CHAPTER 8.0

GAS PHASE ODOR TREATMENT

8.1 Overview of Literature Reviewed

Fifty-one papers, articles, reports, and theses, covering a wide range of gas phase odor treatment technologies, were reviewed. The breakdown of papers by topic was as follows:

- Biofilters (13)
- Biological scrubbers (11)
- Membrane bioreactors (1)
- Activated-sludge diffusion (3)
- Chemical scrubbers (4)
- Activated carbon (5)
- Ionization (4)
- Cold plasma reactors (3)
- Photocatalytic reactors (1)
- Overviews (6)

Figure 8-1 shows a distribution of topic areas. The general topic of biological treatment of odors represented about 53 percent of the papers reviewed; most of the papers were published within the past 5 years.

Of the 51 papers, 29 were found in technical journals or conference proceedings, and eight in “soft journals” such as equipment trade magazines; three were theses, and one was a technical report for a municipal client (that is, gray literature). Figure 8-2 shows the distribution of papers by type of literature.

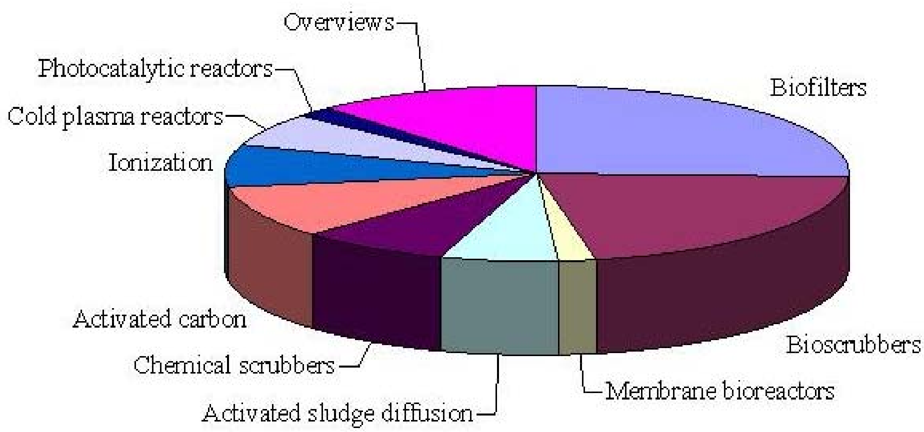


Figure 8-1. Distribution of Topic Areas

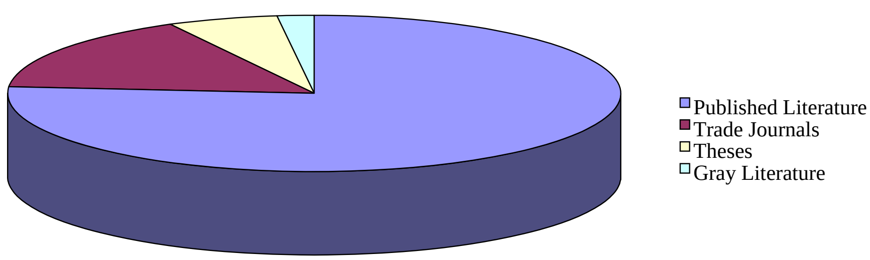


Figure 8-2. Literature Distribution by Source

8.2 Background

In collection systems, controlling odors sometimes requires "capture-and-treat" approaches, whereby a fan is used to pull odorous air from a structure and convey it to an odor treatment device. This is as opposed to the direct addition of chemicals to oxidize, precipitate, or prevent the release of odors and H_2S. The capture-and-treat approach is often used at sensitive locations where the free flow of air down a sewer is blocked by either (1) the discharge of the sewer into a pump station wet well, (2) an inverted siphon without an air jumper—or with an inadequately sized one—or (3) inadequate sewer headspace. Because of the drag exerted by the flowing sewage on the headspace air, the air travels down the pipe until it reaches an obstruction. The lack of an outlet for this air causes pressurization of the headspace, forcing the odorous gases out vents, cracks, seams, etc. This phenomenon also occurs at a significant grade change, such as when sewage travels down a steep sewer that "flattens out" at the bottom of the hill. Air pressure is negative upstream of the slope change, causing air to be drawn into the sewer, but is positive after the slope change, forcing odors out of manholes, etc. In collection systems, the most common application of odor control technology is for pump station wet wells. More-extensive odor control may be necessary at pump stations that remove and process grit and screenings. Other than pump stations, capture-and-treat systems are sometimes used to control odor emissions from siphon head structures, junction boxes, and drop structures, where headspace pressurization and odor release occur.

