

DUALL

Beta NO_x 2000[®] Wet Scrubbers

*SINGLE AND MULTIPLE STAGE
HIGH EFFICIENCY NITROGEN OXIDE
SCRUBBING SYSTEMS*



Over 99% efficient on
total NO_x removal

The safest oxidation/
reduction technology

Cost effective

Corrosion resistant

Eliminates the red NO_x plume

Low profile, space
saving design available

RESEARCH AND DEVELOPMENT

Until the late 1980's, high efficiency total NO_x (NO+NO₂) wet scrubbing was not available commercially. The stability and relative insolubility of the NO component of NO_x was the reason. Duall systems engineers recognized this problem and designed a super efficient NO oxidation system to provide the market place with a total NO_x wet scrubbing process. Currently, the competitive nature of the market has made better operating efficiency for this type system a requirement. Again, Duall has responded.

Duall, through research and development with the University of Michigan Chemical Engineering Department, has developed a unique, high efficiency wet oxidation/reduction approach to control your NO_x emissions. Refining and updating this process has led to a new generation of total NO_x scrubbers for the chemical process industry.

The table below is a sample of independent third party test results, demonstrating the incredible oxidation efficiency of NO to NO₂ in a Beta NO_x 2000® system, as well as simultaneous destruction of SO₂.

	Test#1 Inlet	Test#1 Outlet	Test#2 Inlet	Test#2 Outlet
Nitric Oxide ppbv	943	<1.0	1010	<1.0
Nitric Oxide lb/hr	0.19	<0.0002	0.21	<0.0002
Sulfur Dioxide ppbv	509	2.8	1091	1.0
Sulfur Dioxide lb/hr	0.22	0.001	0.48	0.0004
Scrubber Efficiencies	Nitric Oxide Test#1	Nitric Oxide Test#2	Sulfur Dioxide Test#1	Sulfur Dioxide Test#2
	99.9%	99.9%	99.4%	99.9%

Testing occurred in August of 1995. Scrubber tested was operating at 45,000 ACFM at essentially ambient conditions. Test methods using certified gas standards were: USEPA 7 for NO and USEPA 6 for SO₂. A chemiluminescent analyzer was the analytical device.

PERFORMANCE GUARANTEE

All Duall Beta NO_x 2000® systems are warranted to perform as outlined in our Basis of Design. Please contact Duall for a complete copy of our "Performance Guarantee for Nitrogen Oxide (NO_x) Scrubber Systems" (Form Number G-26).

TYPICAL APPLICATIONS

- Aluminum anodizing and bright dip
- Precious metals refining
- High alloy steel etching
- Chemical nitration



Application: Aluminum Etching
Problem: NO_x, HNO₃, HF
Solution: Beta NO_x 2000® Single Stage



Application: Specialty steel production (acid etching)
Problem: NO_x and mixed acid fumes
Solution: Beta NO_x 2000® Two Stage



Application: Oxidation/Reduction of NO_x
Problem: Total NO_x = NO + NO₂
Solution: Beta Nox 2000® Three Stage

SINGLE STAGE BETA NOx 2000®

This is a high-efficiency single stage wet absorption system. This system is used to destroy the brown/red color associated with nitrogen dioxide. System designs can be warranted up to 99% NO₂ removal based on customer needs. If the ratio of NO₂/NO is three or greater, the system can significantly remove the nitric oxide component of NO_x as well (up to 70% removal of NO component). The system design incorporates pH and ORP control for automatic caustic and reducer additions. It is sometimes possible to scrub the nitrogen dioxide component with pH control only, depending on specific conditions and requirements.

This system is a compact, easy to use, and cost effective means to control NO_x fumes from your process equipment.

TWO STAGE BETA NOx 2000®

There are two types of dual stage scrubbing systems for NO_x treatment. The first is an oxidation/reduction system used to control both Nitric Oxide and Nitrogen Dioxide. The equipment arrangement is specific for the inlet condition where nitric oxide is the predominant NO_x species present. The first stage is used to oxidize excess Nitric Oxide, with the second stage being a reduction of nitrogen dioxide. The end product is harmless. The system uses a caustic pH control for each recirculation tank. ORP control of the oxidation chemical occurs in Stage 1 recycle tank and ORP control of reducer chemistry in Stage 2 recycle tank. Warranted total NO_x destruction of up to 99% is achievable with this style system.

The second version of this two column arrangement is a caustic absorption/reduction system used to control very high levels of Nitrogen Dioxide. This style system is designed to minimize chemical usage of reducer by incorporating pH control only in Stage 1 with pH/ORP controls in Stage 2.

THREE STAGE BETA NOx 2000®

This reduction/oxidation/reduction style system is required where Nitrogen Dioxide is the predominant NO_x species present, but total NO_x control including Nitric Oxide is necessary. This system allows for removal of the Nitrogen Dioxide component prior to oxidation to use the oxidant more cost effectively. Stages #1, and #3 are identical, both being Nitrogen Dioxide reducing columns. Stage #2 is the oxidizing step. Total NO_x destruction of up to 99% is achievable with this multi-stage arrangement, while minimizing chemical costs and offering a high degree of operational flexibility.

STANDARD FEATURES

- C-channel steel skid mounted recirculation tanks with PVC corrosion resistant coating.
- UV-resistant thermoplastics for outdoor applications.
- Hot gas and extrusion welded construction.
- Homogenous thermoplastic construction for complete corrosion resistance, and simple repair/maintenance.
- Hydrostatic factory testing.
- Easy pop-out access doors.
- PVC schedule 80 piping.
- Full union PVC ball valves.
- Sealless vertical pumps (factory mounted).
- Packing removal doors.
- Differential pressure gauges.
- Heavy-duty flanges.
- Heavy-duty scrubber bottom.
- 316 stainless steel hardware.

