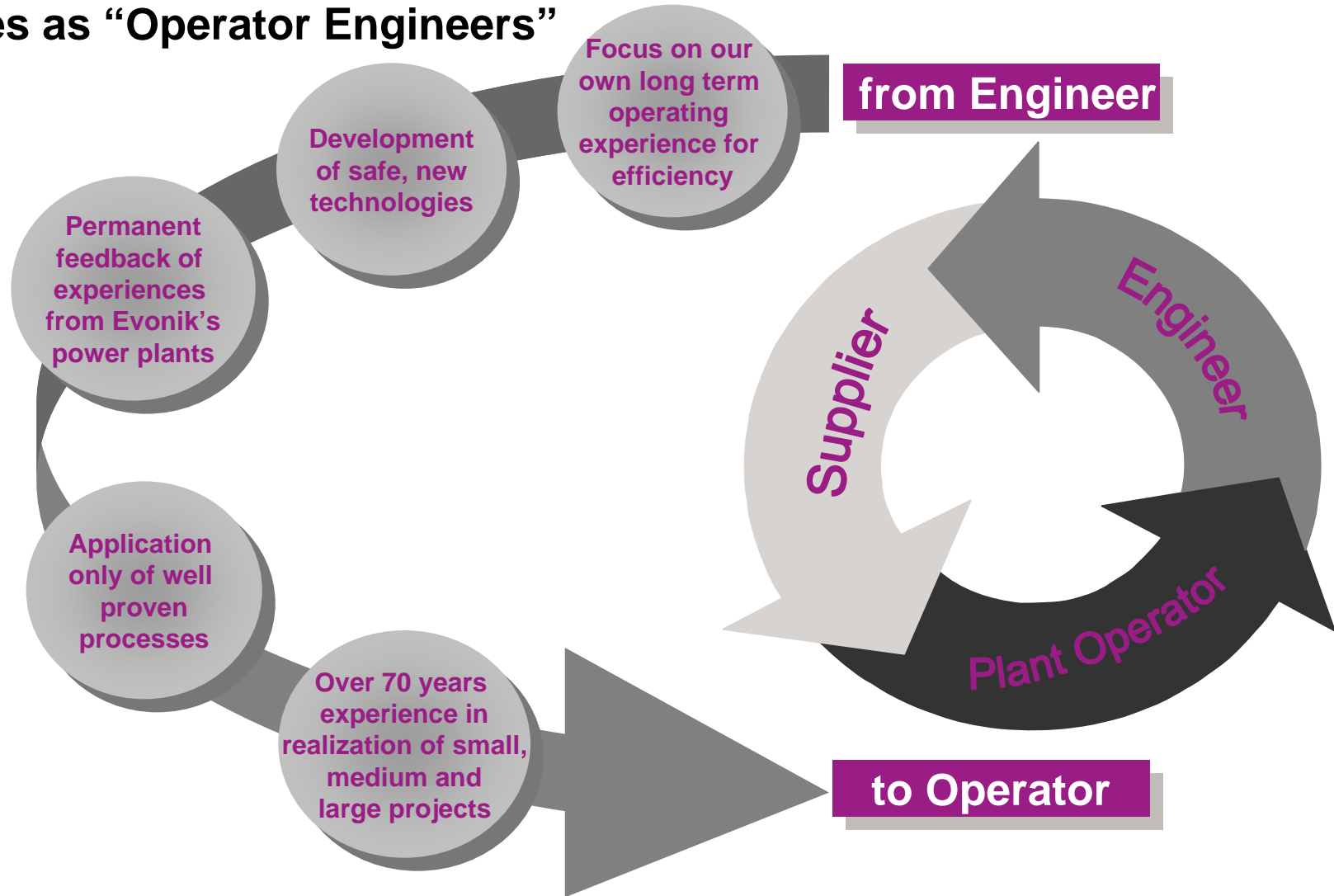


EVONIK
INDUSTRIES

Evonik Energy Services



We always go the full circle and provide our services as “Operator Engineers”



