IWS® System

Ionizing Wet Scrubber

VERANTIS

Environmental Solutions Group

Verantis Solves Industrial Environmental Control Challenges All Over The World.

As the global leader for industrial pollution control, thermal treatment, energy recovery systems and corrosion resistant blowers, Verantis Environmental Solutions Group delivers innovation that goes far beyond compliance. We help you to solve tough challenges that meet industry and local regulations as well as improve efficiencies and maximize return on investment along the way.

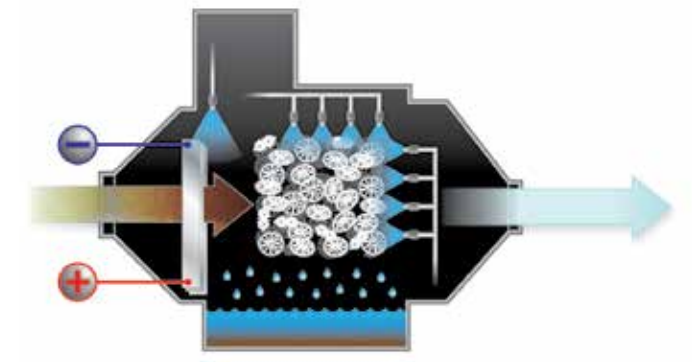
No matter the size, scope, or complexity of your environmental control or industrial process challenges, Verantis Environmental Solutions Group has the answers. With a global presence and more than a half century of experience, we understand the continually evolving environmental regulations in your part of the world and your industry and we have the expertise to help you comply with them. Whether you are designing a facility or retrofitting an installation at your existing plant, you can count on Verantis and our proven, patented technologies to give you cost-effective, long-lasting, guaranteed results.

Engineering and Consulting Services

Our in-house environmental engineering and consulting group lets us build our solutions around you.

Meeting the most complex and technically demanding environmental control challenges takes much more than off-the-shelf equipment. Verantis Environmental Solutions Group provides one of the most experienced in-house team of engineers and consultants in the industry. Our experts work closely with you to identify and develop optimal systems that are specifically tailored to your needs.

We aim not only to help you comply with regulations, but also to help you achieve higher efficiencies while maximizing your return on investment. It's our engineering and consulting expertise that makes Verantis the go-to firm for the most difficult, demanding, and multifaceted pollution control challenges impacting the industries around the world.



Principles Of Operation

The Verantis Ionizing Wet Scrubber* (IWS)® system is a proven means for the removal of pollutants from industrial process gas streams. The IWS combines the established principles of electrostatic particle charging, image force attraction, inertial impaction, and gas absorption to collect submicron solid particles, liquid particles and noxious and malodorous gases simultaneously. The IWS system requires little energy and its collection efficiency is high for both submicron and micron size particles.

The Ionizing Wet Scrubber utilizes high voltage ionization to electrostatically charge particulate in the gas stream before the particles enter a Tellerette® packed scrubber section where they are removed by attraction of the charged particles to neutral surfaces. Particles of seven to eight microns and larger are collected through inertial impaction. As small particles flow through the scrubber, then pass close to the surfaces of Tellerette packing and scrubbing liquid droplets, the electrostatic charge on the particles cause them to be attracted to these neutral surfaces by image force attraction. All particles are eventually washed out of the scrubber with the exit liquor. Noxious and malodorous gases are absorbed and reacted in the same scrubbing liquor.

*Patent Nos. 3,874,858 and 3,958,958

®Registered trademark of Verantis Corporation.

Operating Advantages

Particle Collection – The IWS system utilizes grounded plates and neutral Tellerette packing as its collection surface to achieve particulate removal. Scrubbing liquid droplets also act as collection surfaces. Particles of any size or composition are collected by the IWS. Fine particles (0.05 to 2 microns) are collected with high efficiency, regardless of their composition (organic or inorganic with either high or low resistivity). Particle collection efficiency over long term service remains consistently high.

