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A successful Mixing Device for the Flow in Power Plants

Hans Ruscheweyh, Prof. Dr.-Eng., Ruscheweyh Consult GmbH, Germany
M. Quitadamo, Babcock Power Inc., Worcester, USA

Abstract

A static mixing device for gas flow has been developed by the author, Hans Ruscheweyh, in his research laboratory for application in power plants. It is based on a special vortex system which is acting as an aerodynamic squirl. The mixing devices consist of a set of mixer plates of different shape, size and tilt arrangement, named "Delta Wing Mixer®". The mixer plates are rigid plates in an optimized position. There are no movable elements. The mixer is very effective and has low pressure loss.

An application is given in **SCR plants** (DeNOx-plants). The removal rate of the NO_x depends on the mixing quality of the ammonia within the flue gas in relation to the NO_x-distribution leaving the boiler. For a stable mixing between the ammonia and the NO_x the NO_x distribution must be equalized first. This is executed with a special Delta Wing device, named "Cross Mixer®". The achieved mixing quality is in the range of 1% RMS deviation from the mean.

An example of a SCR plant with Delta-Wing-Mixer is shown in **Fig.1**.

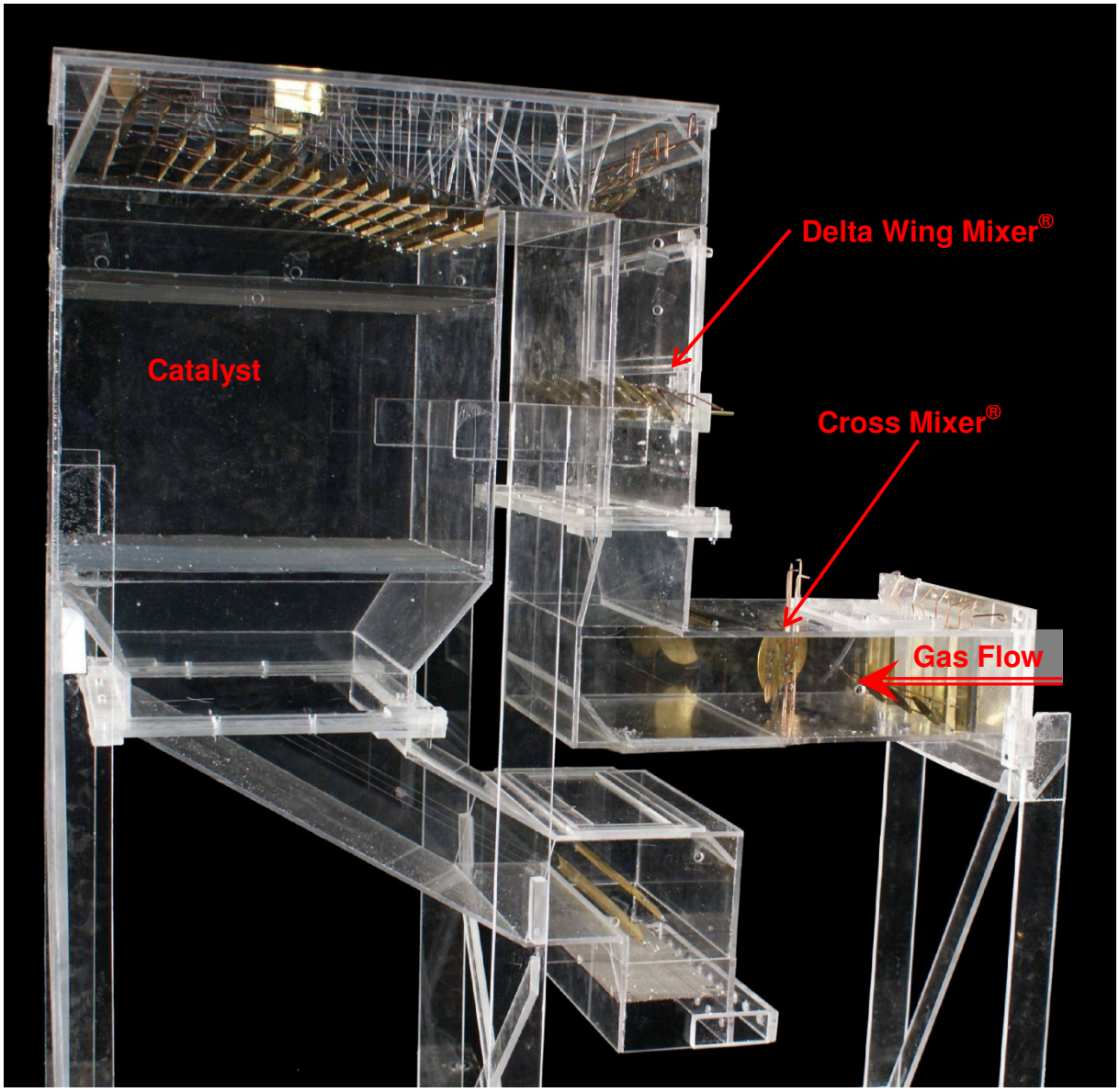

Fig.1: Example of a SCR plant with Delta Wing Mixers.
Model in the test arrangement

Another application is given for the **sorbent injection** into the flue gas in order to improve the removal of other waste products, e.g. mercury or SO_3. A Delta Wing Mixer® is placed upstream of the injection nozzle. The generated vortex at the mixer plate catches the sorbent and mixes the particles with the flue gas very intensively within a short distance. The mixing technique enables a sufficient sorbent distribution even in complicated ducts. An example is given in **Fig. 2**.

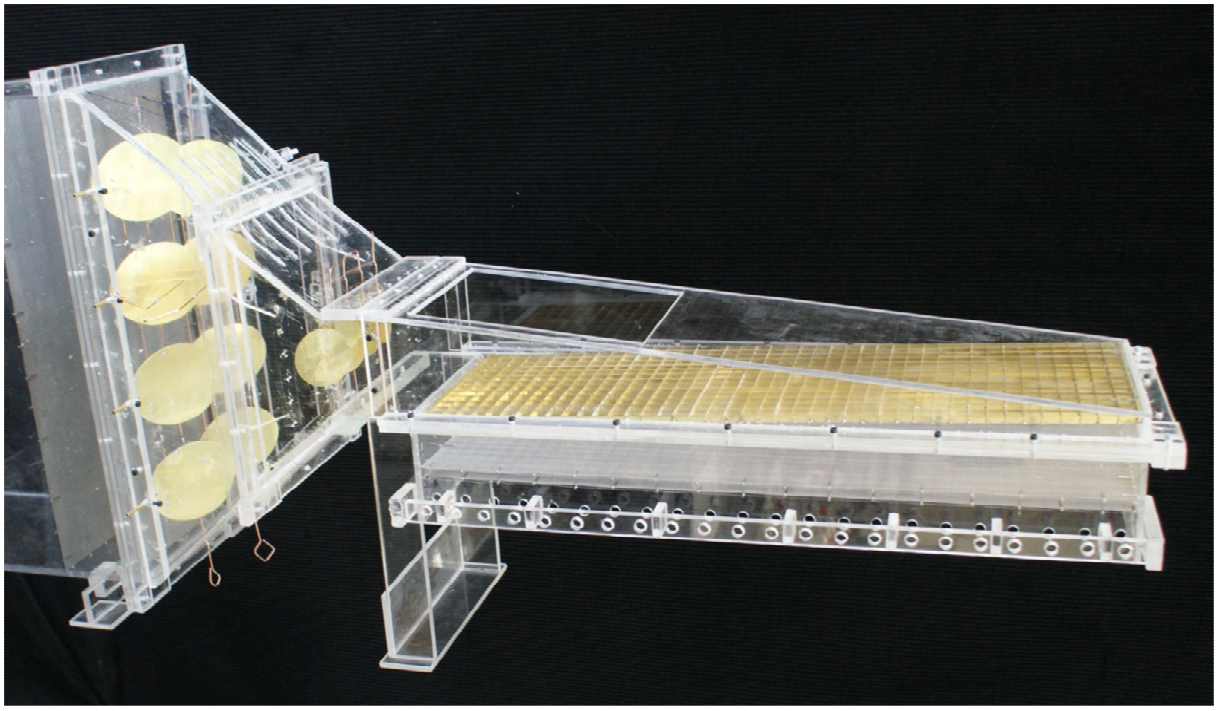

Fig. 2: Sorbent injection with “Delta Wing Mixer®” in front of an Electro Precipitator (ESP).
Model in the test arrangement