Ventilation rate is an important parameter in sizing an odor control system. Unfortunately, air movement patterns in sewers and sewer structures are not well understood and are rarely measured, making difficult the selection of the proper airflow to achieve a negative pressure. In some cases, standard air exchange criteria such as "12 air changes per hour" are applied to wet wells that are entered by workers. However, such rules of thumb often have little basis in achieving the main objective in sewer ventilation: preventing the escape of odors by maintaining a slight negative pressure. For covered processes at wastewater treatment facilities, some practitioners have proposed ventilation rates in proportion to the covered surface area, with the range dependent on the "tightness" of the cover and the degree of infiltration through cracks and openings. Guidelines range from 0.2 to 0.5 $m^3/min/m^2$ of covered surface area (0.5 to 1.5 cfm/ft^2).

There are many technologies used to treat odorous air. Below is a review of those known to be successful for odor control, along with some that are in the research and development stage. For each technology, a brief description is provided, followed by a discussion of application, performance, and development status.

8.3 Chemical Scrubbers

8.3.1 Description

Packed-tower, wet-chemical scrubbers have long been the workhorse of the odor control industry. Chemical scrubbing is a fully proven technology that performs effectively and predictably. Chemical scrubbers consist of corrosion-resistant vessels in which odorous air contacts a chemical solution to absorb or oxidize odorous constituents. The most common configuration of a chemical scrubber consists of a vertical tower filled with plastic packing in which contaminated air flowing upward contacts a chemical solution flowing downward (Figure 8-3). In wastewater treatment applications, the chemical solution typically consists of sodium hypochlorite (bleach) or sodium hydroxide (caustic soda) or both. In the majority of cases, chemicals are metered into a scrubbant recycle line to maintain pH and oxidation-reduction potential (ORP) set points. Proper levels of chemicals control the absorption and oxidation of H_2S and other reduced-sulfur compounds. Chemical scrubbers have a small footprint and can be constructed to perform in multiple stages, depending on the types and levels of contaminants to be removed.

8.3.2 Application

Chemical scrubbers are widely used for treating odors from wastewater treatment facilities. Although chemical scrubbers can achieve high odor removal efficiency for a wide range of odorant loadings, the systems require a significant level of operation and maintenance. In collection systems, this has generally limited their application to larger pump stations that are routinely monitored by operations staff. Further, the systems require the storage and metering of chemicals such as sodium hypochlorite (bleach) and sodium hydroxide (caustic soda) that are often undesirable in residential neighborhoods. Although "package" scrubber systems are available for small pump stations, most municipalities choose systems that require less operator attention, such as biofilters and activated carbon adsorbers, because facilities in the collection system may be checked only intermittently by operations staff.

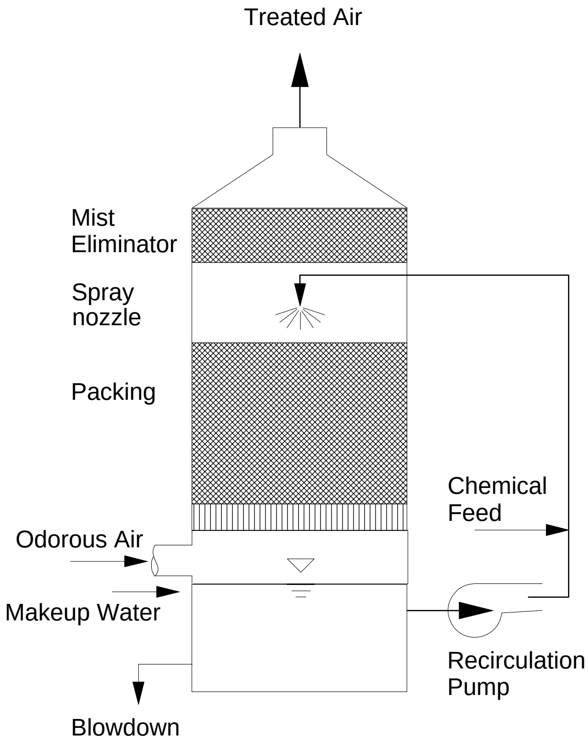


Figure 8-3. Packed Tower Chemical Scrubber

8.3.3 Performance

Chemical scrubbers using sodium hypochlorite and sodium hydroxide remove H_2S and many odorous sulfur compounds very well; those using sulfuric acid remove ammonia and trimethyl amine very well. Chemical scrubbers' performance is predictable, and the makeup of the chemical solution can be modified easily by changing the set points. Odor removal efficiency typically exceeds 90 percent, and H_2S removal can be 99.9 percent.