Gas Absorption – The IWS system simultaneously absorbs gases. Noxious gases are removed through physical absorption and/or absorption that is accompanied by chemical reaction.

Low Energy Consumption – Pressure drop through a single stage IWS is only 0.5 in. to 1.5 in. water column. Energy for particle charging is low at approximately 0.2 to 0.4 KVA per 1000 CFM.

Corrosion Resistance – The shell and most internal parts of the IWS are commonly fabricated of premium fiberglass reinforced plastic and thermoplastic materials. The predominance of plastic and composite construction assures corrosion-free operation in the presence of acid gases such as HCl, HF, Cl_2, NH_3, SO_2 and SO_3. For noncorrosive applications, metallic construction is also available.

Fractional Collector – The IWS system acts as a fractional collector. The percent of particulate removed varies little with load and particle size distribution over a wide range. As particulate load increases, the percent removed remains nearly constant. The collection efficiency for fine particles is nearly as great as for coarse particles.

Turn Down – Collection efficiency improves with turn down from 100% to 0% load.

Size Range – Factory assembled modules are available in a variety of capacities and can also be grouped together to handle virtually any gas volume.

SUBMICRON PARTICULATE AND NOXIOUS GASES REMOVED SIMULTANEOUSLY

Particle Charging Section - Short intensely charged. High voltage DC power. Low energy consumption.

Ionizer Elements - Continuous flushing prevents solids build up.

Factory Assembled Modules - Fast, inexpensive field installation.

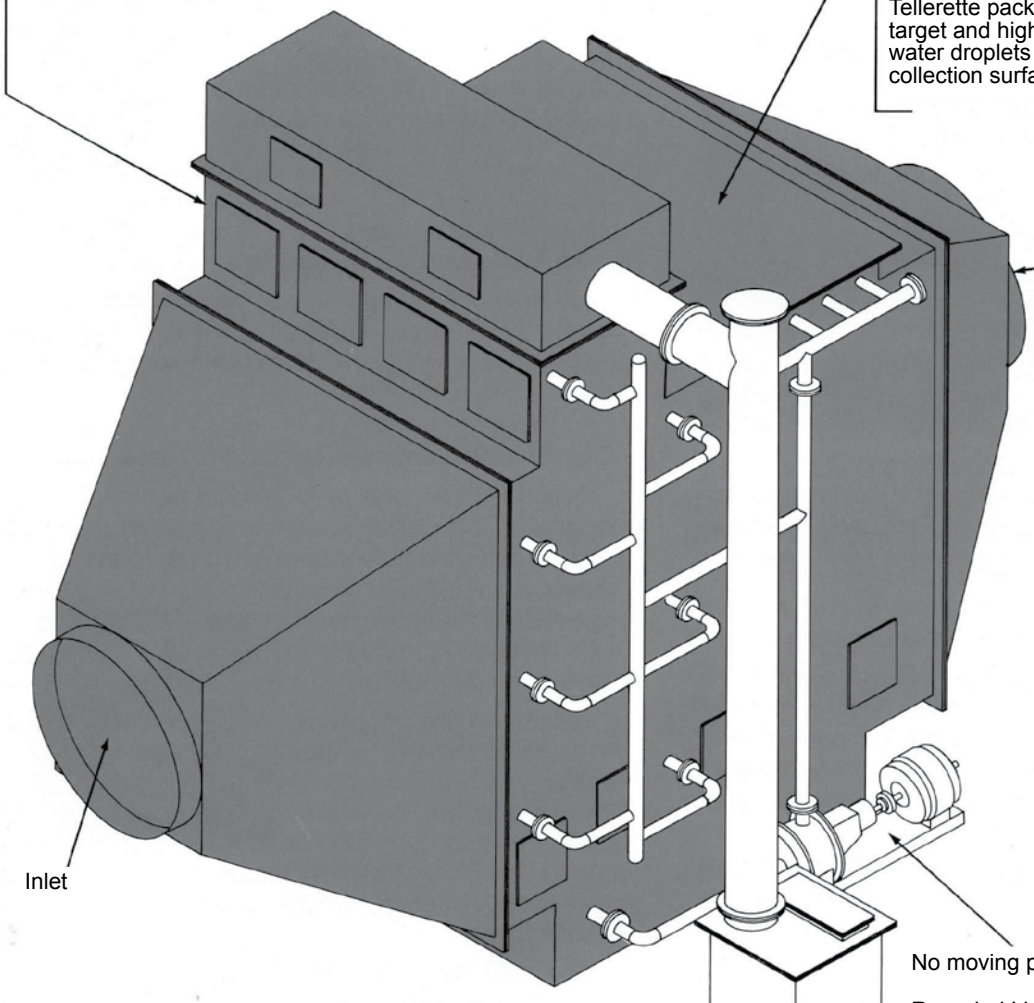
All particles charge as they enter the scrubber section.

