



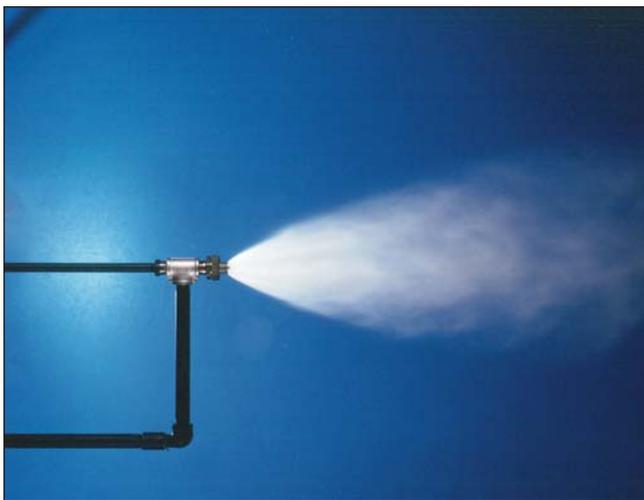
# Bionomic Boiler MACT Emission Control Technologies

## Introduction

Bionomic Industries' extensive line of field-proven, cost effective wet and dry scrubber and electrostatic technology choices can easily and economically help you achieve compliance with EPA Boiler MACT regulations for hydrochloric acid, particulate or mercury control.

Bionomics' wide range of equipment enables selection of the best control technology to remove a specific or combination of MACT regulated pollutants to meet your particular facility requirements. This results in a system that achieves performance compliance yet is cost effective in terms of both initial capital investment and operating costs.

All Bionomic flue gas emission control products described below are engineered for reliable trouble-free operation and designed to work seamlessly with your boiler to maintain smooth uninterrupted power-house operation. All systems are backed by our 25 years of expertise and experience in providing complete and successful air pollution control solutions worldwide.



*ULTIMIX™ Mist Nozzle*

## Wet Technology Options

### ULTIMIX™ Inline Mist Scrubber

The Bionomic ULTIMIX™ Inline Mist Scrubber incorporates our highly effective droplet absorption technology to efficiently remove hydrochloric acid in an extremely low-cost, space saving arrangement.

This simple system utilizes our revolutionary ULTIMIX mist nozzles mounted on lances which are positioned within properly-sized existing duct runs, new ducting or an exhaust stack. ULTIMIX nozzles are engineered to create an extremely fine and uniform liquid scrubbing mist utilizing either hydraulic pump pressure or two phase shear air pressure from a compressor. The ULTIMIX's extensive average droplet generation of over a billion droplets creates a huge amount of liquid surface area for rapid gas cleaning. ULTIMIX is an extremely flexible design that can be configured in either single or multiple mist zone arrangements to achieve the required removal efficiency of the acid gas.

In operation, an alkaline compound, typically sodium hydroxide or carbonate, is used as the scrubbing liquid and fed to the mist nozzles. The generated mist after scrubbing the hydrochloric acid is later removed with specially designed, high efficiency mist eliminators. The captured scrubbing liquid drains to effluent treatment, or is partially recycled from an external recycling tank containing fresh scrubbing liquid and fed back to the ULTIMIX nozzle lances.

A special spray dryer version of the ULTIMIX system is also available for installations with electrostatic precipitators. In this arrangement, the electrostatic precipitator is used to collect a dry sodium chloride reaction by-product with the fly ash.

The ULTIMIX system features a low-pressure drop requirement, normally 1 inch w.c., which enables the use of existing fans in most cases.

### Series 5000 Packed Tower Scrubber

The Bionomic Series 5000 Packed Tower Scrubber incorporates high performance packing components for maximum hydrochloric acid gas removal capability of over 99% with low energy requirements. This scrubber type is ideally suited to follow particulate precleaning devices such as a baghouse or electrostatic precipitator.



During operation, boiler flue gas to be scrubbed enters the lower section of the tower and flows upward through a packed bed containing 2 to 3-1/2 inch size ring-shaped packing placed in random fashion. This packed bed offers tens of thousands of square feet of contact surface area between the gas and scrubbing liquid in an average size scrubber. A scrubbing solution consisting of water or chemical reagent is distributed evenly through nonclog type spray nozzles over the top of the packing. It then flows downward through the bed in a countercurrent direction to the gas, thoroughly wetting the packing surfaces. The flue gas follows a torturous path through the bed, thoroughly mixing with the wetted packing components while absorbing and removing the acid gas in the liquid films created. The scrubbing liquid then drains into the integral sump section of the tower and is discharged for wastewater treatment in a once through system. If the scrubbing solution is recirculated with additional chemical reagent, it is returned to the packed bed using a centrifugal circulation pump.

The Series 5000 Packed Tower is energy efficient with a pressure drop of only 1 to 2-1/2 inches w.c. during operation. The scrubber is best suited for use with either once through water or basic sodium chemical scrubbing solutions.

