Bionicom HEI™ (High Energy Ionizer) Wet Electrostatic Precipitator Technology at a Glance

HEI® WESP vs. Traditional Gas Cleaning Devices

<table>
<thead>
<tr>
<th>HEI® WESP</th>
<th>Traditional Gas Cleaning Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Energy Costs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>HEI™ WET® PRECIP.</strong></td>
<td><strong>$41,000</strong></td>
</tr>
<tr>
<td><strong>FABRICFILTER</strong></td>
<td><strong>$59,000</strong></td>
</tr>
<tr>
<td><strong>DRY® PRECIP.</strong></td>
<td><strong>$51,000</strong></td>
</tr>
<tr>
<td><strong>VENTURI® SCRUBBER</strong></td>
<td><strong>$171,000</strong></td>
</tr>
</tbody>
</table>

The Annual Estimated Costs were based on the following:
1. Gas volume treated: 40,000 to 45,000 SCFM
2. Pressure drop: HEI™ WESP–2"W G; Baghouse–8"-12"W G; Dry ESP–1"W G; and, Wet Scrubber–35"-45"W G
3. Electricity cost: $0.06 per KWH
4. Daily operation: 24 hours/day
5. Operating hours/days per year: 350 days or 8,400 hours per year
6. Item considered for each device as it may apply: H.V. power supplies, utility/power, pressure drop/loss, pumps, purge air blowers, insulator compartment heaters, controls, cleaning, pulsing, valves, etc.

**Proprietary HEI™ High Energy Ionizer® WESP Technology**—Greatly reduces Precipitator Size as much as 200% and Increases Collection Efficiency

**Modular Design and Fabrication Facilities Quick-On-Site Installation and Startup**

**Flexible Discharge Electrode/Collection Tube Design—**Allows Size and Configuration Changes to Meet Application-Specific Requirements

**Durable Rigid Metal Discharge Electrodes—**Replace Flimsy Electrode Wires or Rods that can Warp or Break

**Robust Discharge Electrode Mount Supports—**Reduce Misalignment due to Mechanical Stress or Heat Distortion and Prevent Waste of Energy and Low Collection Efficiency due to Corona Discharge Arcing

**High Voltage Insulators Located Out of Gas Stream—**Contains a Common Source of Premature and Costly Insulator Failure

**Large Open-Area Gas Inlet Distribution Devices—**Eliminate Packing or Marble Bed Components that can Plug or Cause Fouling

**Unique Top-Mounted EZ Align™ Electrode System—**Reduces Setup Time and Eliminates Need for Bottom Alignment Devices

**Simple and Effective Irrigation and Particulate Collection Systems—**Reduce Risk of Fugitive Particles and Provide Line-Metering Controls

**Choice of Upper or Lower Discharge Configurations—**Permits More Economic use of the HEI® WESP to Accommodate a Wide Range of Applications and System Layouts

**PLC-Based Voltage and Spark Controls—**Provide Maximum Control to Maintain Electric Field Stability

**Energy Consumption of HEI® WESP vs. Other APC Devices**

The Bionicom HEI® WESP System operates at lower pressure drops than scrubbers or fabric filters and provides the lowest energy consumption costs compared to other air pollution control devices.

**Bionicom Industries, Inc.**
777 Corporate Drive
Mahwah, N J 07430
201/529-1094 • Fax: 201/529-0252
E-mail: sales@bionicomind.com
Website: www.bionicomind.com

© Copyright Bionicom Industries, Inc., 2002
HEI® (High Energy Ionizer) and EZ Align™ are trademarks of Bionicom Industries, Inc.
RoofBed™ is a trademark of Bionicom Industries, Inc. Patent Nos. 6,007,005

...Providing State-of-the-Art Fine Particulate Control Through Advanced High Energy Ionization