8.3.4 State of the Art

Of the four papers on chemical scrubbers reviewed, one dealt with using hydrogen peroxide instead of sodium hypochlorite as a scrubbant chemical, one addressed operational issues with scrubbers, one investigated the formation of chlorinated organics, and one was a vendor-prepared case study. Two of these papers also dealt with converting a chemical scrubber to a biotrickling filter. The processes that occur in chemical scrubbers are well researched and documented. With the exception of new methods to control chemical feed rates (for example, using outlet H_2S concentration rather than pH/ORP) or novel "package" configurations of multistage systems, there have been relatively few developments in the wet-scrubber industry in the last 20 years. Traditional pH/ORP control of chemical feed rates is still the standard control system, but fundamental problems with this method remain. These include the lag time between the chemical dosing point and the location where pH/ORP is monitored and the difficulty in maintaining a stable operation under variable loading conditions.

8.4 Activated-Carbon Adsorbers

8.4.1 Description

Activated-carbon adsorbers, like chemical scrubbers, are a traditional workhorse of the odor control industry. Activated carbon adsorbers are simple systems consisting of a corrosion-resistant vessel containing an activated carbon medium through which odorous air is passed to remove odorous contaminants by adsorption. Systems configurations can be “single-bed” or “dual-bed,” with each bed of carbon being about 3 ft thick. In dual-bed systems, the inlet airflow is split, and air passes through the two beds in parallel (one air stream upward, one downward) and is exhausted through stacks at the top. Figure 8-4 shows a typical dual-bed activated-carbon adsorber. For wastewater treatment applications, the activated-carbon medium is often a “specialty” carbon designed for H_2S and sewage odors (Section 8.4.4). For relatively dilute odors or for polishing the exhaust from other odor control processes, “virgin” coconut-shell or coal-based carbon can be used.

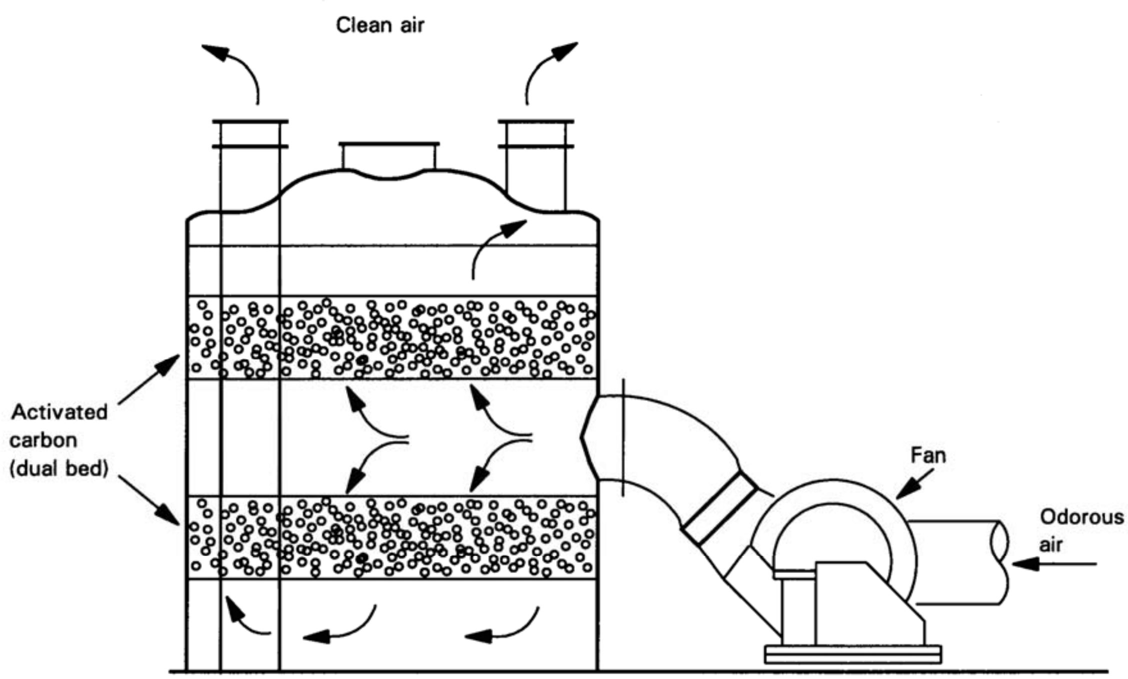


Figure 8-4. Dual-Bed Activated-Carbon Adsorber

8.4.2 Application

The simplicity of an activated carbon system favors its use at pump stations or other unstaffed sites in the collection system—electric power is all that is required for utilities. Carbon is generally effective for a wide range of odorants. There are many vendors of activated-carbon systems, and the performance and longevity of the medium is relatively predictable. New developments in carbon media have extended the range of H_2S loadings for which carbon is appropriate. Activated carbon continues to be widely used for odor control applications at wastewater collection and treatment facilities.

