

**CROLL REYNOLDS**  
Process Vacuum | Air Pollution Control

# WET SCRUBBING SYSTEMS



# CROLL REYNOLDS AIR POLLUTION CONTROL: MEETING THE CHALLENGE

For more than 50 years Croll Reynolds has provided solutions to those faced with the challenge of efficient resource utilization and the responsibility for meeting stringent emission standards. Current and proposed regulations call for swift compliance, while the recovery and reuse of valuable process vapor has become standard operating procedure throughout the world.

Regardless of the air pollutant or industrial source, Croll Reynolds has the engineering know-how and application experience to design and manufacture a system to meet the most demanding performance requirements.

## System Design

Croll Reynolds offers a full range of air pollution control technologies. Our engineers are prepared to analyze your requirements and engineer a solution for virtually any application. From a single-stage, stand alone unit to an automated, multi-stage system complete with state-of-the-art instrumentation and programmable logic controllers, Croll Reynolds' team of chemical, mechanical and electrical engineers will work together to meet your performance needs.

We specialize in the design of High Energy Venturi Scrubbers, Jet Venturi Scrubbers and Packed Towers. Croll Reynolds' strength lies in its ability to integrate these products into a solution tailored to meet the most exacting requirements.

## Solving Problems Others Won't Touch

Years of research and innovative engineering experience have earned Croll Reynolds a reputation for resolving the most difficult challenges. We have handled a wide variety of toxic, hazardous, common, and uncommon gases including:

- HCl
- HF
- HBr
- H<sub>2</sub>S
- SO<sub>2</sub>
- NH<sub>3</sub>
- Cl<sub>2</sub>
- Alcohols
- Silicon Dioxide
- Silicon Tetrachloride
- NOx
- Fine Oil Mist
- Boron Trifluoride
- Organic Anhydrides
- Sulfuric Acid Mist
- Lime Dust
- Phosgene
- Ethylene Oxide
- Propylene Oxide
- VOC's
- UOP CycleMax™  
Regeneration Gas
- ...to name a few!

Croll Reynolds provides an effective approach to particulate, toxic gas VOC and odor elimination for many industrial processes.

Whether we have experience with your specific requirement, or you have a one-of-a-kind application, Croll Reynolds has the expertise to design equipment to suit your specifications. For over 50 years, we have successfully served the following industries:

- Aerospace
- Chemical
- Electronics
- Fertilizer
- Fibers
- Food Processing
- Medical
- Metallurgical &  
Precious Metals Refining
- Petrochemical
- Pharmaceutical
- Pulp & Paper
- Rubber & Plastics
- Semiconductor
- Textile
- Waste Incineration
- Animal Feed Processing

## Packages Systems

Croll Reynolds specializes in packaged, custom-designed, air pollution control systems. Our units arrive on site, skid-mounted with integrated instrumentation, piping and controls. To ensure trouble-free service, Croll Reynolds' air pollution control systems are run-tested at our shops before shipment.

## Materials of Construction

FRP (fiberglass reinforced plastic) and stainless steel are commonly used in the manufacture of air pollution control equipment. Materials of construction vary according to application however. Our design engineers are well-versed in the

use of high-nickel alloys, non-ferrous metals, thermoplastics and thermoplastic-lined materials. Corrosion-resistant plastics and metals are often used in the fabrication of internal components. Croll Reynolds' air pollution control equipment meets or exceeds all applicable industry standards.

## CASE STUDY:

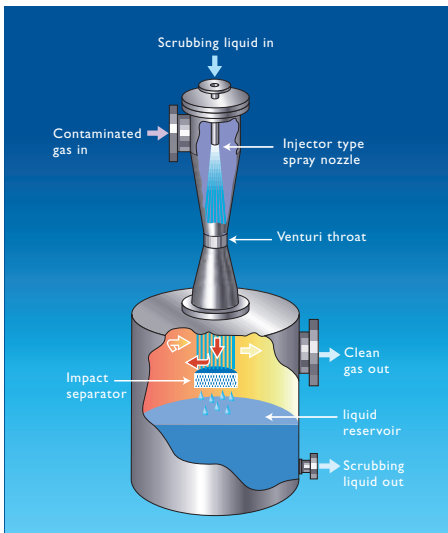
### Systems Work Together for HCl Removal and Recovery

A specialty chemical manufacturer was looking for a way to remove HCl from its off-gas before it was discharged to the atmosphere.