---

**Advanced Operating Features That Deliver Performance Benefits You Can Count On**

- Proprietary HEI™ High Energy Ionizer® WESP Technology—Greatly reduces Precipitator Size as much as 200% and Increases Collection Efficiency
- Modular Design and Fabrication Facilities Quick-On-Site Installation and Startup
- Flexible Discharge Electrode/Collection Tube Design—Allows Size and Configuration Changes to Meet Application-Specific Requirements
- Durable Rigid Metal Discharge Electrodes—Replace Flimsy Electrode Wires or Rods that can Warp or Break
- Robust Discharge Electrode Mount Supports—Reduce Misalignment due to Mechanical Stress or Heat Distortion and Prevent Waste of Energy and Low Collection Efficiency due to Corona Discharge Arcing
- High Voltage Insulators Located Out of Gas Stream—Contains a Common Source of Premature and Costly Insulator Failure
- Large Open-Area Gas Inlet Distribution Devices—Eliminate Packing or Marble Bed Components that can Plug or Cause Fouling
- Unique Top-Mounted EZ Align™ Electrode System—Reduces Setup Time and Eliminates Need for Bottom Alignment Devices
- Simple and Effective Irrigation and Particulate Collection Systems—Reduce Risk of Fugitive Particles and Provide Line-Metering Controls
- Choice of Upper or Lower Discharge Configurations—Permits More Economic use of the HEI® WESP to Accommodate a Wide Range of Applications and System Layouts
- PLC-Based Voltage and Spark Controls—Provide Maximum Control to Maintain Electric Field Stability

**Engineered Air Pollution Control Systems With Unparalleled Performance**

---

**Bionicom HEI™ (High Energy Ionizer) Wet Electrostatic Precipitator System**
For Low-Energy Collection of Fine or Submicron Particles in Gas Streams

---

**Proprietary H EI™ (H igh Energy Ionizer) W ESP Technology—**
Greatly reduces Precipitator Size as much as 200% and Increases Collection Efficiency

**Modular Design and Fabrication Facilities Quick-On-Site Installation and Startup**

**Flexible Discharge Electrode/Collection Tube Design—**
Allows Size and Configuration Changes to Meet Application-Specific Requirements

**Durable Rigid Metal Discharge Electrodes—**
Replace Flimsy Electrode Wires or Rods that can Warp or Break

**Robust Discharge Electrode Mount Supports—**
Reduce Misalignment due to Mechanical Stress or Heat Distortion and Prevent Waste of Energy and Low Collection Efficiency due to Corona Discharge Arcing

**High Voltage Insulators Located Out of Gas Stream—**
Contains a Common Source of Premature and Costly Insulator Failure

**Large Open-Area Gas Inlet Distribution Devices—**
Eliminate Packing or Marble Bed Components that can Plug or Cause Fouling

**Unique Top-Mounted EZ Align™ Electrode System—**
Reduces Setup Time and Eliminates Need for Bottom Alignment Devices

**Simple and Effective Irrigation and Particulate Collection Systems—**
Reduce Risk of Fugitive Particles and Provide Line-Metering Controls

**Choice of Upper or Lower Discharge Configurations—**
Permits More Economic use of the HEI® WESP to Accommodate a Wide Range of Applications and System Layouts

**PLC-Based Voltage and Spark Controls—**
Provide Maximum Control to Maintain Electric Field Stability

**Energy Consumption of HEI® WESP vs. Other APC Devices**

The Bionicom HEI® WESP System operates at lower pressure drops than scrubbers or fabric filters and provides the lowest energy consumption costs compared to other air pollution control devices.

