

HAMON RESEARCH-COTTRELL, INC.



Valero Memphis Refinery

WET GAS SCRUBBER



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ExxonMobil's Wet Gas Scrubbing (WGS) technology allows refiners to reliably meet tough FCC emission regulations with well-proven technology.

In 2002 and 2003, ExxonMobil Research and Engineering Company (EMRE) and Hamon Research-Cottrell (HR-C), entered into licensing and sublicensing agreements to provide ExxonMobil's Wet Gas Scrubbing technology to sublicensees of HR-C.

Expect these advantages:

- Can avoid costly CO boiler upgrades with allowable scrubber pressure drops as low as zero inches of water
- Takes advantage of HRC's almost 100 years of experience and global leadership position in providing air pollution control equipment to a wide range of industries, including refineries.
- Maximizes cat cracker availability - scrubber run lengths match longest FCC up-time in the industry
- Meets or exceeds toughest particulate and SO_x emission regulations
- Produces environmentally benign wastewater safe for direct discharge
- Collected catalyst suitable for direct low cost disposal

EASILY RETROFITS INTO EXISTING PLANTS

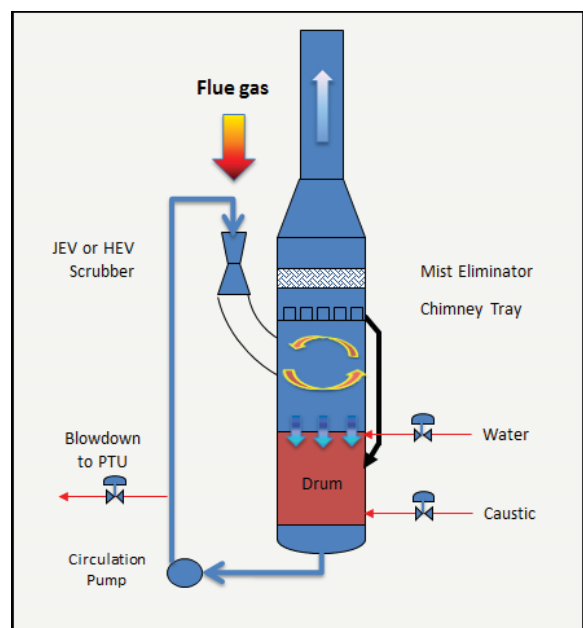
Hamon Research-Cottrell / ExxonMobil wet gas scrubber (WGS) technology removes particulates and SO₂ by intimate mixing with an aqueous scrubbing liquid. The technology can be enhanced to meet tighter restrictions on NO_x (WGS Plus) or particulate with the addition of integrated wet ESP polishing.

WGS technology can be retrofitted into full-burn or partial-burn FCC units, even those with first generation CO boilers and very low flue gas pressure.

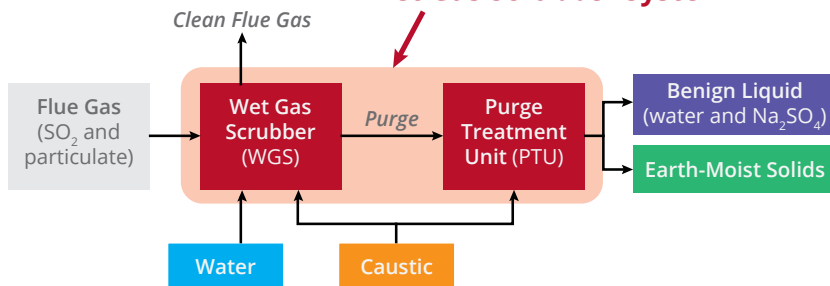
In partial-burn units, where the available flue gas pressure is low the WGS Jet Ejector Venturi design is used. The JEV creates suction pressure at the venturi throat from the action of the recirculated scrubber liquid. The application of WGS JEV scrubbing may avoid the need to upgrade older CO boiler. This JEV design offers the lowest pressure drop of any commercial scrubber.

For full-burn units, where higher gas pressures are available, the WGS High Energy Venturi is used. The HEV design uses the available energy in the flue gas to create the small droplets needed to scrub particulate and SO₂ at high efficiency.

The typical scope for a WGS project includes the scrubber vessel from the flue gas inlets to the stack, the recirculation pumps and piping, scrubber instrumentation and control, caustic and water make up systems, scrubber purge, and the purge treatment unit to produce solids for disposal and benign waste water.