Plastic Shell and Internal - Corrosion resistant. Minimum maintenance.

Collection Surfaces - continuously flushed in scrubber section

All scrubber surfaces (packing, water drops, shell) are electrically charged and act as impingement surfaces or collect particles through image attraction.

Tellerette packing is an excellent impingement target and highly efficient collector. Also creates water droplets for additional impingement and collection surfaces.



Exhaust of IWS can be connected directly to stack fan or to another IWS for increased collection efficiency.

Inlet

No moving parts (only pump).

Recycled Liquid - For gas absorption, solids flushing.

Sealed High Voltage DC Power Supply.

IWS System Components

Ionizer (Charging) Section

Particles are first electrostatically charged within an ionizer section that utilizes a high voltage, D.C. power source. Discharge electrodes have negative polarity and wetted “mini-plates” serve as grounded electrodes.

High Voltage Transformer/Rectifier

High voltage D.C. power for the ionizing section is provided by a high voltage transformer/rectifier. Rectification is accomplished by silicon diodes which are suitably protected against transient voltages for efficient and long-term, trouble-free service.

Control Cabinet

All control and remaining power functions for the IWS are combined in a single, standard, factory pre-wired control cabinet which can be located at any convenient location, either adjacent to or remotely located from the IWS. The control cabinet is connected to the high voltage transformer/rectifier by five leads attached to cabinet terminals.

Voltage control for high voltage is achieved by thyristor control through phase-angle variation. An ultra-fast response, solid state, automatic voltage control automatically controls high voltage levels and spark rate for optimum performance. A manual control is also provided for backup and for trouble shooting.

Operation is simple and straightforward. All functions are automatic. Necessary graphical display is provided to monitor the operation.

Flushing

The grounded electrode plate surfaces of the IWS are continuously flushed by a flow of water or other suitable liquid. This assures that optimum electrical performance is maintained at all times by washing away any resistive solids or residues that could collect on the “mini plate” and cause reduced performance.

A second flushing system is also provided which periodically deluge flushes all internal areas of the ionizer section. The deluge flushing is completely automatic and is set to provide a flushing cycle every four hours or as experience dictates. Water for the periodic deluge flush is recycled liquid from the scrubber recycle system.

Charged Particle Scrubber

The IWS incorporates a crossflow scrubber section following the ionization section. The scrubber section employs Tellerette packing to absorb gases and collect both liquid and solid particles from the gas stream.

The contaminated gas stream moves horizontally through a Tellerette packing bed that is irrigated by scrubbing liquid flowing vertically down through the packing. The inherent advantages of the crossflow design result in high operating reliability, high air flow rate, low pressure drop and low operating cost.

Sump

The IWS contains an integral sump to recirculate the scrubbing liquid directly after it passes through the packed-bed section. Use of an integral sump reduces cost and minimizes floor space requirements.

Recycle Pump and Piping

Pump(s) and complete recirculation piping for the IWS are normally provided for continuous wetting of the ionizer plates, deluge flushing of the ionizer section and continuous irrigation of the crossflow scrubber.