**ANNUAL ENERGY COSTS**

<table>
<thead>
<tr>
<th>HEI® WESP</th>
<th>Traditional Gas Cleaning Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEI™ WET® PRECIP.</strong></td>
<td><strong>$41,000</strong></td>
</tr>
<tr>
<td><strong>FABRICFILTER</strong></td>
<td><strong>$59,000</strong></td>
</tr>
<tr>
<td><strong>DRY® PRECIP.</strong></td>
<td><strong>$51,000</strong></td>
</tr>
<tr>
<td><strong>VENTURI® SCRUBBER</strong></td>
<td><strong>$171,000</strong></td>
</tr>
</tbody>
</table>

The Annual Estimated Costs were based on the following:
1. Gas volume treated: 40,000 to 45,000 SCFM
2. Pressure drop: HEI™ WESP–2"W G; Baghouse–8"-12"W G; Dry ESP–1"W G; and, Wet Scrubber–35"-45"W G
3. Electricity cost: $0.06 per KWH
4. Daily operation: 24 hours/day
5. Operating hours/days per year: 350 days or 8,400 hours per year
6. Item considered for each device as it may apply: H.V. power supplies, utility/power, pressure drop/loss, pumps, purge air blowers, insulator compartment heaters, controls, cleaning, pulsing, valves, etc.

**Hardwire Improvements for Enhanced Reliability**

**Scrubber Fabric Dry HEI**

**Filter ESP WESP**

**Extremely fine solid particle removal**

**Aerosols and acid mists**

**Low gas temp/high dew point**

**Sticky particulate**

**Gas absorption required**

**High resistivity particles**

**Providing State-of-the-Art Fine Particulate Control Through Advanced High Energy Ionization**
The Bionic® HEI™ Wet Electrostatic Precipitator System is a major breakthrough in the advancement of state-of-the-art particulate control. Designed around proven hardware improvements that deliver high reliability and outstanding collection performance, the HEI™ WESP System incorporates a unique discharge electrode technology that can be sized to specific applications. The system’s recent design improvements includes a high intensity corona discharge to achieve superior collection efficiency and reject any concurrent particulate-laden gas stream. The HEI™ WESP System incorporates a unique discharge electrode technology that can be sized to specific applications. The system’s recent design improvements results in improved collection efficiency and reject any concurrent particulate-laden gas stream. The HEI™ WESP System incorporates a unique discharge electrode technology that can be sized to specific applications. The system’s recent design improvements results in improved collection efficiency and reject any concurrent particulate-laden gas stream. The HEI™ WESP System incorporates a unique discharge electrode technology that can be sized to specific applications. The system’s recent design improvements results in improved collection efficiency and reject any concurrent particulate-laden gas stream.
The Bionic HEI™ Wet Electrostatic Precipitator (HEI WESP) System is the most effective and reliable system available for cleaning acidic gases, particulate laden gas streams, and condensable organic vapors.

**Operating Principle**
A Simplicity Yet Highly Effective System

The Bionic HEI™ Wet Electrostatic Precipitator offers one of the most effective techniques available for low-energy collection of acid and/or particulate laden gas streams. During operation, acid and/or particulate laden gases enter the precipitator and are directed into the electrostatic field. The fire or explosion potential for combustion, solid, and liquid products is thereby eliminated.

**Phases of Operation**

1. **Dirtout Reactivation**
   - High Temperature Reactivation (for CEM or Certification Applications)

2. **Precipitation**
   - Collection of fine or submicron particles in gas streams.

3. **Washing**
   - Condensation-Forced Washing and Particle Collection

**System Benefits**

- **High Collection Efficiency**
- **Reduced Pressure Drop**
- **Minimum Maintenance**
- **Low Ozone Production**

**Available Options**

- Unagon SM Electrodes
- Inlet and Outlet Ductwork
- Accessory Systems

**Adaptability to a Wide Variety of Gas Cleaning Applications and Conditions**

- High Concentration of Submicron Particles
- High Temperature Particulate Collections
- Aeration Removal
- Delay of Toxic Particulate in Gas Stream
- Gas Stream has Already Condensed to, or Below, the dew point

**Supervisor’s Note**

- The Bionic HEI™ Wet Electrostatic Precipitator is a practical, cost-effective solution for applications involving “blue haze” emissions. A condition caused by a large percentage of submicron particulates, these systems are ideal for controlling emissions from any air pollution control device. Typical applications include contaminating organic vapors, salt fumes, metal oxide fumes, ash and other emissions found in chemical, plastics, laboratory, mining, ferrous and nonferrous metal, foundries, fertilizer, metal, pulp & paper, textile, food products, pellet products, food products, electronics, semiconductor, pharmaceuticals, glass and paper industries.

