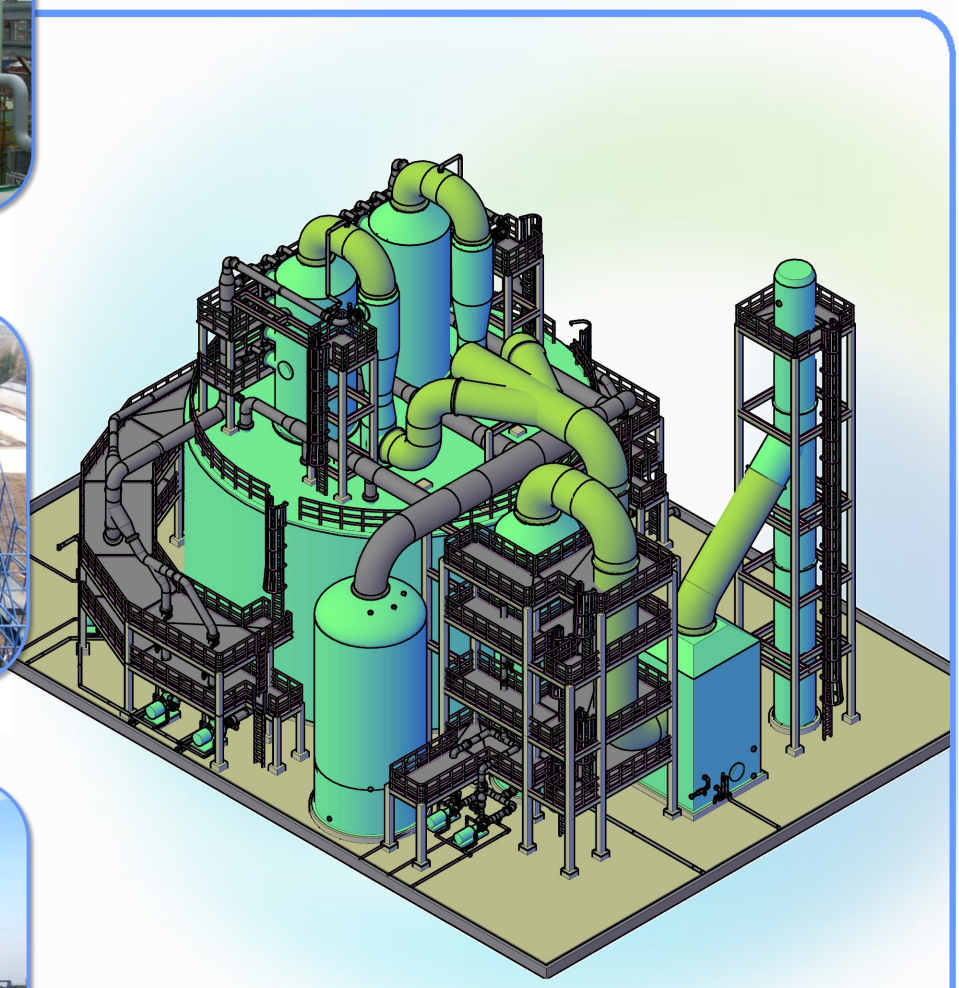
VERANTIS
Environmental Solutions Group

Environmental Solutions for
Polysilicon & Siloxane Production



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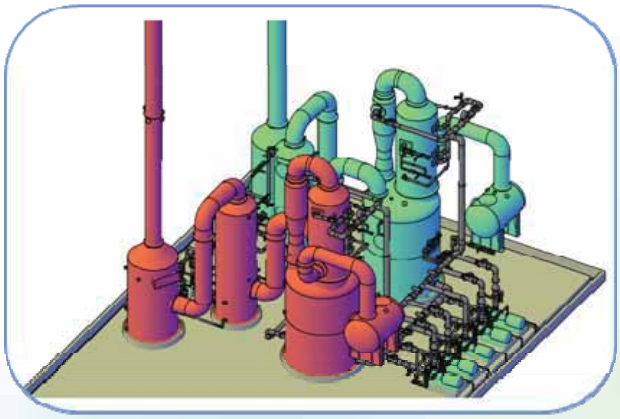
Trichlorosilane Production

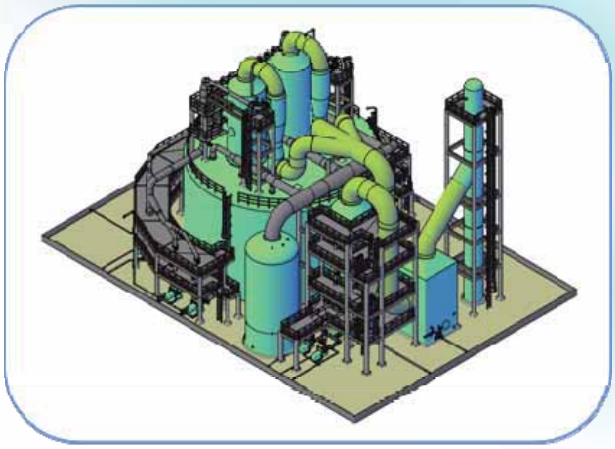
The composition of exhaust gases from TCS production can include various chlorosilanes, silicon tetrachloride, and hydrogen gas. Understanding the hydrolysis and interaction of these chemicals along with associated heat generation, reaction byproducts, and proper pH control is critical to maintaining continuous operation of the pollution abatement equipment.