Evonik Energy Services



First Systems used Vaporizers to change Ammonia phase –

- **Purpose of vaporizers in ammonia delivery**
 - **Vaporization takes place when liquid ammonia vaporizes and replaces the vapor that is being withdrawn from the top of the tanks.**
 - **Vaporizer is needed if the heat from the air surrounding the tank is not sufficient or cannot flow through the walls of the tank fast enough to maintain the vaporizing rate demanded.**
 - **If sufficient heat is not available, the pressure in the tank will drop causing a system shut-down.**
 - **A vaporizer will close the pressure switch electrical contacts and turn on the heaters inside the vaporizer shell when the pressure drops below the pressure switch setting.**



Evonik Energy Services



First Systems used Vaporizers to change Ammonia phase –

- **Continued Purpose of vaporizers in ammonia delivery**
 - **Liquid will flow out of the bottom of the tank and into the vaporizer shell where it is heated and converted to vapor. The vapor then flows to the top of the tank where it can be withdrawn to maintain the vaporizing rate of the system.**
 - **The requirement or need for this supplemental heat is dependant on several factors: the ambient temperature of air surrounding the tank, the air movement around the tank, the volume of liquid within the tank and the vapor withdrawal rate.**



Evonik Energy Services



First Systems used Vaporizers to change Ammonia phase –

- Purpose of vaporizers in ammonia delivery
 - Vaporizer packages are available in two (2) configurations:
 - Option 1: Steam ammonia vaporizer with welded steel mounting brackets
 - Option 2: Electric heating elements with ASME code vaporizer shell

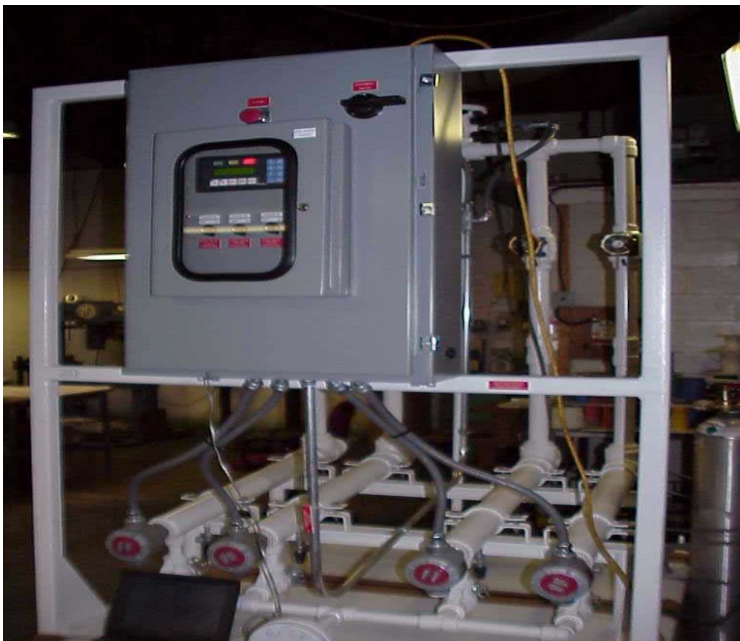


Evonik Energy Services



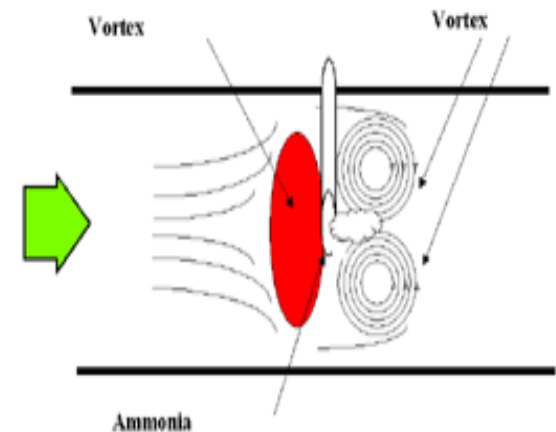
Pump packages include: Two (2) NH₃ pumps with strainers, by-pass relief, isolation valves and pressure gauges.

