

PACKED BED FUME SCRUBBERS



30,000 CFM Horizontal Packed Bed Scrubber with polypropylene construction to remove chemical fumes emitted from acid-dip tanks at a semiconductor manufacturing facility. Dual-train exhaust ductwork with automated dampers and FRP fans provides maximum control over the scrubbing process.



Two-stage Packed Bed Scrubber to remove acids and alkalis from dryer exhaust gas

Monroe Environmental® is a single source solution for highly durable and efficient Packed Bed Scrubbers. A Packed Bed Scrubber is a wet scrubber that removes acids, soluble gasses, chemicals, fumes, and odors. Contaminated gas flows through a specially designed packing media that is wetted with recirculated liquid. The liquid solvent absorbs the gas pollutant by physical or chemical means. A blowdown from the reservoir with makeup water addition removes contaminant products before they precipitate.

- Capacities: 10 – 75,000 CFM with a single unit
- Efficiencies to 99.99%
- Vertical and horizontal configurations
- Counter-flow and cross-flow models
- Cylindrical and rectangular construction designs
- Pre-quench and venturi stages available
- Pilot systems available for application and process testing

Design Features

- Materials of construction include:
 - FRP
 - RTP (Reinforced Thermoset Plastic) and dual laminate
 - PVC and CPVC
 - Polypropylene and polyethylene
 - Stainless steel, mild steel, and FRP-lined mild steel
 - Nickel alloys
 - Titanium
- Wide range of packing media including rings and saddles in various materials. Structured packing is also available.
- Complete instrumentation and electrical controls are available for stand alone operation or connection with a facility's centralized control or monitoring systems.
- Chemical treatment, including oxidation and neutralization, is available to increase absorption of gaseous pollutants.
- pH control available when applicable.

- Corrosion resistant AMCA rated fan on the inlet or outlet side of the scrubber.
- Corrosion resistant recirculating pumps for scrubber liquid recirculation.
- Non-plugging spray nozzles for wetting packing in a wide range of corrosion resistant materials. Special liquid distributors may also be used.
- Moisture eliminators with chevron, mist pad, or loose fill type designs.

Applications

- Acid fumes and gasses
- Chemical fumes and odors
- Food processing odors
- Landfill gasses
- Metal finishing fumes
- Steel processing fumes
- Wastewater treatment plant odors
- And many others



12,500 CFM scrubbing system for HCl and Cl₂ removal from RTO exhaust



Fume Scrubbing: 1,200 CFM Packed Tower Scrubber; PVC construction with top-mounted fan for removal of iodine fumes from reactor tanks

Efficient Fume Scrubber Design

Monroe Environmental Packed Bed Scrubbers are custom designed to meet or exceed the specific removal efficiency required for each customer's application and process. To optimize the performance of each unit, Monroe will analyze:

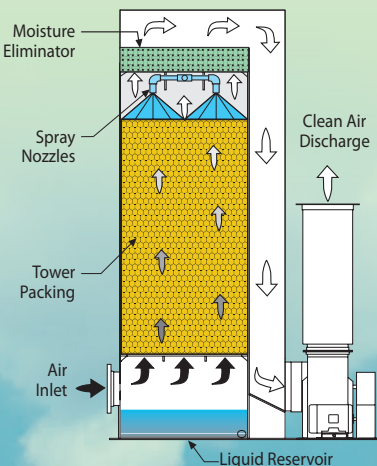
- Contaminant solubility
- Vapor pressures
- Wash liquid flow rate
- Liquid to gas ratio
- Packing chamber height, diameter, and volume
- Packing media type and size
- Chemical additives
- pH control
- Precipitation of reaction products
- Multiple solution scrubbing
- Required scrubbing stages
- Pressure drop across packing
- Materials of construction
- Site requirements



Non-plugging spray nozzles above bed of loose fill polypropylene packing

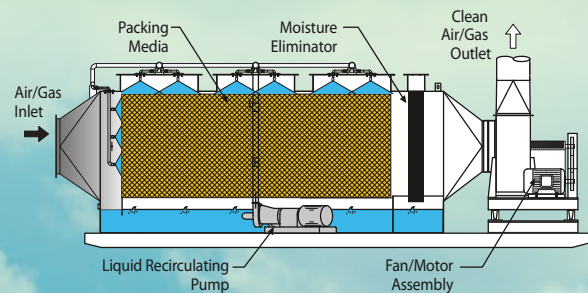
Vertical Packed Bed Scrubber

This is a counter-flow design that has contaminated gas flowing upwards and recirculated liquid spraying downwards through the packing media. Vertical scrubbers typically have a smaller footprint and can have greater removal efficiency than Horizontal Packed Bed Scrubbers. Multiple scrubbing stages with different scrubbing solutions can be achieved by having more than one scrubbing tower in series.