OPTIONS

- Automatic liquid hold up valves for on/off service.
- Tank agitation.
- Automatic control valving with proximity position indicators.
- Variable frequency drives.
- Balanced ventilation systems.
- Factory assembled and operated systems.
- Local motor disconnects.
- Chemical tanker off-loading stations and storage tanks.
- Structural framing and catwalk assemblies.
- P. E. stamped equipment designs.
- On-line mass balancing.
- Blowdown waste treatment tank systems.
- Tail gas odor control safety systems.
- PC operator interface and PLC control system.
- High efficiency acid aerosol fiberbed control columns.

SCRUBBER SYSTEM COMPLETE DESIGN CAPABILITY

- Wet and dry particulate control.
- Hot gas quenching.
- Condensers.
- Heat Exchangers.
- Multi-stage mist collectors.
- Hoods and duct.

GENERAL EQUIPMENT SPECIFICATIONS

NOx Exhaust Gas Scrubbers: Scrubbers shall be designed for specified collection removal efficiency of air contaminants arising from the process equipment listed herein. Collection efficiencies shall apply to the unit as a whole, including mist eliminators downstream of the packing. Overall mass collection efficiency shall be ___% or better at design gas flow.

Field pilot system and stack testing services available. These costs are applicable to purchase of beta NOx 2000® system.

NOTE: Consult factory for field/pilot testing services terms and conditions.

Corrosion Resistance:

1. Scrubbers, including all internals and appurtenances, shall be completely resistant to chemical corrosion from the process equipment listed herein.
2. Scrubber housing shall be constructed of Type II, Grade I, high-impact polyvinyl chloride (PVC) conforming to ASTM D 1784-69 Cell 1433D. Outdoor installation shall be white PVC for UV resistance, polypropylene, or FRP/PVC, fiberglass with PVC liner.

Base: Each scrubber shall be complete with a corrosion-resistant coated steel base of sufficient strength to make the unit self supporting when wet.

Scrubber Piping:

1. Furnish all scrubber internal piping necessary for recirculation of scrubber solution such that installer need only make single external piping connections for scrubbing solution supply and return. Piping shall be polyvinyl chloride (PVC). Wherever possible, piping shall be installed at the factory. Interior piping to be removable through access doors for maintenance.
2. Spray nozzles shall be full cone non-clogging type of sufficient quantity to insure complete coverage of the packing face. On horizontal scrubbers, overhead spray headers shall be provided to prevent channeling of the gas stream.

Pumps: Recirculation pumps shall be vertical sealless centrifugal chemical duty type, constructed of materials completely resistant to corrosion from all contaminants listed herein are standard. Pump motors shall be single-speed, NEMA Design B, Class-B insulated, 230/460 volts, 3-phase, 60-hertz. All external pump and drive components shall be of corrosion-resistant construction or otherwise epoxy-coated. Pumps shall be securely mounted to sump box or remote tank. Pumps shall be sized to handle a minimum of 40 feet of head on self-contained and 70 feet of head on remote recirculation systems. Horizontal ANSI B73.1 Type Recirculation Pumps are optional.

Remote Recirculation Tanks: If required, each scrubber will be furnished with a remote recirculation tank to be constructed of PVC, Polypropylene, PVC/FRP overlay, or FRP. Fittings will be provided on the tank for pump suction, overflow, and drain. Tanks shall be of sufficient capacity and structural rigidity for intended

service. Tank freeboard above the overflow connection shall be of sufficient volume to contain liquid volume suspended in supply and return pipes and scrubbers. Recirculation pumps shall be mounted on top of tank.

Fans:

1. The fans shall have been tested and rated according to AMCA Standard 210 and ASHRAE Standard 51. They shall be certified by the Air Movement and Control Association (AMCA) and shall be licensed to bear the AMCA seal.
2. All fan parts in contact with the airstream shall be resistant to attack by contaminants found in the exhaust air.

Scrubber Packing: The scrubber packing shall be resistant to corrosion from all contaminants specified. Packing shall be non-clogging, non-nesting and of such design and bed depth as to achieve certified collection efficiencies stated herein. Minimum surface area of packing to be 31 square feet per cubic foot.

Mist Eliminator: A mist eliminator shall be provided to effectively remove entrained water droplets prior to leaving the scrubber.

Access Panels: Removable access panels for packing removal, spray nozzles and mist eliminator maintenance shall be furnished. Transparent view parts to allow for inspection of packing and spray nozzles are also standard.

Flow Meter: A flow meter for indicating/adjusting fresh-water make-up will be furnished. Dwyer instruments Series RM that clearly indicates design flow on scale will be utilized.

Pressure Gauge: All Duall fume scrubbers are supplied with a pressure gauge to monitor pressure differential across the filter packing. The Duall specified gauge would be a Dwyer Instruments Series 2000 Magnehelic, or equal.

Options

- Factory hydrostatic and pressure testing.
- Pre-purchase stack testing for NOx.
- Pre-purchase slip stream pilot scrubbing and performance testing.
- CEM monitoring and chemical feed integration.
- Performance testing.
- ANSI horizontal recirculation pumps.
- Auxiliary pump and fan systems.
- Air diaphragm chemical feed pumps.
- Ejector for draft inducement up to 10,000 SCFM.
- PLC and operator interface.

Complete Electrical Control Systems

- Integral chemical feed controls
- Motor starter panels and/or MCC options.
- Alarm system with interlocks.
- NEMA 4 control cabinets.
- Chemical usage and NOx charting or trending.