8.4.3 Performance

Carbon performs very well in wastewater odor control applications; it is generally effective for a wide range of odorants, and over the past 20 years, significant improvements have been made to the medium so that it more effectively removes hydrogen sulfide, a main component of sewage odors (especially in collection systems). The disadvantage of carbon is that high-odorant loadings may cause breakthrough and rapid media exhaustion, thus making frequent media regeneration or replacement necessary.

8.4.4 State of the Art

In the past 10 years, there have been significant advances in activated carbon designed for H_2S removal. The traditional approach had been to impregnate the medium with sodium hydroxide or potassium hydroxide to improve H_2S removal (via absorption/reaction). Unfortunately, the medium was subject to spontaneous combustion and plugging, and it required disposal as a hazardous waste owing to its high pH. The first major innovation was a "catalytic" carbon, developed by Calgon, in which the H_2S is oxidized to sulfate on the surface of the carbon. Its ability to remove H_2S can be restored by soaking or washing it in water to remove the sulfate. More recently, single-use "high-H_2S-capacity" carbon has been developed by US Filter–Westates and others. While not regenerable, its H_2S removal capacity is up to six times that of virgin (untreated) carbon. Table 8-1, with data from Westates, shows the H_2S capacity of various carbons:

Table 8-1. H_2S-Removal Capacity of Various Carbon Media

	H_2S Removed	
Carbon	Grams per Cubic Centimeter	Percent by Weight
Coconut-shell	0.05	10
Caustic-impregnated	0.14	25
Water-wash catalytic	0.09	16
Single-use, high-capacity	0.30	62

Of the sources on using carbon for odor control that were reviewed, one (a thesis) researched the use of unmodified carbon on odor and H_2S removal, one investigated using activated carbon cloth for odor removal, one (a thesis) researched the removal of carbonyl sulfide, and one evaluated the mechanism of removing biological H_2S in unmodified activated carbon.

New activated-carbon media designed for H_2S and sewage odors has advanced the state of the art for odor treatment via carbon adsorption and thus expanded the range of applications for which carbon treatment is a viable and cost-effective alternative.

8.5 Biofilters

8.5.1 Description

Biofiltration is a technology developed mostly in Europe that has been used widely in the U.S. for the past 15 years. Biofilters are now a viable and accepted alternative to chemical scrubbers and activated-carbon systems. There is a variety of engineered, "in-ground" biofilters as well as proprietary, "in-vessel" biofilters in use at wastewater treatment plants and pump stations throughout North America.

The traditional biofilter consists of an open bed of organic material through which odorous air is passed. The medium is often a blend of wood chips, compost, and bark nuggets designed to maintain porosity while allowing good contact between the odorants and the biologically active bed. Figure 8-5 is a schematic of a traditional biofilter. Soil is also used as a natural medium. One vendor has developed a nondegradable biofilter medium consisting of a porous substrate coated with nutrients, buffers, and adsorbents.

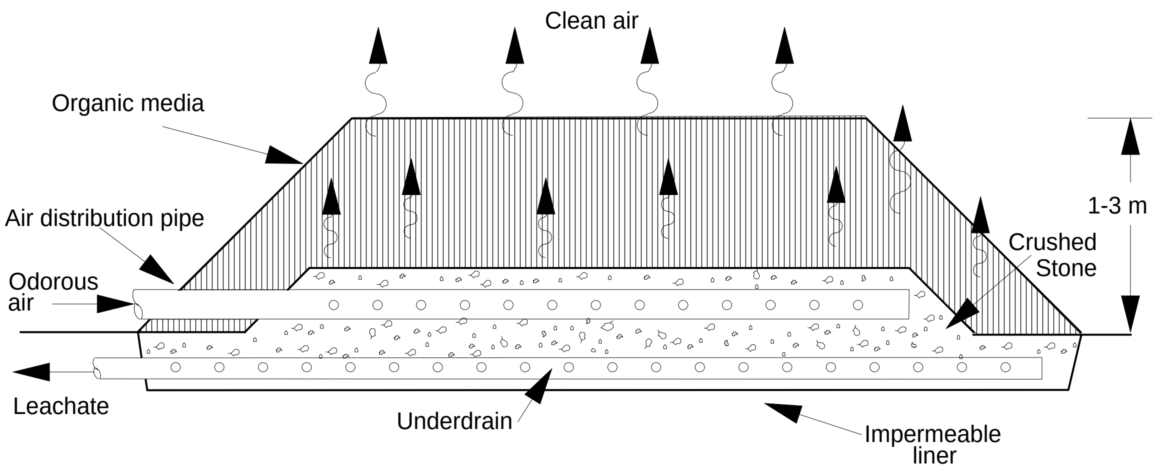


Figure 8-5. In-Ground Organic-Media Biofilter

Good distribution of air through the media and maintenance of the proper moisture content are essential. Moisture can be applied by prehumidification, sprinklers, and soaker hoses. Vendor-supplied “package” biofilter systems have addressed these issues in the design of the vessels and humidification systems. There are many different configurations of proprietary in-vessel biofilters.