Each pump can deliver from 15 to 200 gallons per minute of liquid ammonia @ 75 psi differential, depending on size and flow requirements.



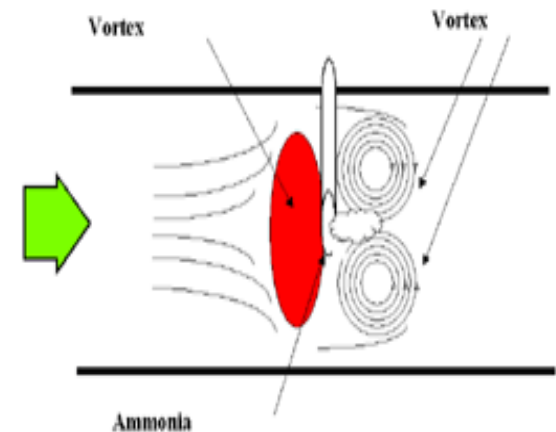
Advancements in the delivery system are very few but we will discuss the ones available

- **Delta Wing Patented Technology**
- **Patented Technology of Balcke Durr**
- **Patent is actually for the triangle shaped material used to induce eddys and vortices**
- **Static Mixer system that is characterized by the fact that extensive steady state are generated at the leading edges of delta shaped plates.**



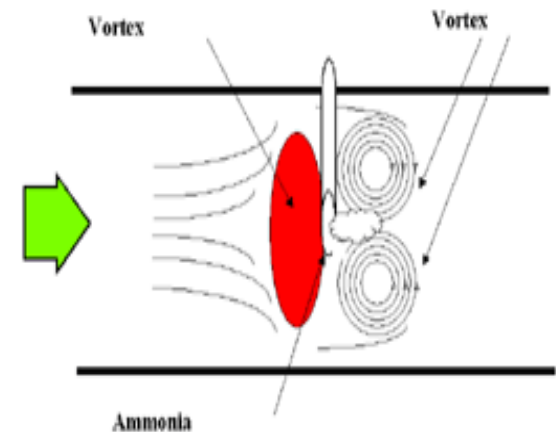
Advancements in the delivery system are very few but we will discuss the ones available (continued)

- Others shapes were soon tried with better success and finally the better shape for even distribution was the ellipse or disc shape.
- This technology allows ammonia to be directly injected into a mixture of dilution air that produces a 5% mixture of ammonia.
- These vortices are double and have a conical shape. They rotate in opposite direction and their diameters gradually increase after leaving the plate.



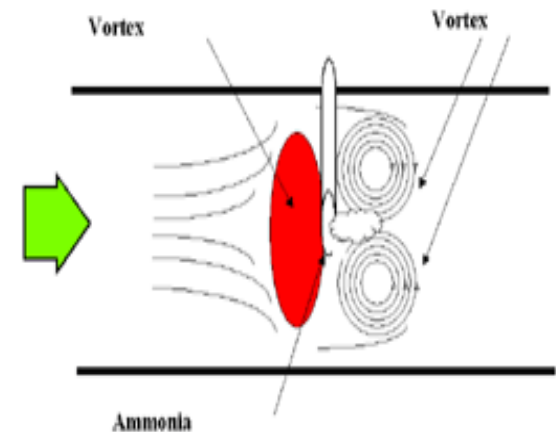
Delta Wing Technology Principals

- The intensive rotation of these vortices generates large flow components normal to the main flow direction which are used for the mixing of ammonia, NOx, fly ash and temperature.
- Optimizes SCR operation
- Optimizes AIG system operation
- Creates turbulent flow eddies based on angle and orientation of discs to create homogeneous flow.