### Series 6000 Sieve Tray/Bubble Cap Scrubber

The Bionomic Series 6000 Sieve Tray/Bubble Cap Tray Scrubber employs our proprietary Lo-Flo Tray in a perforated sieve or bubble capped riser design. It is capable of scrubbing out both fly ash particulate and hydrochloric acid contaminants. Our tray scrubbers are less susceptible to plugging from particulate in the gas stream than a packed tower design, while offering up to 99% hydrochloric acid removal and fairly high particulate removal.

Depending on the removal efficiency needed, the number of tray levels supplied can vary between two and five. Pressure drop ranges from 3 to 11 inches of w.c. for this type of scrubber.



During operation, the gas to be cleaned flows vertically upward into the tray section through the sieve holes or capped risers, which can vary up to 1-inch diameter. Scrubbing liquid is introduced to the top tray where it flows in a horizontal cross flow direction to the gas rising over the tray's surface. The gas velocity through the tray openings, holds the liquid up on the tray and creates a froth layer where violent gas and liquid contact occurs to

remove particulate and acid gas. After traveling across the tray, the liquid flows over a weir and down to each successive tray level for further scrubbing and contaminant removal. The spent liquid finally cascades into the sump section of the scrubber vessel and discharged on once through water arrangements, or retained in the sump for recirculation and reuse when a chemical reagent scrubbing solution is used.

The unique design of the Bionomic Lo-Flo Tray Scrubber enables use of water condensate or other industrial effluent sources to completely eliminate or reduce unit operating cost. If unavailable, sodium or calcium based chemical reagents can be used for the scrubbing liquid.

### Series 7000 Adjustable Throat Venturi Scrubber

Bionomic's Series 7000 Adjustable Throat Venturi Scrubber is the preferred wet scrubber choice for meeting MACT compliance when both particulate and hydrochloric acid need to be controlled. With hundreds installed, it is field-proven to effectively meet virtually any emission reduction requirement.

An inherent advantage of this extremely flexible scrubber design is the adjustable throat compensator. This provides the ability to vary or maintain collection efficiency while accepting large turndowns in flue gas flow rates. It is ideally suited for multiple boiler installations or large fluctuations in boiler output.



In operation, scrubbing liquid is introduced to the scrubber through fully open nonclog pipe headers. The contaminated gas enters through the top of the venturi scrubber with the scrubbing liquid in a cocurrent flow arrangement. The gas and scrubbing liquid then enter into a narrow throat section where a high-pressure drop accelerates the gas and shears the scrubbing

liquid into extremely fine small micron-sized droplets to impact and collect the particulate. At the same time, soluble hydrochloric acid gas is absorbed. The agglomerated scrubbing liquid with contaminants then enters into a cyclonic entrainment or impingement separator vessel, where a chevron mist eliminator removes liquid with captured particulate from the gas stream before exiting the unit.

The scrubbing liquid then drains into an integral sump section of the scrubber where constant discharge of scrubbed particles along with liquid makeup takes place. Scrubbing liquid is constantly recirculated back to the distributors with a feed pump.

This extremely adaptable scrubber design can utilize a wide variety of chemical reagents when hydrochloric acid removal is needed. The list of satisfactory reagents includes: hydrated lime, soda ash, and caustic. Based on the specific particulate collection efficiency required, and boiler flue gas output, the Series 7000 Adjustable Throat Venturi's pressure drop normally ranges between 6 and 20 inches w.c.

### Series 9700 Spray Tower

Bionomic's Series 9700 Spray Tower is a simple yet complete spray type scrubber for removal of hydrochloric acid. Highly efficient, this scrubber is capable of achieving over 98% removal of the acid gas. The Series 9700 Spray Tower consists of an open, vertical cylindrical vessel fitted with banks of hydraulically atomized spray distributors. This scrubber can be used on particulate laden gas streams or with scrubbing liquids containing heavy solids due to its open, no obstruction interior design. To reduce operating costs, all Series 9700 Spray Towers are fitted with proprietary, large passage size spray nozzles to enable use of scale forming lime as a scrubbing reagent.

In operation, the scrubbing liquid is introduced at medium pressure to large open passage nozzles arranged on pipe headers. The scrubbing liquid pumped at a high rate is atomized into coarse droplets in the nozzles to create a deluge of torrential rain within the vessel. Intimate contact between the gas contaminants and scrubbing liquid droplets absorbs the hydrochloric acid and collects through impaction fly ash particulate. Several spray headers are arranged in banks to form spray zones to ensure thorough gas washing. Each subsequent zone increases the removal efficiency of the hydrochloric acid to achieve the needed outlet loading.

Scrubbing liquid is constantly recirculated from an integral sump to the spray headers using a pump. A partial but constant blow down of spent scrubbing liquid and a continuous fresh liquid makeup keeps solids concentration in the liquid within desired levels.

The Series 9700 Spray Tower's large gas turndown capability is the key advantage that enables this simple scrubber to be installed on one or more boilers with large fluctuations in steam output. This scrubber features a low 1 to 2 inch w.c. pressure drop, which in many cases allows usage of the existing boiler fan.



