

ODOR CONTROL TECHNOLOGY SUMMARY

Technology: CHEMICAL SCRUBBERS

Description:

Chemical scrubbers are a common odor control technology. The basic objective of a scrubber is to provide contact between odorous air, water, and chemicals to provide oxidation or entrainment of the odorous compounds. The odorous compounds are absorbed into the scrubber liquid, where they are oxidized and/or removed from the scrubber as an overflow or blowdown stream.



Chemical Scrubber

The basic components of the scrubber are the vessel; packing material; liquid recirculation system with spray nozzles, recirculation pump, a sump; and a mist eliminator. A fan draws or pushes the odorous air into the scrubber. The air passes through the packing bed where it comes in contact and is absorbed into the liquid solution sprayed from nozzles above the packing bed. The liquid solution, after passing through the packing bed, falls into the sump, where it is recirculated or discarded. The air exits the packing bed and is routed through the mist eliminator to minimize liquid droplets from exiting the scrubber.

Typical chemicals used in the liquid solution to oxidize hydrogen sulfide and other reduced sulfur compounds include sodium hypochlorite (bleach) and sodium hydroxide (caustic). The oxidation reactions are dependent on pH, with the optimum scrubber solution pH being in the 9.5 – 10.5 range. In this range, hydrogen sulfide is absorbed into the recirculation liquid. As pH decreases below the optimum range, the hydrogen sulfide solubility decreases and is not effectively absorbed into the scrubber solution. As pH increases above the optimum range, more chemical is used than necessary, and more carbon dioxide is scrubbed from the air stream. The scrubber chemical concentrations are typically automatically controlled by monitoring the liquid solution pH and ORP (Oxidation-Reduction Potential). A pH probe and controller maintain the proper pH by regulating the rate sodium hydroxide is added to the solution. An ORP probe and controller maintain the proper chlorine residual by regulating the rate sodium hypochlorite is added to the solution. Make-up water is continuously fed to the scrubber to force out contaminants that accumulate in the sump out the overflow.

Where removal of ammonia and other nitrogen compounds is required, a two-stage scrubber system using a dilute sulfuric acid solution in the first stage is typically used. The ammonia reacts with the sulfuric acid to form ammonium sulfate, a soluble, non-volatile salt, which is removed from the scrubber effluent through the overflow.

Wet scrubbers are a proven odor control technology which can remove up to 99.5% of hydrogen sulfide, even at high concentrations. They require a relatively small footprint, but require significant operational and maintenance attention, chemical handling and storage, and require disposal of scrubber effluent wastewater. Due to the special handling requirements of the chemicals involved, extensive training of operators of these systems is required. They are not considered to be effective for removal of volatile organic compounds (VOC's) and are also not effective where odorous organic compounds are to be treated.

Applicable Treatment Processes:

All liquid treatment plant processes, pump stations, sludge thickening, sludge dewatering.

Typical Design Criteria:

Air flow velocity	< 8.5 feet/sec (500 fpm)
Detention time (in packing)	1.5 - 2 sec
Packing depth	6 – 10 feet (dependent on contaminant loading)
H ₂ S removal efficiency	99%

Major Design Considerations:

a. Contaminants to be removed

Chemical treatment selection is based on contaminants to be removed. Hydrogen sulfide may be treated using a solution of sodium hypochlorite and sodium hydroxide. Ammonia may be treated using a dilute solution of sulfuric acid. VOC's are not effectively treated in wet chemical scrubber systems.

b. Number of stages required

A multiple stage scrubber system may be required for removal of multiple contaminants such as hydrogen sulfide and ammonia. Multiple stages may also be used for treatment of very high contaminant concentrations. Two and three stage systems are common.

c. Liquid solution controls

The liquid solution must be properly monitored and controlled to ensure proper pH and ORP levels are maintained in the scrubber solution for efficient operation. Liquid levels must also be monitored and controlled.

d. Packing material

Packing should possess high surface area to volume ratio and possess shapes and sizes to provide a tortuous path for adequate detention time, while minimizing pressure drop. Materials vary dependent on contaminants being treated and the temperature of the air.