**Illustration**

- High Moisture Content Gas Stream
- Gas Absorption Plus Particulate Collection is Required

**Other key features of the HEI™ WESP System are the use maximum flexibility through a choice of two innovations, adaptable designs that can meet any number of specific performance requirements, and improved corrosion-resistant materials of construction.**

**Table**

<table>
<thead>
<tr>
<th>HEI™ Electrode</th>
<th>CONVENTIONAL ELECTRODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELECTRODE</td>
<td>WIRE</td>
</tr>
<tr>
<td>COLLECTING</td>
<td></td>
</tr>
<tr>
<td>FIELD</td>
<td></td>
</tr>
<tr>
<td>WEAK FIELD</td>
<td></td>
</tr>
<tr>
<td>SAME FIELD</td>
<td></td>
</tr>
<tr>
<td>STRONG FIELD</td>
<td></td>
</tr>
<tr>
<td>NO AXIAL EXPANSION</td>
<td></td>
</tr>
<tr>
<td>RADIAL EXPANSION</td>
<td></td>
</tr>
</tbody>
</table>

**Diagram**

- HEI™ Electrode vs. Traditional Electrode
- Enhanced Removal Performance and Long Term Reliability
- Nonfouling Rotor™ Scrubber–
- and Gas Absorption Prior to HEI WESP Treatment
- Unagon SM Extended Area Collecting Electrodes–
- and Upper and Lower Housing Compartments

**System Features**

- High Voltage Insulator
- Purge Air
- High Voltage F Power Supply
- I.D. Fan
- I.D. Fan
- In the WESP: Cleaning Process, the Conductance Change, and Change in the Unagon Electrode
- Bionom H™ Electrodes

**Technology**

- RotaBed™ Precollector
- Inlet and Outlet Ductwork
- Accessory Systems
- CEM Equipment
- Dry and Wet Scrubbing

**List of Benefits**

- High collection efficiency
- Reduced pressure drop
- Minimum maintenance
- Low ozone production

**Applications**

- Municipal waste treatment
- Pulp & paper
- Wood products
- Textile
- Food products
- Electronic
- Semiconductor
- Pharmaceutical
- Metal
- Chemical
- Plastics
- Laboratory
- Mining
- Ferrous metal
- Nonferrous metal
- Hazardous ash and other emissions found in chemical, plastics, laboratory, mining, ferrous and nonferrous metal, foundries, fertilizer, metal, pulp & paper, textile, food products, pellet products, food products, electronics, semiconductor, pharmaceuticals, glass and paper industries.

**Diagram**

- Bionom H™ Electrodes can be used as “polishing”, first stage in existing emission abatement systems, and in combination with other air pollution control devices.
The Bionomic HEI™ Wet Electrostatic Precipitator System represents a major breakthrough in the advancement of stack-emission-free particulate control. Conventional particulate control equipment is often inadequate for the collection of very fine particulates that deliver high reliability and outstanding collection performance, the HEI® WESP System incorporates a unique discharge electrode technology that can be sized to specific applications. The systems embrace geometric innovations that greatly enhance collection in the entire length of the tube's treatment area. This high intensity current provides particle charging needs that are too high to obtain from those of conventional precipitators resulting in higher particulate charge, higher collection efficiency, and smaller particulate size. The Bionomic HEI® WESP System also offers the user maximum flexibility through a choice of two innovative, adaptable designs that can meet any application need. These designs are based upon the high intensity discharge electrode's unique configuration and gas condensation. The HEI® WESP System can be configured in a gas upflow or downflow configuration. The unit includes a combination condenser, RotaBed Pre-Scrubber for rapid gas condensation and particles loading reduction. RotaBed voltage and spark controls to maintain maximum electric field stability, outgassing tube locations, and low, improved materials of construction. The system offers a very low pressure drop that permits gases complete the advanced yet economical HEI® WESP System.