Alternate design approaches can be adapted for use in the IWS liquid distribution system. The method employed is contingent upon the customer’s requirements and job site restrictions.

Construction and Corrosion Resistance

The IWS shell and most internal parts are normally fabricated of fiberglass reinforced plastic (FRP) and other polymeric materials. The preponderance of plastic as a material of construction assures corrosion-free operation in the presence of gases such as HCl, HF, NH_3, SO_2, and SO_3. Additionally, structural support requirements are minimized by the units’ light weight.

Extensive use of proven, long service life plastics throughout the IWS is possible because of its unique design, construction and operating principles. The only metal required is for the electrical components employed within the ionizing section. These metallic components are fabricated of alloy materials chosen for each application to provide maximum corrosion resistance in the service environment.

The IWS can also be constructed of metallic components where corrosive conditions are not a problem and the use of FRP materials are not economical or practical in a specific application.

IWS Operating Characteristics

Particle Collection

Results from pilot tests and more than 200 actual full size operating systems verify that particles of virtually any size and composition are collected by the IWS. Submicron solid/liquid particles as minute as 0.05 microns, coarse particles having organic or inorganic structures and conductive or highly resistive particles, are all collected as high efficiency.

Image Force Attraction

The predominant influence acting within the IWS to collect submicron size particulate is the mechanism of impingement of electrons on particulate “Image Force Attraction”.

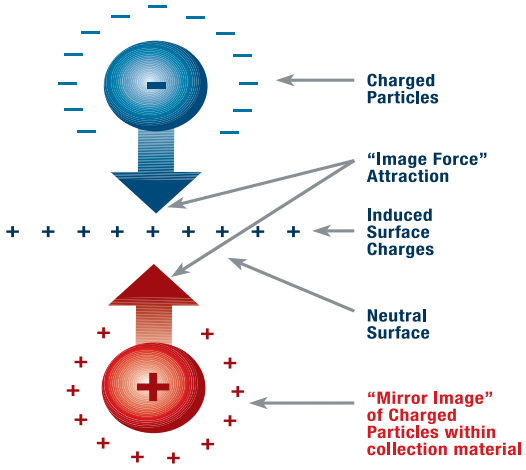
Image force attraction occurs whenever an electrostatically charged particle comes within the boundary layer (usually within one millimeter) of a neutral surface. As the charged particle comes close to the neutral surface, an electrostatic charge of opposite polarity is induced at the neutral surface. The force of attraction is similar to that which would exist between a charged particle and an imaginary particle of equal but opposite polarity located at an equal distance behind the surface. It is as though the charged particle was seeing its “mirror image”.

Inertial Impaction

Particles of seven to eight microns in size and larger are collected by inertial impaction. Particles impinge on a Tellerette packing surface, are captured, and flushed away. Tellerette packing is used exclusively in the IWS.

The unique geometrical design configuration of the Tellerette makes it an excellent impingement target. Highly efficient collection is due to the large number of small target areas. Greater particulate collection efficiency, higher gas absorption efficiency and greater flow capacities are all characteristic of Tellerette packing, as opposed to extended surface packings.

Patented Ionization



Induced surface charges collect ionized particulate and aerosols from the process gas stream.

Scrubbing and Gas Absorption (Mass Transfer)

Removal of gaseous contaminants in the scrubber is achieved by the principles of mass transfer whereby gaseous molecules from the air stream are transferred to the scrubbing liquid. Transfer is achieved by a combination of diffusion, physical absorption and/or chemical reaction.