## HEI™ Wet Electrostatic Precipitator

When the application also involves meeting MACT elemental mercury removal standards that result when burning low chloride containing coals, the Bionomic's HEI™ (High Energy Ionization) Wet Electrostatic Precipitator is the leading, low cost solution for tackling this problem. The HEI WESP represents a major breakthrough in the advancement of fine particulate mercury control.

At the inlet of the HEI WESP, the untreated boiler gas is first presaturated with a water fog to enable more efficient charging of the mercury particulate. The gas then passes into the particle charging and collecting zone. Utilizing a high intensity ionized corona charging principle, mercury and other particles are charged using individual, rigid mast ring charging electrodes centered within hex shaped collecting tubes. Mercury and other particulate charged with the ionized gas are swept onto the collecting surface of the tubes where an automatic water wash system is periodically triggered to clean the tubes. The unique design of the HEI WESP allows online cleaning of collected particulate while maintaining the required removal efficiency. The remaining water can then be recycled for reuse after particle filtering.

The HEI WESP features extremely low-pressure drop so existing fans normally do not require replacement. Units are available in both a gas downflow and upflow design to more easily meet layout constraints.



HEI™ Wet Electrostatic Precipitator

DRI-SORB™

## Dry Technology Options

### DRI-SORB™ Sorbent Injection or Semi-Dry Systems

The Bionomic DRI-SORB Dry Scrubber System utilizes a pulse jet fabric filter collector in combination with either a dry sorbent injection or inline semi-dry spray system that uses various chemical reagents to remove both hydrochloric acid and particulate. This technology produces a dry by-product for ease of disposal, and is best suited for plant sites that are unable to treat a liquid effluent discharge.

The dry sorbent injection system utilizes hydrated lime or bicarbonate as the scrubbing reagent. The semi-dry spray system uses a liquid slurry of hydrated lime, sodium carbonate or sodium bicarbonate. If mercury removal is also required, a secondary injection system utilizing activated carbon is added to adsorb the elemental mercury vapor.

Typically a basic DRI-SORB scrubber system includes a pulse jet fabric filter collector, dry venturi scrubber or slurry absorbent spray system to ensure proper reagent dispersion into the gas stream, and reagent storage silo with necessary reagent preparation and feed equipment. Conveyors transfer the ash and salt reaction by-products from the system to a storage hopper for a predetermined method of disposal.

In operation, boiler gas containing acid gas and particulate that need to be removed pass through either an absorbent spray system or dry venturi where they are mixed with the chemical reagent. Temperature of the flue gas is normally controlled within a range of 275 to 375 degrees Fahrenheit using damper controlled dilution air, a heat exchanger or moisture addition. The type of reagent and injection method determines the specific temperature requirement.

In the semi-dry spray version, the reaction between acid gases and scrubbing liquid occurs in the ductwork, and the salt particulate with fly ash is removed in the fabric filter collector. In the sorbent injection type, the dry reagent powder is thoroughly mixed in the dry venturi and dispersed into the gas stream. This mixture enters the fabric filter collector where the majority of acid gas removal occurs in the filter bags, which become coated with the injected reagent. For both system types, the collected cake on the filter bags is periodically removed by pulse cleaning using compressed air. The solids are then discharged into the bag-house hopper section for removal and disposal in a dry form.

The DRI-SORB system is capable of achieving over 99% removal of particulate emissions and 98% of the hydrochloric acid. The typical pressure drop allowance across these systems can vary between 8 and 11 inches w.c.

## Complete System and Turnkey Installation Capabilities

All Bionomic scrubber and electrostatic devices can be supplied in our ScrubPac™ concept as a complete, pre-engineered packaged system. Purchasing a ScrubPac system saves project and systems engineering costs, guarantees a high quality, reliable system, and reduces startup time.

ScrubPac systems include all necessary auxiliary equipment and components required such as recirculation pumps, piping networks, ductwork, chemical reagent feed system, instrumentation, controls, induced or forced draft fan and exhaust stack. The end result is single source supply and responsibility. All components provided in our ScrubPac systems are field-proven for reliability and operating flawlessly in hundreds of installations worldwide.

If you are also looking for a reputable firm to install and manage your MACT compliance project, Bionomic Industries has the capability to provide a complete Turnkey Solution inclusive of project management, installation, supervision, and startup services. Our experienced professionals install your system and make sure it is maintained properly for smooth operation under our system startup and employee training program. After startup, your operating personnel are instructed on all aspects of proper system function, troubleshooting, and maintenance.

## After Sales Service Program

Bionomic Industries also offers an optional OPTI-SCRUB™ program to ensure your system operates smoothly and operating costs are kept in check. With this program "near-real-time" system operation can be monitored and diagnosed remotely by our experienced team of engineers. In this manner, we can provide helpful assistance in correcting any problems that may arise and ensure the system is functioning at optimum and needed performance levels.

ULTIMIX™, HEI™, DRI-SORB™, ScrubPac™, and OPTI-SCRUB™ are trademarks of Bionomic Industries, Inc.



To request additional information or to speak to one of our sales engineers about your particular Boiler MACT compliance project needs, please contact us at:



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