Croll Reynolds designed and manufactured a system which uses two Jet Venturi Fume Scrubbers in series, followed by two Packed Towers in series. Intimate mixing of the gas stream and scrubbing liquid allows the Jet Venturi Scrubbers to remove 98% of the HCl and the Packed Towers to remove the remainder. The Jet Venturi Scrubbers collect 98% of the HCl while creating a marketable aqueous HCl solution. The Packed Towers recirculate the diluted NaOH solution, and "polish" the gas stream to meet ultra low HCl discharge limits.

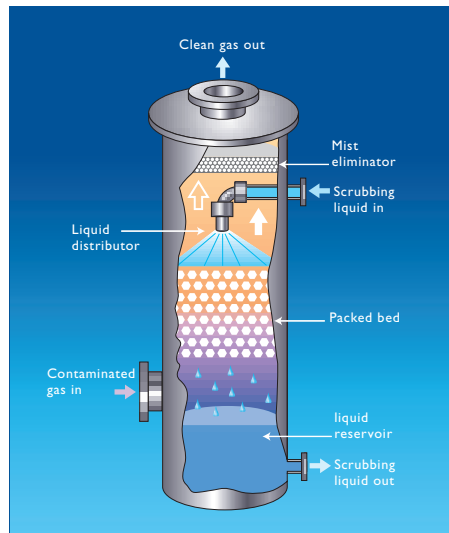
The units have proved to be virtually maintenance free, with final emissions concentrations of approximately 2 PPM. Liquid waste production is minimal and the recovery of salable HCl has offset the cost of the system.

**About The Cover:** Croll Reynolds provides its technology for the Strategic Defense Initiative. It is one of the world's largest vacuum and air pollution control installations.



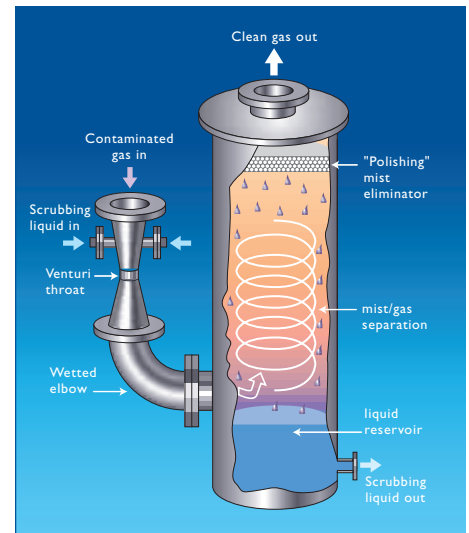
### JET VENTURI SCRUBBER

Motivating fluid exits the nozzle in a hollow cone spray pattern, creating a draft. Contact between the scrubbing liquid and the gas results in high gas mass transfer and/or particulate capture without the need for a blower. The mixture discharges into a Croll Reynolds designed separator.



### PACKED TOWER SCRUBBER

Utilizing the most current packing designs to provide contact between gas and liquid streams, the Packed Tower Scrubber achieves the extremely low toxic gas discharge limits required to meet emission standards.



### HIGH ENERGY VENTURI SCRUBBER

Energy from the high-velocity contaminated gas stream laden with sub-micron dust particles and toxic gases is used to atomize the scrubber liquid. Intense liquid/gas mixing occurs in the HE Venturi throat, scrubbing the toxic gases and encapsulating the dust in the liquid. Proprietary gas flow patterns in the separator efficiently separate the liquid droplets from the clean gas. The clean gas exits to atmosphere while the scrubber liquid is returned to the sump.

## WET SCRUBBERS

### Jet Venturi Scrubber

The Jet Venturi Scrubber utilizes a liquid motivated ejector design to entrain contaminated gases, generally without the need for a blower. The relatively high liquid-to-gas ratio, liquid atomization, and open internal design provide effective scrubbing of heavily contaminated gases with minimal maintenance and virtually unlimited turndown capabilities.

Its ability to handle wide ranging conditions while removing both toxic gases and particulate matter makes the Jet Venturi one of the most flexible designs available. It is often used as a first stage in a multi-stage pollution control system.

### Packed Tower Scrubber

The Croll Reynolds Packed Tower Scrubber utilizes a vertical counter-current design for efficient absorption of a variety of toxic gases. In addition to its extensive uses in air pollution control, the Packed Tower can serve as a gas/liquid contactor in a number of process applications. Efficiencies of 99.9% and greater

are not unusual for many scrubbing applications.