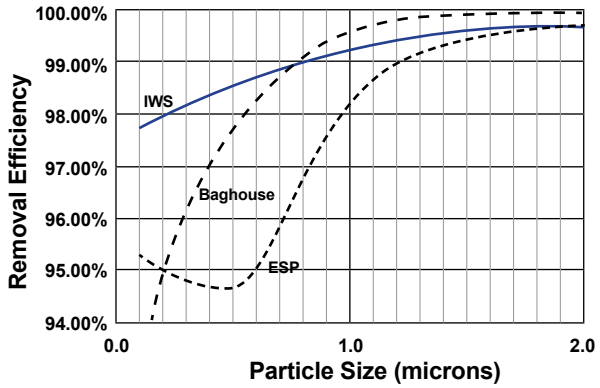
Gaseous collection efficiency is directly dependent upon the irrigation rate, the horizontal depth of packing and the gas velocity through the scrubber. Depending on the depth of the Tellerette packed bed, the liquid flow rate, and composition of the scrubbing liquid, efficiencies up to 99.9% gas absorption can be obtained.

In an application where two or more gaseous contaminants are to be removed, it is often desirable to scrub with chemically different liquids. This can readily be achieved with the cross-flow scrubber geometry which easily accommodates two or more separate scrubbing beds.

The use of two or more packed beds is usually associated with applications requiring multiple gas/solids removal, solids/odor removal and other complex scrubbing problems.

Collection Efficiency

IWS collection efficiency in the fine particle range decreases only slightly as the particles become smaller. In conventional electrostatic precipitators, collection efficiency drops in the submicron area, especially in the 0.2 to 0.6 micron range. For cloth collectors, collection efficiency decrease sharply when particle are 0.5 microns and smaller. A comparison of the collection efficiency characteristics versus particle size of these devices are depicted below.



Staging For Higher Efficiency

The IWS is a fractional collector. A single-stage IWS unit will remove a nearly constant percentage of incoming particles regardless of particle size distribution. Where a higher collection efficiency is required than is possible with a single-stage IWS, a second IWS stage can be used. The percent collection efficiency of the second-stage IWS will be approximately the same as the first-stage IWS despite the reduction in loading to it.

Shown below are pilot test stack outlet photos of IWS operation in various modes. Consider the application where a single-stage unit will remove 83% of the entering particulate. By adding a second-stage and obtaining a similar collection efficiency of 83%, an overall efficiency of 97% is achieved. Because of the fractional collector characteristics of the IWS, the performance of an existing unit can be upgraded with a second stage to meet more stringent code requirements.

Liquid Irrigation

The IWS is designed to maximize efficient use of the scrubbing liquid. To achieve optimum scrubbing liquid distribution, the scrubber contains spray header assemblies with low pressure, large orifice nozzles. Droplets formed by the spray nozzles enhance the absorption capacity of the scrubber.

Scrubbing Liquid

Liquid flow rates are based on specific operating conditions. The scrubbing liquid is usually recirculated, thus reducing both consumption of fresh liquid and overflow or blowdown from the scrubber. A small amount of fresh makeup liquid is usually fed continuously to the scrubber system. The fresh liquid keeps the absorbed gaseous pollutant concentration in the recycled liquid at a sufficiently low level to maintain efficient gas absorption. Fresh makeup liquid is also required to balance evaporation losses. Liquid can be fresh water, clean process water, or chemically treated liquids. Water treated with chemicals such as caustic soda, or soda ash is used only when fresh water or process water will not achieve the desired collection efficiency, or when treated water suits the waste treatment criteria of the specific plant.

Opacity Reduction

The IWS can remove the light loadings of submicron particulate that cause a “blue haze” emission. The IWS can be designed to obtain opacities of 5% or less to give clear or nearly clear stack discharges.

Energy

Pressure drop through a single-stage IWS is only .5 to 1.5 inches water column and is controlled primarily by the pressure drop through the wet scrubber section. Additional small amounts of energy are required for high-voltage charging and for the recycle pump.

Total system energy usage is approximately 2.0-2.5 BHP/1000 ACFM for a single-stage IWS and 4.0-5.0 BHP/1000 ACFM for a two-stage IWS installation.