Simple Cycle Exhaust System after gas turbines requires an intensive mixing of the flue gas flow as well as the injected ammonia for the NO_x reduction. The “Delta Wing”- Mixing Technique enables a good flow distribution at the heat exchanger and at the catalyst. Flow separations and return flow in the one sided diffuser are avoided and the heat exchanging process as well as the removal rate of the NO_x is improved. **Fig 3** presents an application after a gas turbine and at the heat exchanger in the expanded duct.

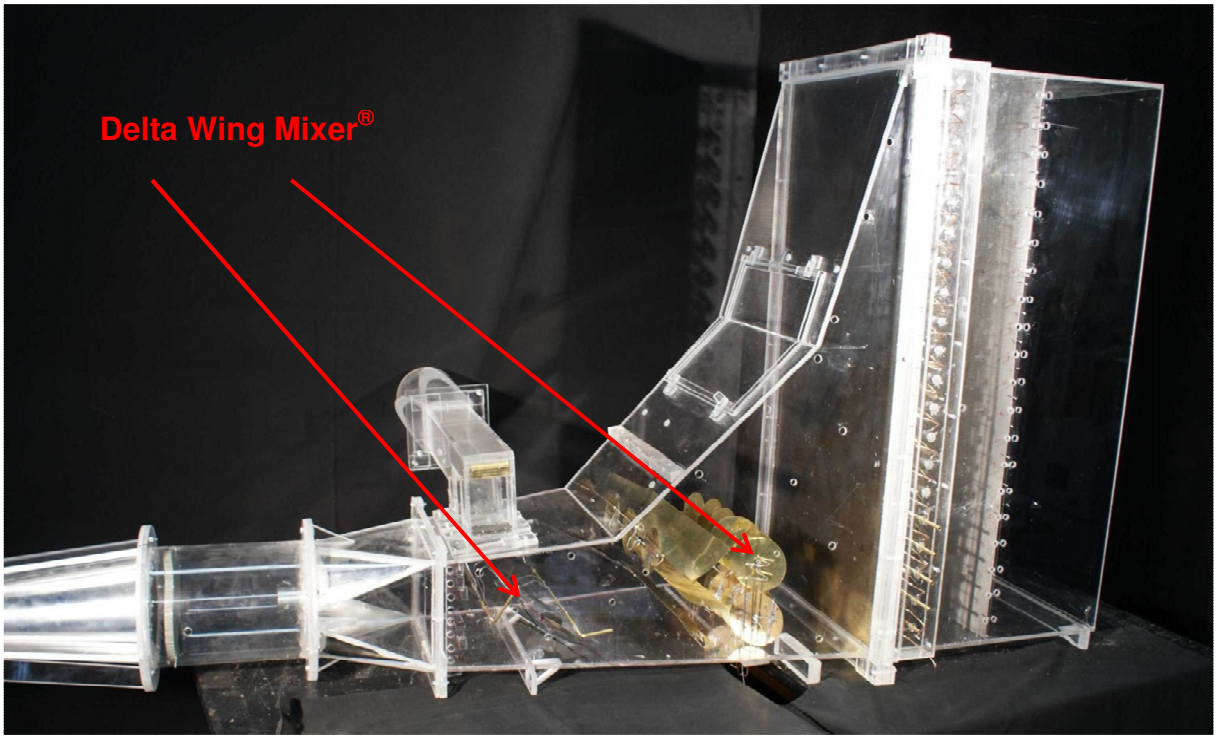

Fig 3: Delta Wing Mixer® in the Simple Cycle Exhaust System.
Model in the test arrangement

Dry-Wet cooling towers (also named hybrid cooling tower) require an intensive mixing of the wet and dry air within the cooling tower cell in order to avoid visible plume at the fan stack outlet. The mixing length is extremely short. Delta Wing Mixer® enables a sufficient mixing. **Fig. 4** shows a model with the Delta Wing Mixer in the cooling tower cell below the fan. The quality of the mixing at the fan stack outlet is in the range of 10% RMS deviation from the mean, which avoids the condensation of the cooling tower air.