During operation, gas flows upward through a packed bed while scrubbing liquid flows down (by gravity) over the packing material. The counter-flow design principle offers optimal mass transfer. Croll Reynolds supplies cross flow and co-current flow Packed Tower designs as well.

### High Energy Venturi Scrubber

The High Energy Venturi Scrubber is ideally suited to the capture of small particles between 0.5 and 3 microns. Its effectiveness in the sub-micron range is critically dependent on gas-side pressure drop. This design requires little or no maintenance.

For applications where variation in flow require throat velocity compensation to maintain specified scrubbing efficiencies, Croll Reynolds offers both automatic and manual variable throat designs. The automatic throat is used where flow conditions vary widely and frequent adjustments are required. When occasional variations occur, a manually-controlled throat is generally sufficient.

### Quality and Customer Service

Croll Reynolds' reputation for the highest quality is an outgrowth of its years of service to the process industries. Since 1917, when it became the preeminent supplier of custom-designed process vacuum systems in the world, Croll Reynolds has engaged in an intensive program of design, development and quality control.

Quality Control is a prime focus at Croll Reynolds for every project, from design through manufacture and delivery. At our Research and Test facility, the quality of each design is confirmed prior to shipment.

As a further service to our customers, life-cycle records are maintained on every system, including component specifications, detailed parts and construction materials lists and performance data.

After installation, Croll Reynolds engineers are available to answer question concerning applications and system operations, while trained field representatives stand ready to assist on site.

## SPECIALIZED APPLICATIONS

### EtO/PO Scrubbers

Ethylene Oxide gas (EtO) is used to reduce or render inactive microbial populations in sterilization processes. EtO sterilizes materials and products that would be damaged by conventional sterilization techniques which employ heat, moisture, or radiation. Propylene Oxide (PO) and Ethylene Oxide are also used as precursors in the production of a number of critical chemicals.

Croll-Reynolds' proprietary EtO/PO scrubbing systems utilize absorption and hydrolysis of these oxides to glycols to effectively treat EtO and PO contaminated gases. Efficiencies greater than 99.9% are guaranteed. Fully automated systems are available.

### NOx Scrubbers

Conventional scrubbers are limited to low NOx removal efficiencies due to the nature of the aqueous absorption chemistry involved. Croll Reynolds' patented "High Surface Area" media effectively overcomes those limitations — without the need for exotic or expensive chemicals or a costly and complex operational scheme.

This technology is particularly well suited for applications where an orange plume is produced by high levels of NOx.

### UOP CCR Platformer CYCLEMAX™ Regeneration Section

Croll-Reynolds is the specified supplier of the UOP CCR Platformer CycleMax™ regeneration section venturi scrubbers. We supply the proprietary HASTELLOYS C276/2000 venturi scrubber that is one of the keys to the CycleMax™ regeneration section's success. The venturi helps remove HCl/Cl<sub>2</sub> gases from the regenerator thus maintaining the critical HCl/Cl<sub>2</sub> balance in the catalyst bed. This contributes to extended catalyst life and higher yields.



## PROVIDING WORLDWIDE SOLUTIONS

With Manufacturing, Research and Test facilities in the Far East as well as in the United States, and a worldwide network of representatives, Croll Reynolds has emerged as a leading supplier of high-performance air pollution control equipment to the world.

From the Pharmaceutical Plants of New Jersey to the Oil Refineries of Brazil; from the Industrialized Plains of India to the Palm Plantations of Malaysia; Croll Reynolds is the resource for innovative engineering and unparalleled expertise.

Croll Reynolds began manufacturing air pollution control systems in the 1950s utilizing technology developed by its

Vacuum Division. The synergy between divisions continues to offer a powerful design and engineering advantage unique to the industry.

Croll Reynolds' Vacuum Division designs and manufactures steam jet ejectors; combination ejector/liquid ring pump systems; vacuum chilling systems; thermocompressors; and other related equipment. Croll Reynolds products are sold throughout the world by factory-trained process vacuum system specialists.

Call or e-mail us for the office location of the factory-trained process vacuum or air pollution control specialist nearest you.



Croll-Reynolds' Corporate Headquarters, Parsippany, NJ.



Croll-Reynolds' Quality Control, Research and Test facility, Teterboro, NJ.



Croll-Reynolds' China Headquarters with manufacturing, Shanghai, China.



Croll-Reynolds' India offices with manufacturing, Ahmedabad, Gujarat, India.

# CROLL REYNOLDS

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