Ionizing Wet Scrubber (IWS) Opacity Performance

Two-Stage IWS Operating

Single-Stage IWS Operating

Both Ionizers Off

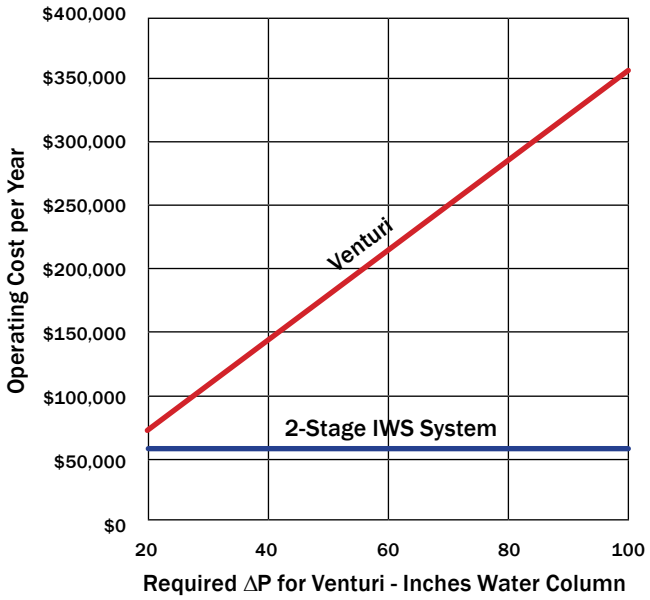
IWS Comparisons

Other types of air pollution control equipment (i.e. venturi scrubbers, electrostatic precipitators, and baghouses) generally require metal hardware/components, therefore use of this equipment in corrosive environments is severely limited. Additionally, sophisticated design configurations makes this equipment extremely costly and/or difficult to operate and maintain. These problems do not exist with the IWS because of the simplified design, minimum use of metallic components, low pressure drop and low operating/maintenance costs.

Venturi scrubbers which are specifically designed for fine particulate removal in corrosive environments can be constructed of corrosion resistant materials. However, these require high-speed, high-energy fans constructed of exotic alloys which makes the venturi expensive to fabricate, difficult to maintain and costly to operate. Also, venturi scrubbers frequently require expensive reduced voltage starting equipment, costly electrical substation installation and elaborate controls to handle fluctuating loads.

Operating energy costs with the IWS are only a fraction of the costs of a venturi. The accompanying graph provides a comparison, and is based on the following parameters and use of a two-stage system:

Capacity 25000 CFM @ (standard Conditions)
Pump Includes 15 BHP for both systems
Duty 24 hrs. x 365 days = 8760 hrs.
Energy Costs 7.5¢ /KWH 1 BHP/yr. @ 7.5¢/KWH = $550.00/yr.
Fan Efficiency 60%
Motor Efficiency 90%



Conventional Electrostatic Precipitators (ESP) require large metallic collection surfaces and contain a multitude of internal hardware components which are exposed to the gas stream. If ESP's are used in corrosive environments, non-corrosion resistant metallic surfaces must be covered with corrosion resistant materials or expensive, corrosion resistant alloys must be used.

Baghouses are susceptible to corrosive operating environments particularly when water vapor content is high and condensation can occur; where the particulate to be collected is sticky, gummy, and cannot be removed by normal bag shaking or pulsing; or where the service conditions seriously degrade the bag fabric.