Operating Principle

The Bionomic HEI® Wet Electrostatic Precipitator offers one of the most effective technical solutions available for cleaning and finishing particulate in gas stream. During operation, acid and/or particulate laden gases enters the patented Topper Discharge for pre-treatment to condition and/or reduce heavy particulate loading. Further gas saturation and pretreatment takes place in the HEI® Conditioning System prior to remaining particulate laden gas flow through the region between HEI® WESP's discharge electrodes and the grounded collecting electrodes. This highly charged free gas is converted into an ionizing corona that result from Ultima pretreatment or conditioning process also become charged and migrate onto the collecting electrodes. Then, entrained pollutant particles are electrostatically driven to the grounded collecting electrodes, as gas flow through the collection area, the highly charged field produces charged particles that are not easily collected by any other air pollution control device. Typical examples include: check and other exhausts found in chemical, plastics, welding, farming, cotton and asbestos dust, woodworking, metalworking, foundry, and all petrochemical products, metal, food products, electronics, semiconductor, fiber, oil, glass and paper industries.

Adaptability to a Wide Variety of Gas Cleaning Applications and Conditions

Bionomic HEI® WESP Systems can be supplied virtually any emission source and provide for variable gas streams cleaning over a wide range of particulate, gas hours or wet scrubbing. They are particularly effective where the gas stream profile or application requirements meet one or more of the following criteria:

- High Temperature Gas Streams
- High Concentration of Submicron Particulates and/or High Moisture Gas Stream
- Air Assisted Scrubbing
- High Solids Loadings
- Higher Filtration Efficiencies and Reduces Fouling in Condensation-Forced Washing and Particle Collection
- Stack, Fan, Chemical Feed Systems, Water and Effluent Treatment Systems, In-Ground Quench, Condenser and Control, and Other Requirements
- Other Key Features of the HEI® WESP System are the available applications for particulate loading, gas cleaning, and conditioning. Unlike other precipitator designs that utilize sprays, overflow weirs or packed marble beds, the HEI® WESP System is the only design that can incorporate the Unique™ Conditioning System for gas saturation and collection tube loading, and the patented, rotating RotaBed™ Pre-Scrubber for rapid gas condensation and particles loading reduction. RotaBed voltage and spark controls to maintain maximum electric field stability, outgassing tube locations, and low, improved materials of construction. The system offers a very low pressure drop that permits gases complete the advanced yet economical HEI® WESP System.

Available Options That Deliver Enhanced Electrical Performance and Long-Term Durability

- Integral Precipitating Modules including Bionomic’s Patented Topper Discharge for pre-treatment to Condition and Gas Absorption Prior to HEI® WESP Treatment
- Unagon™ Extended Area Collecting Electrodes—Offers higher collecting efficiency and reduced re-entrainment
- Forced Air or Water Jacketed Collection Tubes—Ensures enhanced corrosion protection and particle collection
- Improved Corrosion-Resistant Materials of Construction—Including COR-TEN® for reinforced corrosion protection Collection Electrodes
- Complete Air Polutants Control System Components—Ductwork, Stack, Fan, Chemical Feed Systems, Water and Effluent Treatment Systems, In-Ground Quench, Condenser and Control, and Other Requirements
- Complete HEI® WESP System Engineering Support Services—Sizing Evaluation, Startup Assistance, and Operator Training

The Bionomic HEI® Wet Electrostatic Precipitator offers one of the most effective technical solutions available for cleaning and finishing particulate in gas stream. During operation, acid and/or particulate laden gases enters the patented Topper Discharge for pre-treatment to condition and/or reduce heavy particulate loading. Further gas saturation and pretreatment takes place in the HEI® Conditioning System prior to remaining particulate laden gas flow through the region between HEI® WESP’s discharge electrodes and the grounded collecting electrodes. This highly charged free gas is converted into an ionizing corona that result from Ultima pretreatment or conditioning process also become charged and migrate onto the collecting electrodes. Then, entrained pollutant particles are electrostatically driven to the grounded collecting electrodes, as gas flow through the collection area, the highly charged field produces charged particles that are not easily collected by any other air pollution control device. Typical examples include: check and other exhausts found in chemical, plastics, welding, farming, cotton and asbestos dust, woodworking, metalworking, foundry, and all petrochemical products, metal, food products, electronics, semiconductor, fiber, oil, glass and paper industries.

