ODOR CONTROL TECHNOLOGY SUMMARY

Technology: OXYGEN INJECTION

Description:

Oxygen injection is a chemical treatment for wastewater, used for the prevention of hydrogen sulfide formation and/or oxidation of sulfides in the wastewater. The process is similar to the nitrate addition process, except that dissolved oxygen is the oxidizing agent instead of nitrate. The process is also much less expensive to operate than the nitrate addition process. The oxygen injection process involves adding dissolved oxygen into a force main at a pumping station. The oxygen is injected into high-pressure force mains where a high driving force exists to dissolve 50 – 200 mg/L of oxygen. Anaerobic conditions in force mains are common because oxygen transfer to the wastewater is limited.

Bacteria in wastewater collection systems will use dissolved oxygen, nitrate, and sulfate as oxygen sources for respiration, in that order of preference. Dissolved oxygen is usually present in fresh wastewater, but is rapidly depleted by biological activity. When dissolved oxygen and nitrates in the wastewater are depleted, the bacteria begin utilizing sulfate for respiration. The byproduct of the sulfate uptake process is dissolved sulfide. The dissolved sulfide combines with hydrogen ions to form hydrogen sulfide.

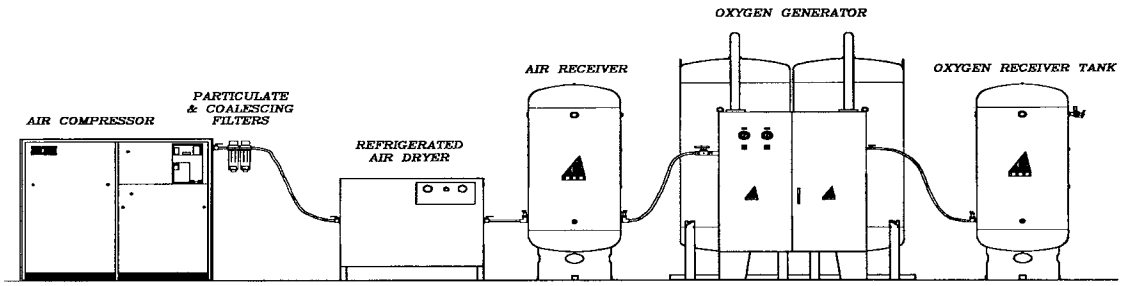
Oxygen injection works by providing dissolved oxygen for the bacteria, to prevent the bacteria from starting the sulfate reduction process.

Oxygen may be produced on-site or delivered in liquid form and stored in tanks. It may be injected by several different methods, including sidestream U-tube injection or venturi eduction. Pressure swing adsorption (PSA) systems provide on-demand oxygen, and may provide the most cost effective method for oxygen injection for wastewater systems.

PSA systems separate oxygen from the air by routing pressurized air through vessels containing beds of molecular sieve (zeolite). The sieve filters the air and adsorbs the nitrogen at high pressure (60 psig), leaving 90 – 95% pure oxygen exiting the sieve. Before the sieve is completely saturated with nitrogen, the inlet air is switched to a second bed. The first bed is regenerated by desorbing the nitrogen through depressurization and then purging it with oxygen. This cycle is continuously repeated, thus the name “pressure swing adsorption”.

The drawing on the next page shows a typical oxygen injection system equipment layout. The system includes an air compressor, filters, air dryer, air receiver tank, oxygen generator containing the sieve vessels, and an oxygen receiver tank. Oxygen may then be delivered to the force main from the oxygen receiver tank. PSA systems are available in many sizes, dependent on oxygen delivery volume requirements.

Advantages of PSA oxygen injection systems include no chemical handling or storage, oxygen is generated on-demand so no large oxygen storage vessels are required, relatively simple operation and maintenance, operating costs are low with no ongoing chemical purchases required. Disadvantages include limited applications in wastewater exist in the U.S. There are several oxygen injection systems in the U.S., but none currently utilizing the PSA technology. Also, safety precautions must be designed into the system for the handling of 90 – 95% pure oxygen.



Typical PSA Oxygen Injection Equipment

Applicable Treatment Processes:

Injection into force mains

Typical Design Criteria:

Dosage	15 – 35 mg oxygen per liter of wastewater (dependent on sulfide loading)

Major Design Considerations:

a. Location of injection

The oxygen should be injected into force mains at a location to allow for adequate mixing and detention time.

b. Force main pressures

PSA systems deliver oxygen at approximately 45 psig. Where force main pressures exceed 45 psig, injection methods for overcoming the differential must be designed. Methods may include oxygen booster compressor or venturi-type injection nozzles.

c. Safety

Since oxygen may accelerate combustion, safety precautions must be designed into the system to ensure safe operation.