8.5.2 Application

Biofilters are frequently used for odor control at pump stations. Proprietary package biofilter systems may even enjoy greater application than traditional in-ground biofilters owing to their smaller footprint. The need for potable water can limit the application of biofilters for junction boxes, inverted siphon headchambers, etc., where potable water is not available. For the past 15 years, biofilters have been applied to a wide variety of odor control applications at wastewater treatment plants and, to a lesser degree, at wastewater collection systems.

8.5.3 Performance

The performance of biofilters is well documented. Odor removal performance is nearly equivalent to that of other traditional control technologies, such as wet scrubbers and activated carbon. Properly designed biofilters can do an excellent job removing both H_2S and reduced-sulfur compounds, although systems often produce a slight residual “earthy” odor. While there is little information in the literature on specific applications of biofilters in wastewater collection systems, there are substantial performance data available on the use of biofilters to treat wastewater treatment plant odors.

8.5.4 State of the Art

Of the 51 papers reviewed, 15 were about biofilters or included a discussion of biofilters. Quigley et al. (2004) provided an excellent summary of the performances of different biofilter media. Shareefdeen et al. (2004) addressed H_2S removal by biofilters in cold climates and provided a case study on removing reduced-sulfur compounds. Three papers described development of biofilter models. Converse et al. (2003) researched volatile organic compound (VOC) removal in biofilters.

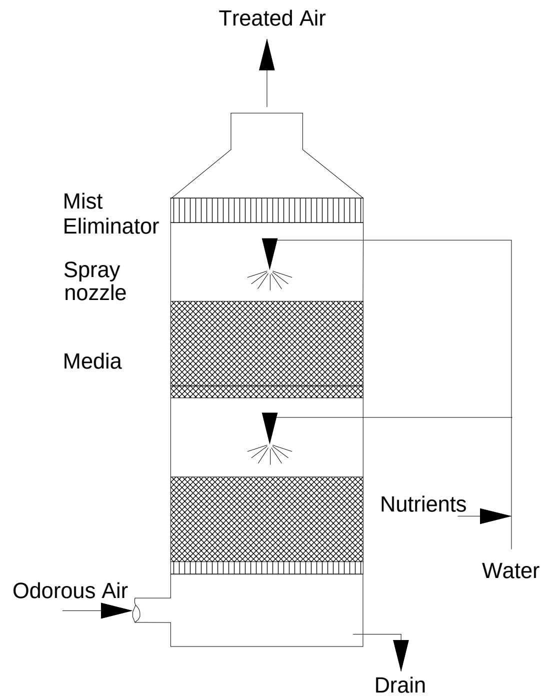
There is a significant body of information throughout the world on the use of biofilters for treatment of odorous air. Although there continue to be failures of biofilters due to misapplications, design errors, and poor operation and maintenance, knowledge of biofilters is comprehensive and continues to improve. Engineered in-ground biofilters using organic media are usually very conservatively designed.

Most biofilters are designed with organic media—blends of compost, wood chips, bark, peat, and other materials—which are subject to natural biological degradation and compaction. This is a significant limitation to organic-media biofilters. One vendor has developed a nondegradable biofilter medium that carries a 10-year warrantee, and there has been research published over the years on using perlite, rock wool, sand, and other nondegradable materials, but the vast majority of biofilters in the United States use a blend of wood-based organic media. This is one area where further research and development may be warranted to overcome the limitations of conventional organic media.

8.6 Biological Scrubbers

8.6.1 Description

Biological scrubbers—also referred to as biotrickling filters—consist typically of vertically oriented vessels containing inert packing or media that support biological growth. The vessels are equipped with spray nozzles to continuously or intermittently apply water and nutrients and an underdrain system to collect and in some cases recirculate the leachate. A typical biological scrubber is shown in Figure 8-6. Most are designed for countercurrent operation, with the air flowing vertically upward while the water trickles downward, though one vendor uses a cocurrent design. Another version of this concept uses a combination of attached biological growth on the media with a small, suspended-growth reactor in the recycle stream. The growth on the fixed media allows absorption and oxidation of odorants as the air passes through the media. The suspended growth reactor is used for the oxidation of odorants after transfer into the scrubbant liquid. Most biological scrubber systems are relatively simple, with few moving parts. The advantage of the biological scrubber over a biofilter is that the vertical orientation of the vessel offers a potentially smaller footprint than most biofilters.