Bionomic HEI® WESP can also be used as “polishing,” that is, to clean up emissions processes behind, and in combination with, other air pollution control devices.

A Simple Yet Highly Effective Operating Principle

Bionomic’s HEI® Wet Electrostatic Precipitator offers one of the most effective technical solutions available for cleaning and finishing particulate in gas stream. During operation, acid and/or particulate laden gases enters the patented Topper Discharge for pre-treatment to condition and/or reduce heavy particulate loading. Further gas saturation and pretreatment takes place in the HEI® Conditioning System prior to remaining particulate laden gas flow through the region between HEI® WESP’s discharge electrodes and the grounded collecting electrodes. This highly charged free gas is converted into an ionizing corona that result from Ultima pretreatment or conditioning process also become charged and migrate onto the collecting electrodes. Then, entrained pollutant particles are electrostatically driven to the grounded collecting electrodes, as gas flow through the collection area, the highly charged field produces charged particles that are not easily collected by any other air pollution control device. Typical examples include: check and other exhausts found in chemical, plastics, welding, farming, cotton and asbestos dust, woodworking, metalworking, foundry, and all petrochemical products, metal, food products, electronics, semiconductor, fiber, oil, glass and paper industries.
Advanced Operating Features That Deliver Performance Benefits You Can Count On

- Proprietary H&EI™ (High Energy Ionizer) WESP Technology—Greatly reduces Precipitator Size as much as 90% and increases Collection Efficiency.
- Modular Design and Fabrication—Facilitates Quicker On-Site Installation and Startup.
- Positive Discharge Electrode/Collection Tube Design—Able to handle Changes to Meet Application-Specific Requirements.
- Extended Rigid Discharge Electrode—Reduces Flow Electrode Wear or Break that can Mar or Break.
- Robust Discharge Electrode Mounts—Reduce Maintenance due to Mechanical Stress or Heat Distortion and Prevent Waste of Energy and Collection Efficiency due to Corona Discharge Arcing.
- Large Open-Area Gas Inlet Distribution Devices—Eliminate Packing or Marble Bed Components that can Plug or Fouling.
- Unique Top-Mounted EZ Align™ Electrode System—Reduces Setup Time and Eliminates Need for Bottom Alignment Devices.
- Simple and Effective Irrigation and Particulate Collection System—Able to Inhibit Flow Patterns and Prevent Line Valve Contamination.
- Choice of Upflow or Downflow Configurations—Permits More Efficient use of HEI™ WESP to Accommodate a Wide Range of Applications and System Layouts.
- PLC-Based Voltage and Spark Controls—Provide Maximum Control to Maintain Electric Field Stability.

Bionomic HEI™ High Energy Ionizer Complete Solution

<table>
<thead>
<tr>
<th>HEI™ WESP</th>
<th>Traditional Gas Cleaning Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>FABRICF</td>
<td>DRYF</td>
</tr>
<tr>
<td>$59,000</td>
<td>$51,000</td>
</tr>
</tbody>
</table>

ANNUAL ENERGY COSTS

- The Annual Estimated Costs were based on the following:
  1. Gas volume treated: 40,000 to 45,000 SCFM
  2. Pressure drop: HEI™ WESP–2” WG; Baghouse–8”-12” WG; Dry ESP–1” WG; and Wet Scrubber–35”-45” WG
  3. Electricity cost: $0.06 per KWH
  4. Daily operation: 24 hours/day
  5. Operating hours/days per year: 350 days or 8,400 hours per year