Horizontal Packed Bed Scrubber

This is a cross-flow design that has recirculated scrubbing liquid flowing vertically downwards while the gas passes horizontally through the packing section. This design is more tolerant of solid particulate that may be contained in the air stream. A Horizontal Packed Bed Scrubber is appropriate when limited headroom is an issue, and it also allows for multiple stages in one housing with separate sumps and scrubbing solution pumps if required.



SCRUBBING APPLICATIONS & ENGINEERING

Monroe Packed Bed Scrubbers have been used effectively to remove a wide range of air pollutants in many industrial and municipal applications. We will evaluate your application requirements to determine the optimum design parameters — a custom solution for your plant.

Air Pollution Control Expertise

Monroe Environmental has experience scrubbing many air pollutants in addition to those listed below. Depending on the application other scrubbing liquids for the listed pollutants may be more appropriate.

- Acid gas scrubbing — (HCl, HF, HBr, HCN, HNO₃, H₂S, etc.)
- Halogen vapors (Cl₂, F₂, Br₂)
- Sulfur compounds (hydrogen sulfide: H₂S, sulfur oxides: SO₂, SO₃)
- Ammonia (NH₃)/amines
- Chromic acids (H₂CrO₄, H₂Cr₂O₇)
- Ethylene oxide (C₂H₄O)
- Ethylene glycol (C₂H₆O₂)
- Formaldehyde (CH₂O)
- Boron compounds (BCl₃, BF₃)
- N-Methylpyrrolidone (NMP) (C₅H₉NO)
- As well as other water or chemically soluble pollutants

Common Scrubbing Liquids

- Sodium hydroxide (NaOH)
- Sodium hypochlorite (NaOCl)
- Potassium hydroxide (KOH)
- Sodium carbonate (Na₂CO₃)
- Sulfuric acid (H₂SO₄) and other acids
- Hydrogen peroxide (H₂O₂)
- H₂S Scavenger
- And many others

Chemical Addition

- Aqueous solutions of the scrubbing chemical react with the gaseous pollutant to increase absorption of the gas into the liquid.
- In some applications, when solubility is high, water alone may be used as the scrubbing liquid.
- Vapor pressure, solubility, and pH are some of the factors that Monroe Environmental will take into consideration when designing a system to maximize removal efficiency.



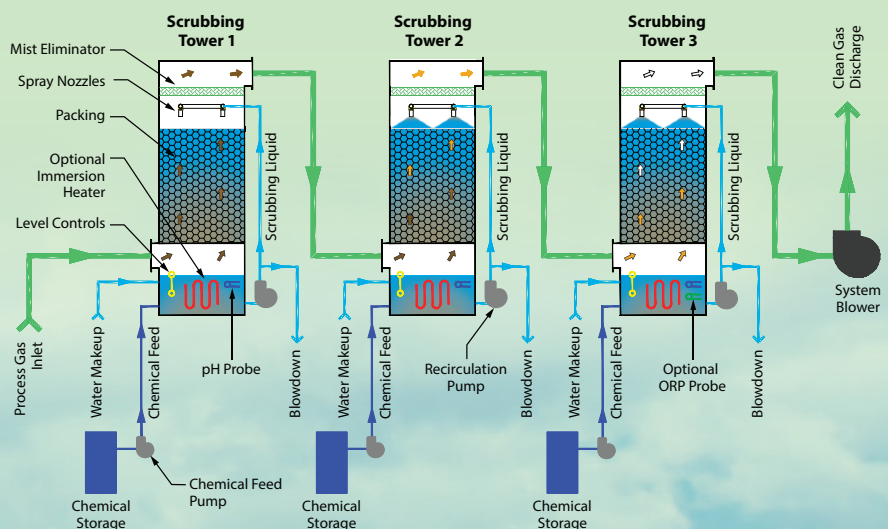
13,500 CFM skid-mounted Horizontal Packed Bed Scrubber, stainless steel construction to scrub acid and caustic fumes

Multi-Stage Air Scrubbing Systems

Multiple scrubbing stages with different scrubbing solutions can be achieved by providing multiple scrubbing towers in series. These configurations can provide the highest removal efficiencies as well as multiple gas constituent removal. The diagram includes three towers in series that could be used for H₂S and ammonia removal.

Additional components that may be necessary to properly treat a given air stream can include:

- Quench Towers
- Venturi Scrubbers with clarification tanks (for particulate removal)
- Carbon Adsorbers
- Fiberglass filters
- And many others





Packed Tower Scrubber for SO₂ removal from waste incinerator exhaust, 316 SS construction



Acid Gas Scrubbing: 1,500 CFM Packed Tower Scrubber, stainless steel pressure vessel construction to remove H₂S from syngas for a diesel fuel conversion process



High pressure scrubbing system to remove sulphur compounds from a propane gas supply



Sulfur Dioxide Scrubbing: SO₂ Scrubber with Quench Section and Packed Tower



7,500 CFM skid-mounted Horizontal Packed Bed Scrubber, polypropylene construction to capture and remove NaOH fumes from kiln exhaust