a. BIO-TRICKLING FILTER

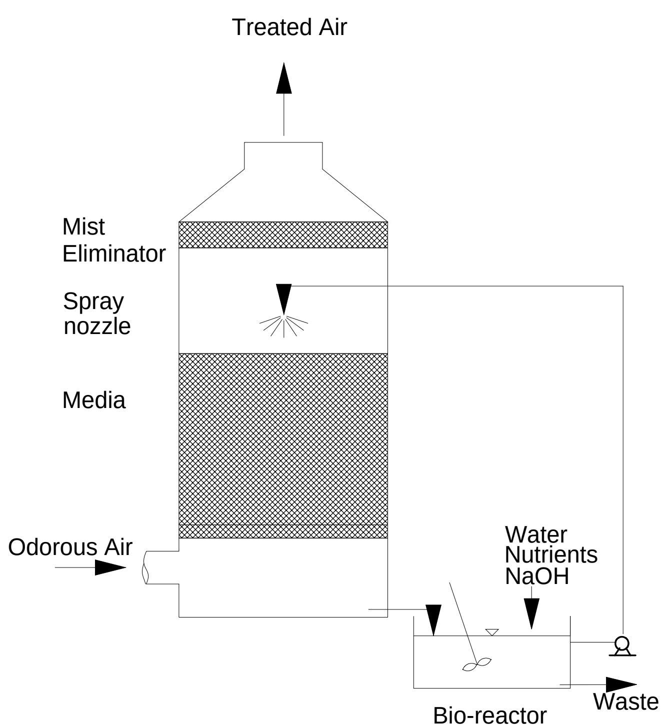


Figure 8-6. Biological Scrubber Systems: Biotrickling Filter (top) and Bioscrubber

8.6.2 Application

Although most biological scrubbers in the United States have been installed at wastewater treatment plants, the technology is suitable for use in collection systems, particularly at pump stations. Biological scrubbers are low maintenance and require little operator attention. As described in the next subsection, the systems produce a musty or earthy odor that depending on the proximity of receptors may require additional polishing.

8.6.3 Performance

Biological scrubbers perform extremely well on hydrogen sulfide, with an H_2S-removal efficiency over 99 percent in some cases. Easter et al. (2005) reported an average of 98 percent H_2S removal from eight biotrickling filters. However, average *odor* removal was only 71 percent. Increasing the empty-bed residence time (EBRT) increases the efficiency of removing odor and H_2S. Higher EBRTs are necessary to treat significant levels of non-H_2S reduced-sulfur compounds. Biotrickling filters have been very successful at pump stations where H_2S is the dominant odorant.

8.6.4 State of the Art

Interest in biological scrubbers as an alternative to biofilters or conventional odor control technologies has increased dramatically in the last 5 years. Of the 51 papers reviewed, 13 addressed biological scrubbers (some papers dealt with both biofilters and biological scrubbers). The availability of small-footprint biological odor control systems with nondegradable media is very attractive to users who seek a reliable, low-operations and -maintenance system that does not use hazardous chemicals and does not require frequent media replacement.

Of the papers on biological scrubbers, several were overviews of biological odor control alternatives, three reported on the conversion of chemical scrubbers to biological scrubbers at the Orange County (Calif.) Sanitation District, and three were laboratory investigations on removing specific contaminants, such as H_2S and ethanol; there was one paper each on (1) pilot testing for odor and VOC removal, (2) a full-scale application in Denmark, and (3) the use of “biological activated carbon” as a medium for a biological scrubber.

Although municipalities have converted existing vessels into biological scrubbers or have designed their own biological scrubbers, most rely on vendor-supplied systems. There are at least six vendors of biological scrubbers; three use random-dump polyurethane foam cubes as the medium, one uses woven-plastic “cassettes,” one uses foam media custom fit to the vessel dimensions, and one uses lava rock media.

Many of the biological scrubber systems currently operating in the United States are in warm climates, where H_2S is the predominant odorant, and where warm temperatures promote high biological activity and good reaction kinetics. For these applications, H_2S removal has generally been excellent. However, there is a lack of information and good performance data on how these systems function in colder climates, where H_2S may be in relatively low concentrations, or where the predominant odorants may be non-H_2S sulfur compounds.

8.7 Ionization Systems

8.7.1 Description

Air ionization or oxygen ionization is a process by which positive and negative ions are generated with a reactive-plasma generator. The technology has been used in Europe for some 20 years. According to vendor literature, the ions activate clusters of oxygen molecules that react with contaminants in the air. One vendor has postulated that the activated oxygen clusters react with H_2S to form sulfate. Normally, the ion generator is applied to filtered, ambient supply air that is then introduced into an odorous room or process to allow contact between the ions and the odorants. Claimed advantages include low power requirements, small footprint, and low capital and operating costs. Figure 8-7 shows a diagram of the air ionization process.