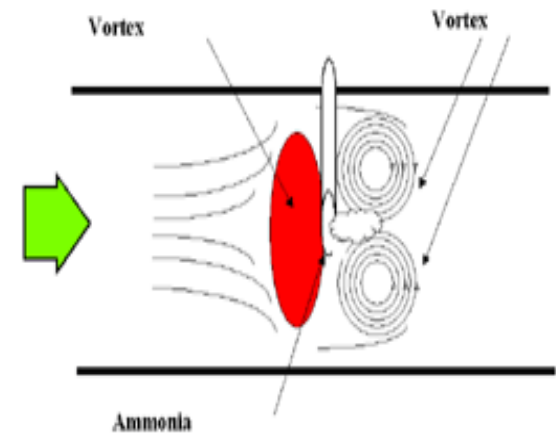
Delta Wing Technology Principals

- **Delta Wing® homogenizes the flow to achieve a maximum catalyst lifetime**
- **Low maintenance and operation costs**
- **Best distribution of the NH_3/NO_x mole ratio, independent from the boiler load conditions or fuel changes**



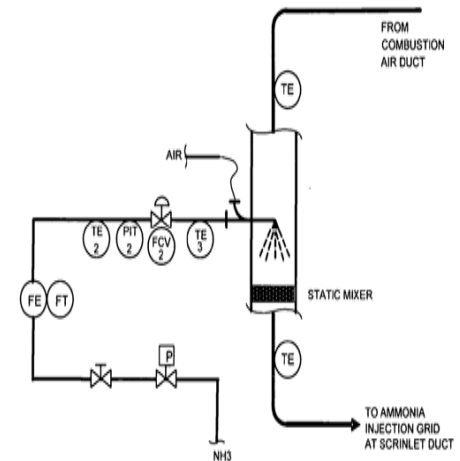
Delta Wing Technology Principals

- Low pressure
- High flexibility in the arrangement
- Excellent fly-ash distribution
minimizes the risks of catalyst block



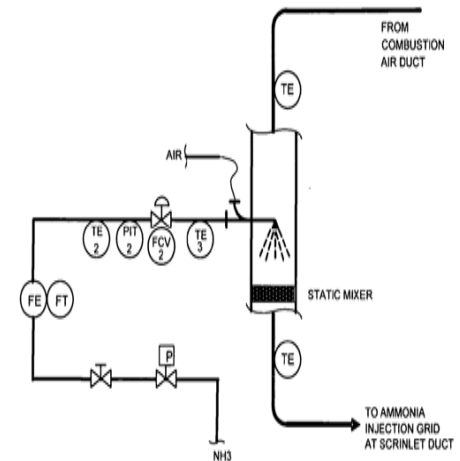
Advancements in the delivery system are very few but we will discuss another one that is available

- **Another system that has been developed by Southern Company is the DIVA system Direct Injection and Vaporization of Ammonia**
- **Provides a system for regulating the flow of a two phase composition containing a liquid and a vapor upstream of the flow control valve**
- **The pressure drop across the flow control valve causes more of the ammonia to flash to vapor**



Advancements in the delivery system are very few but we will discuss another one that is available

- **Air is used to atomize the remaining liquid into small droplets in a dual fluid spray nozzle**
- **Provides a system for regulating the flow of a two phase composition containing A liquid and a vapor upstream of the flow control valve**
- **The pressure drop across the flow control valve causes more of the ammonia to flash to vapor**



Advancements in the delivery system are very few but we will discuss another one that is available

- **Dynegy's Baldwin station uses a similar system that directly injects liquid ammonia into a heated gas stream that causes the fluid to flash into vapor and directly injects into the reactor in a diluted vapor state**
- **This system required pumps to move the liquid into the heated air pipe**





? Question ?



EVONIK
INDUSTRIES



EVONIK
INDUSTRIES