IWS Equipment Specifications

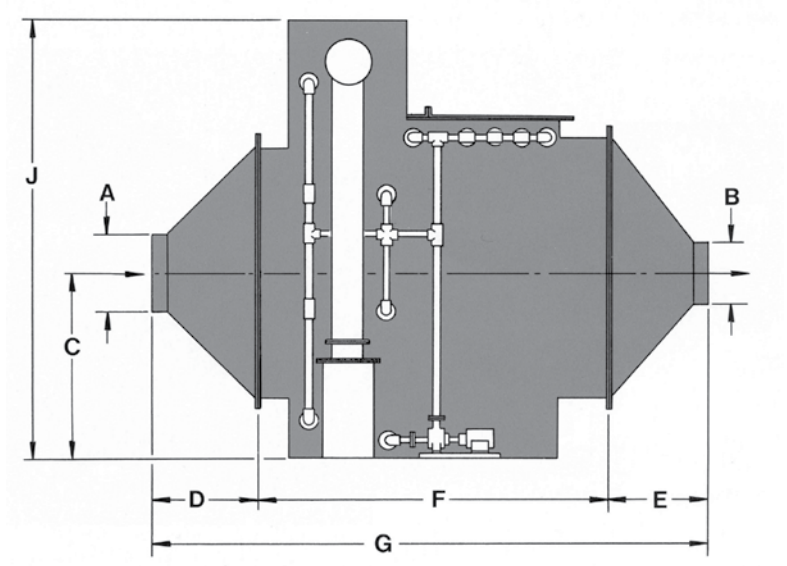
IWS equipment is available in standard factory assembled modules with a wide range of capacities. The IWS modules can be arranged in parallel to handle an infinite variety of gas stream flow rates having capacities much greater than the maximum module available.

In addition to standard IWS modules, Verantis can provide custom designed IWS equipment to suit the application whether it is a retrofit or new installation. Individual units for applications having requirements at greater capacity can also be provided.

Model No.		100	200	300	400	500	600	700	800	900	1000
Nominal Capacity (ACFM)	(Note 1)	3000	6000	9000	12000	15000	18000	21000	24000	27000	30000
Maximum Throughput Capacity	(ACFM)	6000	12000	18000	24000	30000	36000	42000	48000	54000	60000
Inlet Diameter	A	24”	36”	42”	48”	54”	60”	66”	66”	72”	72”
Outlet Diameter	B	20”	30”	36”	36”	42”	48”	54”	54”	60”	60”
Centerline Height	C	6’-5”	7’-5”	7’-5”	8’-5”	8’-5”	8’-5”	8’-5”	8’-9”	8’-9”	9’-3”
Inlet Transition	D	36”	42”	42”	48”	48”	48”	54”	54”	60”	60”
Outlet Transition	E	42”	48”	48”	54”	54”	54”	60”	60”	72”	72”
Module Length	F	12’	12’	12’	12’	12’	12’	12’	12’	12’	12’
Overall Length	G	19’	19’-6”	19’-6”	21’	21’	21’	21’-6”	21’-6”	23’	23’
Width	H	3’-4”	4’-6”	6’-0”	6’-8”	8’-2”	9’-10”	11’-4”	12’-0”	13’-6”	13’-6”
Height	J	16’-1”	18’-1”	18’-1”	20’-1”	20’-1”	20’-1”	20’-1”	20’-8”	20’-8”	21’-8”
Water Make-up Rate (gpm)	(Note 2)	3	6	9	12	15	18	21	24	27	30
Recirculation Rate (gpm)		113	153	204	227	278	334	384	408	460	460
Flush Rate (gpm)		135	210	280	346	411	503	578	629	708	736
Pressure Drop (inches W.C.)	(Note 3)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BHP - Fan	(Note 3)	1	2	2	3	4	5	6	6	7	8
BHP - Pump		5	7	8	9	11	13	14	15	17	17
BHP - High Voltage (equivalent)		4	8	10	12	13	14	16	17	18	20
BHP Total		10	17	20	24	28	32	36	38	42	45
Dry Weight (lbs)	(Note 4)	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000
Operating Weight (lbs)	(Note 4)	11400	14300	18000	20400	23100	27200	32200	33000	35800	37800

[1] Capacity varies with application and efficiency requirements.
[2] Make up rates vary with particulate type and loading.
[3] Pressure based on nominal capacity.
[4] Weights do not include transitions, TR set, or pump

Note: All dimensions approximate. Pressure drop varies from 0.5” to 1.5” depending on gas volume. For multi-stage application, multiply dimension F by number of stages. For installed height, add approximately 30” to dimension J for concrete foundation.