<table>
<thead>
<tr>
<th>Component</th>
<th>CEI™ WESP</th>
<th>Traditional Gas Cleaning Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>High voltage power supplies, utility/powers, pressure drop/loss, pumps, purge air blowers, insulator compartment heaters, controls, cleaning, pulsing, valves, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

...Providing State-of-the-Art Fine Particulate Control Through Advanced High Energy Ionization.
Proprietary H® High Energy Ionizer/WESP Technology—Greatly reduces Precipitator Size as much as 200% and Increases Collection Efficiency

Robust Design Electrode Collector Tube Design—Able Box and Configuration Changes to Meet Application-Specific Requirements

Extruded Rigid High Discharge Electrode—Replaces Finned Electrode Wire or Rod that Can Warp or Break

High Voltage Insulators Located Out of Gas Stream—Eliminates a Common Source of Premature and Costly Insulator Failure

Large Open Area Gas Inlet Distribution Devices—Eliminates Packing or Marble Bed Components that Can Plug or Fouls

Unique Top-Mounted EZ Align™ Electrode System—Reduces Setup Time and Eliminates Need for Bottom Alignment Devices

Choice of Upflow or Downflow Configurations—Permits More Economical use of the HEI® WESP to Accommodate a Wide Range of Applications and System Layouts

Small and Effective Irrigation and Particulate Collection Systems—Uses no Weirs or Piping Networks and Promotes Low Water Consumption

Choice of Upflow or Downflow Configurations—Permits More Economical use of the HEI® WESP to Accommodate a Wide Range of Applications and System Layouts

PLC-Based Voltage and Spark Controls—Provides Maximum Control to Maintain Electric Field Stability

Advanced Operating Features
That Deliver Performance Benefits You Can Count On

Energy Consumption of HEI WESP vs. Other APC Devices
The Bionomic HEI WESP System operates at lower pressure drops than scrubbers or fabric filters and provides the lowest energy consumption costs compared to other air pollution control devices.

ANNUAL ENERGY COSTS

<table>
<thead>
<tr>
<th>Device</th>
<th>Annual Energy Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI™ WESP</td>
<td>$41,000</td>
</tr>
<tr>
<td>Fabric Filter (FF)</td>
<td>$59,000</td>
</tr>
<tr>
<td>Dry ESP</td>
<td>$51,000</td>
</tr>
<tr>
<td>Venturi Scrubber (VS)</td>
<td>$171,000</td>
</tr>
</tbody>
</table>

The Annual Estimated Costs were based on the following:
1. Gas volume treated: 40,000 to 45,000 SCFM
2. Pressure drop: HEI™ WESP–2" WG; Baghouse–8"-12" WG; Dry ESP–1" WG; and, Wet Scrubber–35"-45" WG
3. Electricity cost: $0.06 per KW H
4. Daily operation: 24 hours/day
5. Operating hours/days per year: 350 days or 8,400 hours per year
6. Item considered for each device as it may apply: H.V. power supplies, utility/pow er, pressure drop/loss, pumps, purge air blow ers, insulator compartment heaters, controls, cleaning, pulsing, valves, etc.

Bionomic HEI™ (High Energy Ionizer) Wet Electrostatic Precipitator Technology at a Glance

HEI WESP vs. Traditional Gas Cleaning Devices

<table>
<thead>
<tr>
<th>Feature</th>
<th>HEI WESP</th>
<th>Fabric Filter (FF)</th>
<th>Dry ESP</th>
<th>Venturi Scrubber (VS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive fine particle retention</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ammonia and acid mists</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Low gas temperature drop point</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sticky particle fouling</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High dew point conditions</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Providing State-of-the-Art Fine Particulate Control Through Advanced High Energy Ionization

Bionicom HEI™ (High Energy Ionizer)
Wet Electrostatic Precipitator System
For Low-Energy Collection of Fine or Submicron Particles in Gas Streams