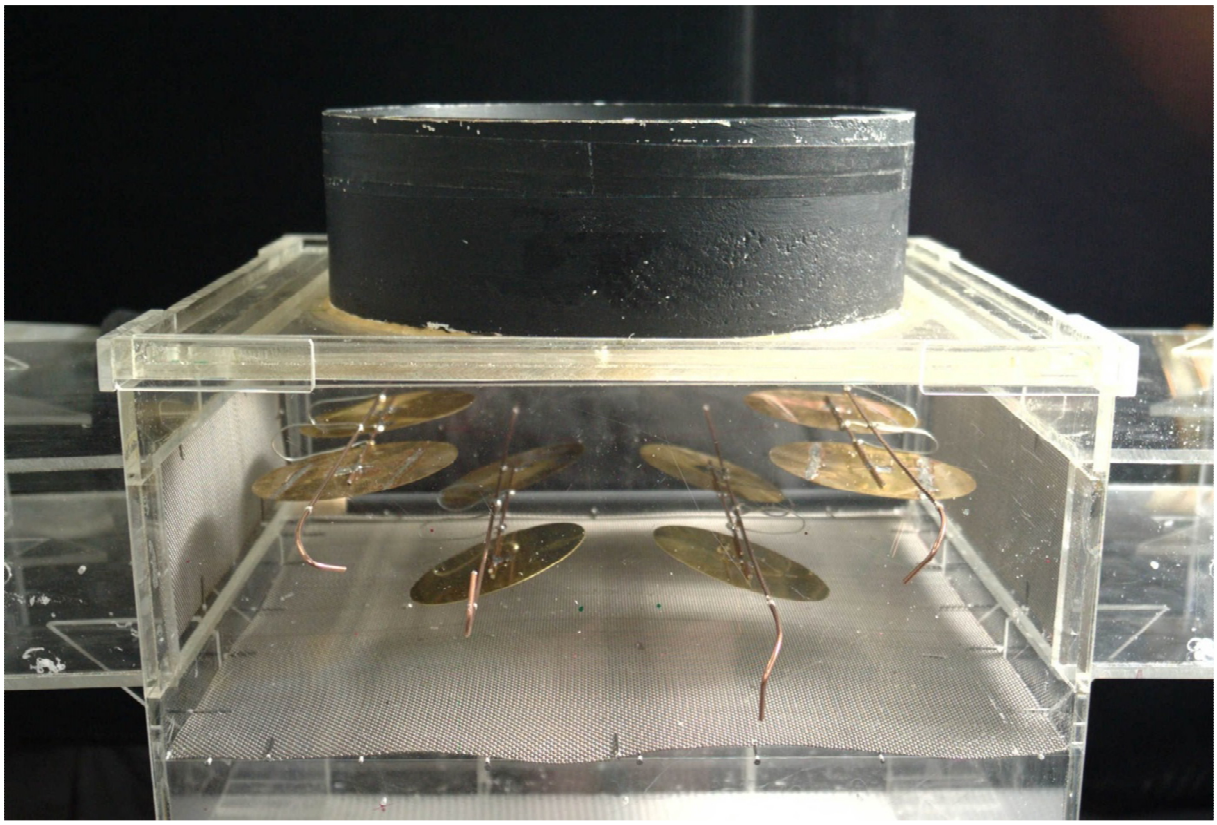

Fig.4: Delta Wing Mixer® in a dry-wet cooling tower.
Model in the test arrangement.