

# Sending shockwaves through the multi-pollutant control business

A new shockwave-based technology for flue gas scrubbing, based on aerodynamic reaction principles and molecular surface chemistry – and already used in radioactive waste incineration applications – promises big energy and cost savings.

**R E Tang, CEFCO Global Clean Energy and A Sanyal, International Environmental & Energy Consultants**

The CEFCO Process is a new approach to coal-plant multi-pollutant capture, based on “free-jet collision scrubbing”, employing shockwaves. The aerodynamic reactor technology that underpins the process, which has been used for a number of years at nuclear waste incineration facilities in the USA, was invented by Thomas K. Ewan. He is one of the five partners (co-inventors) in CEFCO\* Global Clean Energy, LLC of Dallas, Texas, USA, which was formed in 2008. The pollutants targeted are: CO<sub>2</sub>; toxic and trace metals (including Hg); particulates (including below 2.5µ); SO<sub>x</sub>; and NO<sub>x</sub>.

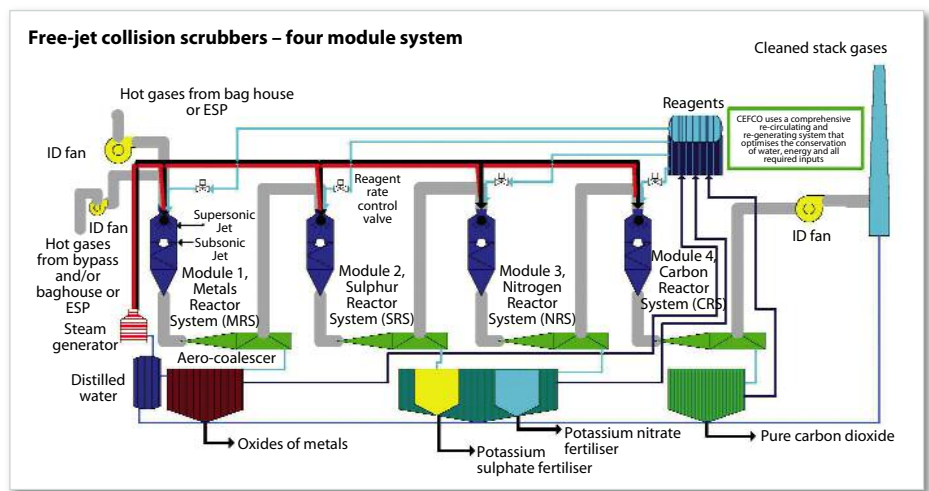
Shockwave free-jet collision scrubbing has already been adopted by the US EPA as a component of its MACT (Maximum Achievable Control Technology) requirements for hazardous waste combustors (HWC), which was codified and published in 2002. CEFCO expects that the new process will prove to comply with MACT requirements for multi-pollutant capture as well as for CO<sub>2</sub> capture, once such CO<sub>2</sub> regulations are enacted. MACT standards are recognised as being more stringent than the current Best Available Control Technology (“BACT”) standards.

The CEFCO Process includes multiple aerodynamically-shaped reactors and aerodynamic coalescers (gas/liquid phase separators) in series for sequential pollutant separation and removal. Each reactor system is designed to remove one of the targeted groups of pollutants, and the steps are repeated in sequence for the remaining pollutants. CEFCO believes that its process will remove at least 90% of the CO<sub>2</sub> and over 99% of the other pollutants.

The enabling technology is based on Ewan’s “flow physics” principles and the highly efficient “molecular surface chemistry” that can be achieved with proprietary aerodynamic reactor and coalescer technology. The flue gas being treated is kept moving very rapidly, with short residence-time (in seconds) in each reactor system.

The key concept of the CEFCO Process is that, by using the Ewan technology and injecting steam at Mach speeds, each targeted group of pollutants in the flue gas is intimately collided with and mixed with very fine rapidly moving liquid droplets. Shockwaves are extremely strong energy and pressure waves affecting every molecule of the flue gas. The pollutants are captured and encapsulated by the liquid droplets (and reacted chemically with the specified reagent). The droplets then are “grown” to a physical size

\*Clean Energy and Fuel Company



sufficiently large to permit separation by a gas/liquid phase flow separating aero-coalescer. As the chemical reactions occur simultaneously in the multiplicity of small droplets which are repeatedly contacted and re-combined, the concept is based on the reactions being completed rapidly in contrast to the traditional near-bulk chemistry reactions in conventional engineering processes which rely on long residence-time for proper contact, input of energy relying on thermodynamics and/or catalysts.

CEFCO calls the distinguishing feature of its process “molecular surface chemistry” because the fine droplets have a large surface-area-to-mass ratio, ensuring rapid mixing and encouraging chemical reactions. Such aerodynamically induced surface-chemical reactions inside the reaction zone absorb the extant energy and the pressure drop extremely rapidly inside the reactor. There is no need to add extra energy or another chemical or complex/metal catalyst in the process, which serves to simplify the chemistry as well as significantly reduce overall operating costs. The energy penalty is thus minimised.

It is expected the total energy penalty/parasitic load for the entire CEFCO Process will be less than 10% – significantly different from that associated with traditional thermodynamics and conventional chemistry and catalysts in such applications.

The complete CEFCO Process includes subsequent processing of the captured pollutants into valuable and saleable end-products. The second component technology (known as the “Cooper Process” invented by Hal B.H. Cooper, another partner in CEFCO) uses selective reagents in conjunction with Ewan’s technology for the conversion of each

separated pollutant, in succession, into concentrated and commercially-marketable forms of metals, fertilisers, and pure CO<sub>2</sub>.

The CEFCO Process is expected to be able to achieve capital and operating costs considerably below those of alternative technologies and its ability to yield pure and saleable products from sequential modules, including captured metal oxides, potassium sulphate and potassium nitrate fertilisers and CO<sub>2</sub>, is expected to further enhance its economic attractiveness.

CEFCO has received a positive international preliminary report on patentability from European Patent Office/Patent Cooperation Treaty examiners and expects to receive a similarly positive response from the US Patent and Trademark Office. The company is optimistic about the eventual issue of patents in due course from various national patent offices, and is seeking distributors and manufacturers in various markets for licensing.

For the continental USA, CEFCO, in July 2010, granted the sole manufacturing licence rights to Peerless Manufacturing Company, which is performing rigorous tests to demonstrate their own system engineering and process integration capabilities.

Meanwhile, interest in the CEFCO Process is growing in the cement business, following the US EPA’s announcement on 29 April 2010 that it will enforce the New Emissions Standards for Hazardous Air Pollutants (“NESHAP”) rule under Cement MACT standards in 2013.

For further information, contact Robert Tang at: [robert.tang@cefcoglobal.com](mailto:robert.tang@cefcoglobal.com). Website: [www.cefcoglobal.com](http://www.cefcoglobal.com)