Pilot Testing Equipment and Facilities

Portable pilot test units having 1000 to 2000 CFM capacity are available for test purposes. These units permit tests to be conducted in the field using actual process slip streams or under laboratory conditions at Verantis.

Pilot tests can be conducted to confirm performance and effectiveness of the IWS for the application, and to provide engineering data for designing full size equipment.
The test equipment is complete so that the potential user has only to duct a slip stream to the unit and supply the necessary utility services (i.e., electrical supply, fresh water make-up, and drain lines).

Field Performance Testing Services

Field performance testing to verify the performance and efficiency of the IWS can be conducted by a contracted testing service. The test method and equipment employed for evaluation and/or performance verification testing depends on the nature of the contaminates, applicable codes, and as mutually agreed upon by all parties.

Products

- Incinerators
- Packed Towers
- Crossflow Scrubbers
- Tray Towers
- Fluid Bed Scrubbers
- Venturis
- Aerosol Filters
- FRP Centrifugal and Axial Fans
- Tower Packing
- Quenches
- Wet Cyclones
- Baghouses
- Custom Integrated Systems

Markets

- Chemical Processing
- Commercial Waste Management
- Semi-Conductor
- LCD Production
- Pharmaceutical
- Metal Processing and Refining
- Food Processing
- Mining
- Fiber Optics and Specialty Glass
- Polysilicon
- Alternative Energy
- Petrochemicals
- Fertilizer
- Wastewater Treatment
- Automotive/Foundries

Tower Packing

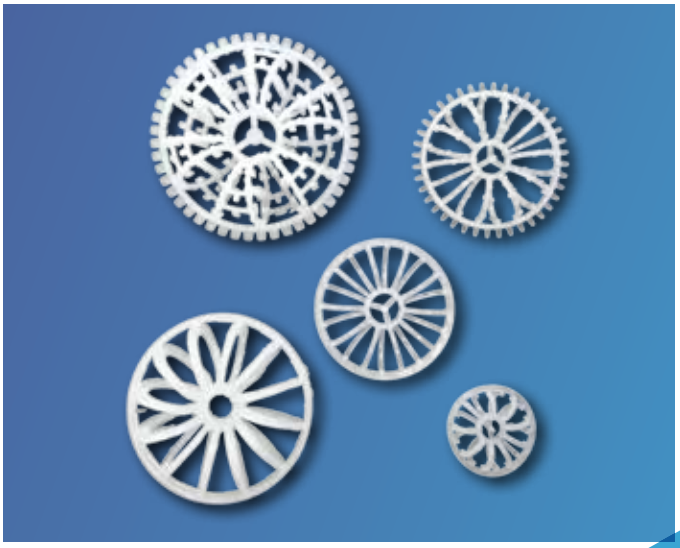
1 Liquid is collected by inertial impaction

2 Droplets form at countless interstitial holdup points

3 As each droplet falls, it strikes the next packing element and bursts, exposing fresh surface to gas

4 This agglomeration/dispersal cycle repeats continuously with no additional energy requirements

5 Containments are absorbed with exceptional efficiency



Tellerette

Tellerette tower packings have a unique patented toroidal helix design that makes them dramatically more efficient than conventional packing in a wide range of mass transfer and particulate collection applications. Verantis Tellerette tower packing is available in a wide range of materials including Polypropylene, Polyethylene, Glass Filled Polypropylene, PVC, CPVC, PVDF® and Xydar®.

Features and Benefits:

- High efficiency, low packing depth in new columns and high absorption efficiency in existing columns.
- Greater gas flow capacity permits use of small diameter, low cost columns.
- Constantly renews and exposes liquid to the gas flow.
- High column stability. No classic flooding.
- No channeling when proper liquid distribution is used.
- Reduces operating costs.
- A shallow bed of Tellerette packing provides effective mist elimination.
- Available in 5 sizes/styles depending on the application.

Contact **Verantis**

Contact Verantis for more information on how we can help you find the best environmental solution for your company.

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