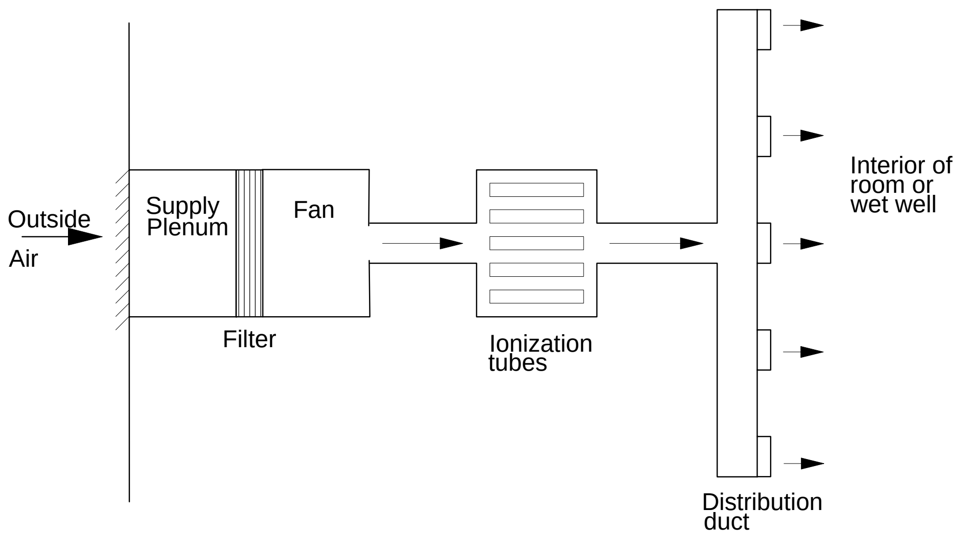


Figure 8-7. Air-Ionization Process

8.7.2 Application

Air ionization technology is potentially applicable to both collection system and wastewater treatment plant odors. In theory, the relatively small ion generators could be installed in pump stations as a means of treating wet well odors. Most of the existing applications are for treating odors from sludge-handling operations.

8.7.3 Performance

The performance of air ionization applications at wastewater treatment facilities is poorly documented. Of the three papers reviewed in the published literature as part of this project, two discussed a pilot study in Germany whereby the air ionization process was used to pretreat VOCs in odorous air prior to biofiltration; a 25–35 percent reduction in VOCs was achieved. A third paper was a presentation of case studies by a U.S. vendor. A field “scentometer” was used to measure “before” and “after” odor levels. H_2S measurements showed virtually complete H_2S removal at one site. The validity of the data is unknown.

The most comprehensive and scientific testing of air ionization was conducted by Webster Environmental Associates, Inc. (2003), for the Orange County (Calif.) Sanitation District. Two different vendor-supplied systems were tested. When no supplemental H_2S was added to the room air to be treated, an approximately 50 percent reduction in odor and H_2S was achieved. This test was done when H_2S concentrations ranged from 0.1 to 0.2 ppm. When bottled H_2S was introduced to achieve a baseline H_2S of 3 to 5 ppm, there was no consistent reduction in odor or H_2S associated with the introduction of ionized air.

8.7.4 State of the Art

Although ionization systems have been used for odor control in Europe for 20 years, there are few scientific data in the published literature to document their effectiveness or the mechanism by which odor reduction occurs. There are relatively few systems in the United States and few data to support the vendors' claims, even though operations staff subjectively report improvements in air quality where the systems are in use.

8.8 Other Biological Systems

8.8.1 Description

Other biological odor treatment systems include diffusion into activated-sludge basins and membrane bioreactors. Activated-sludge diffusion is a process whereby odorous air is introduced into existing blowers and diffused into aeration tanks for treatment. A schematic is shown in Figure 8-8.