Hamon Research-Cottrell / ExxonMobil Wet Gas Scrubber System



HIGH RELIABILITY

Since introduction of the technology in the 1970s, more than 30 FCC units have been fitted with ExxonMobil WGS systems worldwide. Hamon Research-Cottrell has been providing these systems for major refiners since 2005.

The robustness of the design means that even the earliest units continue to reliably perform today. At the same time the combined experience of ExxonMobil and Hamon Research-Cottrell has brought improvements in performance and capital cost, while maintaining the integrity and reliability of the system.

With run lengths in excess of four years and matching the longest FCCU up-time in the industry, WGS units operate until the FCC is ready for its turnaround. In fact, no FCCU has ever shut down due to a problem in an ExxonMobil WGS.

TWO SCRUBBER DESIGNS TO MEET ALL NEEDS

High Energy Venturi (HEV)

- Uses gas pressure to push gas through venturi
- Gas kinetic energy breaks liquid into drops
- Preferred choice when flue gas pressure is high



Jet Ejector Venturi (JEV)

- Liquid flow in the venturi creates suction pressure (Bernoulli's Principle)
- Has lower back pressure than any other scrubber on the market
- Liquid kinetic energy breaks liquid into drops
- Preferred choice when flue gas pressure is low
- Ideal for retrofits with older CO boilers that cannot take high back pressure



SELECTED INSTALLATIONS

- EXXONMOBIL, Baytown
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- EXXONMOBIL, Baton Rouge
- CONOCO PHILLIPS, Linden NJ
- MARATHON, Garyville LA
- KOCH East, Corpus Christi, TX
- EXXONMOBIL Refining
- HESS, Port Reading NJ
- FLINTHILLS West, Corpus Christi, TX
- FINA, Port Arthur TX
- SHELL, Norco LA
- PREMCORE REFINING, Memphis TN
- HOVENSA, US Virgin Islands
- CHEVRON, El Paso TX
- CONOCOPHILLIPS, Linden NJ
- LYONDELL-CITGO, Houston
- CHINESE PETROLEUM CO., Taiwan
- LAGOVEN, Amuay, Venezuela
- EXXONMOBIL, Beaumont TX
- SHELL PUGET SOUND REFINERY
- CONOCO PHILIPS Trainer PA
- TESORO Anacortes
- MOTIVA, Baton Rouge
- CONOCOPHILLIPS Ponca City OK
- PEMEX Minatitlan
- CONOCOPHILIPS Wilmington CA
- EXXONMOBIL Joliet refinery
- CONOCOPHILIPS Alliance refinery
- VALERO Memphis refinery
- VALERO Delaware city refinery
- VALERO Memphis refinery (WGS+)
- LIMA refining
- CNPC refineries (China)

Proven, robust
FCC Wet Gas Scrubbing technology
with the lowest pressure drop
in the industry!

ExxonMobil
Research and Engineering

 **Hamon Research-Cottrell**

Hamon Research-Cottrell

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Hamon Research-Cottrell is part of the worldwide Hamon Group and is a major provider of air pollution control technology. HR-C serves the North American market from its main office in Somerville, NJ.

Hamon Research-Cottrell provides innovative clean air technologies to a wide array of industries including power generation, pulp & paper, petrochemical, chemical, glass, cement, steel, food, and pharmaceuticals. Hamon Research-Cottrell is a worldwide leading supplier of:

- Electrostatic Precipitators
- Fabric Filters
- ReACT™ multi-pollutant control technology
- Dry and Wet Flue Gas Desulfurization Systems
- DeNOx Systems (Selective Non-Catalytic Reduction - SNCR)
- Urea to Ammonia (U2A®) Systems
- ExxonMobil Wet Gas Scrubbers

Hamon Research-Cottrell provides solutions and project services that include new and retrofit equipment, engineering and fabrication, parts and aftermarket support, field services, trouble-shooting, fluid dynamics and specialty consulting.

INTEGRATED SOLUTIONS FOR A CLEAN ENVIRONMENT

The Hamon Group is a global source for engineering and contracting.

Its activities include the design, the manufacturing of critical components, the installation and the after-sale services of cooling systems, process heat exchangers, air pollution control (APC) systems, HRSG's and chimneys.