Verantis' broad range of scrubber designs, along with our extensive chemical engineering experience, enables us to select the right equipment combination to insure maximum system availability when dealing with complex silicon chemistry. Our eductor venturis (EVS Series) and "open" chamber spray towers (ST series) provide high liquid to gas ratios and can be designed in multiple stages to achieve high-efficiency removal and minimize potential fouling. If additional removal is required, our packed tower scrubbers can be used for final exhaust polishing, as well. Complete system design, including upstream knock-out drums to deal with process liquid surges and downstream seal pots to prevent atmospheric air backflow, can be provided.



Emergency Vent Scrubbing

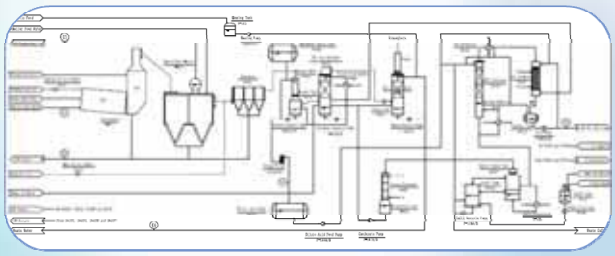
Emergency vent systems pose a bigger challenge than normal process venting systems. The systems must be designed to react quickly to a large release of toxic and/or pollutant gases. A high degree of system readiness, along with the ability to achieve high removal efficiency is a must. Verantis emergency scrubbing systems have been utilized across a broad range of applications in the solar, chemical process and water treatment industries. Our systems are designed to achieve high-efficiency removal while dealing with heat generation and soluble or insoluble byproducts. Depending on the application, combinations of Verantis spray towers (ST Series), eductor venturis (EVS Series), and/or packed towers (SPT Series) can be designed to meet any performance efficiency or required outlet loading.



Thermal Oxidiation Route

(Or "incineration") treats gaseous, liquid and/or solid and slurry chlorinated silane wastes in an incinerator where the wastes are "burned" to SiO2 and HCl. A high level of destruction efficiency is achieved and options are available for Energy and HCl recovery as well as options for "Zero-Discharge" of wet effluents.

Thermal destruction of chlorinated silanes presents the unique challenge of treating incineration exhaust gases containing both hydrochloric acid gas and ultra-fine particles of SiO2. Verantis offers various proven technologies and designs to recover energy from the exhaust gas and recover HCl. Both "wet" and "dry" gas cleaning technologies are available including our IWS® (Ionizing Wet Scrubber) system which combines Verantis proprietary electrostatic particle separation technology with a mass transfer packing section to achieve high particle removal efficiency and acid gas removal.

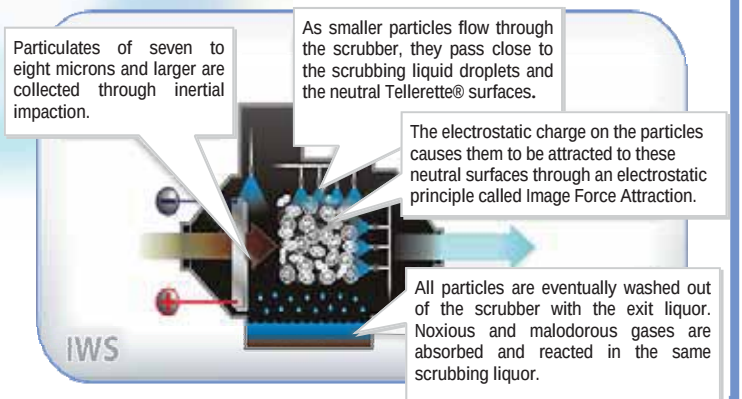


SiO2 Particulate Control

Whether the particulate is fine or coarse, Verantis has a broad range of products for controlling emissions. Our complete line of venturi scrubbers includes fixed throat (VSV series), variable throat (VTV Series) and IWS® (Ionizing Wet Scrubber) designs that can process a wide range of exhaust capacities from very small to vary large.

The Verantis IWS system was designed with this specific application in mind and has been proven to achieve strict compliance standards across a broad range of applications. Typical examples include thermal destruction of silica compounds in the chemical process industry and silicon ingot production in the fiber optics industry.

The IWS system is a design system combining electrostatic charging with a packed scrubber which provides removal of submicron particulate with simultaneous acid gas removal. The crossflow design of the wetted ionizer and packed section minimizes fouling and provides maximum system availability. The IWS units can also be operated in a series providing retrofit flexibility for changes in system capacity or to meet future regulatory requirements.



NOx Control for Acid Etching

The solution for NOx emission control is more complex than standard scrubbing methodology. Achieving the required removal efficiency requires an understanding of the various components of NOx, their interaction, and their effect on visible emissions. Verantis has conducted extensive pilot tests on this application and has installed NOx removal systems on a variety of wet-chemistry applications. We can select the right combination of equipment and chemistry to meet the required process design and guarantee a “clear stack.”

Wastewater Treatment

Wastewater is generated Polysilicon plant from the Process Vent Hydrolyzers, TCS plant Quench, and in the Etch plant. The wastewater comprises mostly of Silicates and Salts (calcium and/or sodium), silicon fines and metal oxides and must be treated to meet the local requirements for pH, TSS (total suspended solids) and TDS (total dissolved solids. In some cases the wastewater can also contain unreacted chlorinated silanes and silicon gels which make the treatment more challenging.

Verantis has the experience and know how to treat this wastewater. TSS removal is accomplished by chemical and physical conditioning of the wastewater and subsequently separating out the solids in a filter press. TDS removal is accomplished by separating out the salts as an aqueous salt solution or as solids in a multi-effect evaporator and/or crystallizer. The water from this plant may be recycled back as clean process water making this a “Zero-Discharge” system.