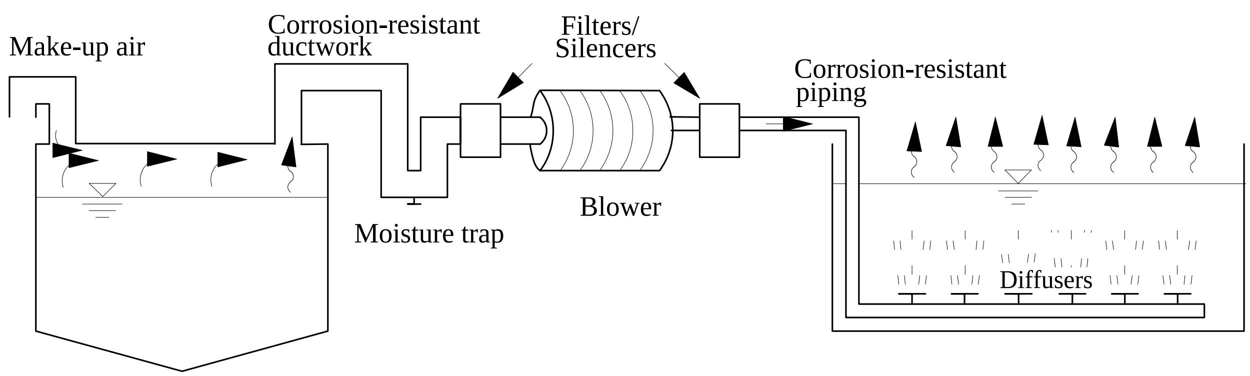


Figure 8-8. Activated-Sludge Scrubbing System

Membrane bioreactors (MBRs) are a relatively new development in the field of wastewater treatment. Although a number of full-scale applications exist for the treatment of wastewater, using MBRs for control of odorous air emissions is still in the research stage. Figure 8-9 illustrates the concept of an MBR for treatment of odorous air.

8.8.2 Application

Since activated-sludge diffusion relies on the availability of an existing activated-sludge process, it has little application for collection systems, other than perhaps the treatment of air from an influent sewer or influent pump station located at the plant.

MBRs have a potential for use in a wastewater collection system or treatment plant. Given the limited stage of development of this technology for odor control, it is impossible to assess the factors that may affect its application.

8.8.3 Performance

The performance of activated-sludge diffusion as a method of odor treatment is excellent and well-documented. Three of the papers reviewed addressed performance of activated-sludge diffusion for odor control.

Use of membrane bioreactors for odorous air treatment has been researched at laboratory scale. Most studies have been on single contaminants.

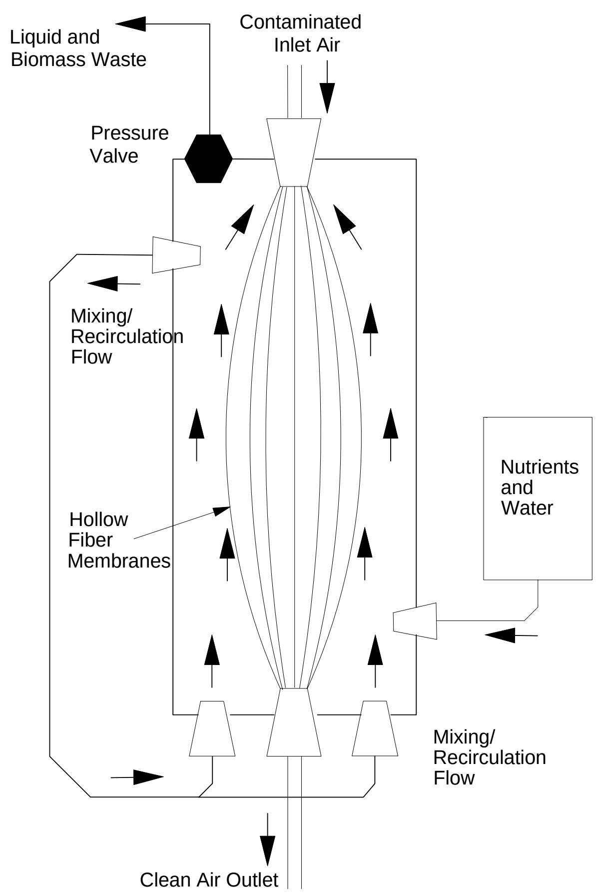


Figure 8-9. Schematic of Hollow Fiber Membrane Reactor

8.8.4 State of the Art

Activated-sludge diffusion is a well-documented odor treatment technique that has limited application to wastewater collection systems owing to its dependence on an existing activated-sludge basin being close to the odor source. Research to better define process mechanisms and limitations is ongoing.

Using membrane bioreactors to treat odorous air emissions is in the developmental stage, with only laboratory data available on its effectiveness. Only one paper on the subject was reviewed as part of this project.

8.9 Hydroxyl Ion Fog

8.9.1 Description

The hydroxyl ion fog process is a proprietary system that is used for wastewater odor control applications. The system combines onsite-generated ozone, water, and compressed air, which produce an atomized fog of ozone and hydroxyl radicals. According to the vendor, this oxidizing fog has a rapid chemical reaction with H_2S and other odorous compounds. The mechanism for removing hydrogen sulfide and other odorants is not well understood. The fog is blown into a wet well or other contained structure to react with the odorous compounds, eliminating the need for a separate vessel. The system has also been applied to ductwork upstream of a wet scrubber. A diagram of the process is shown in Figure 8-10.

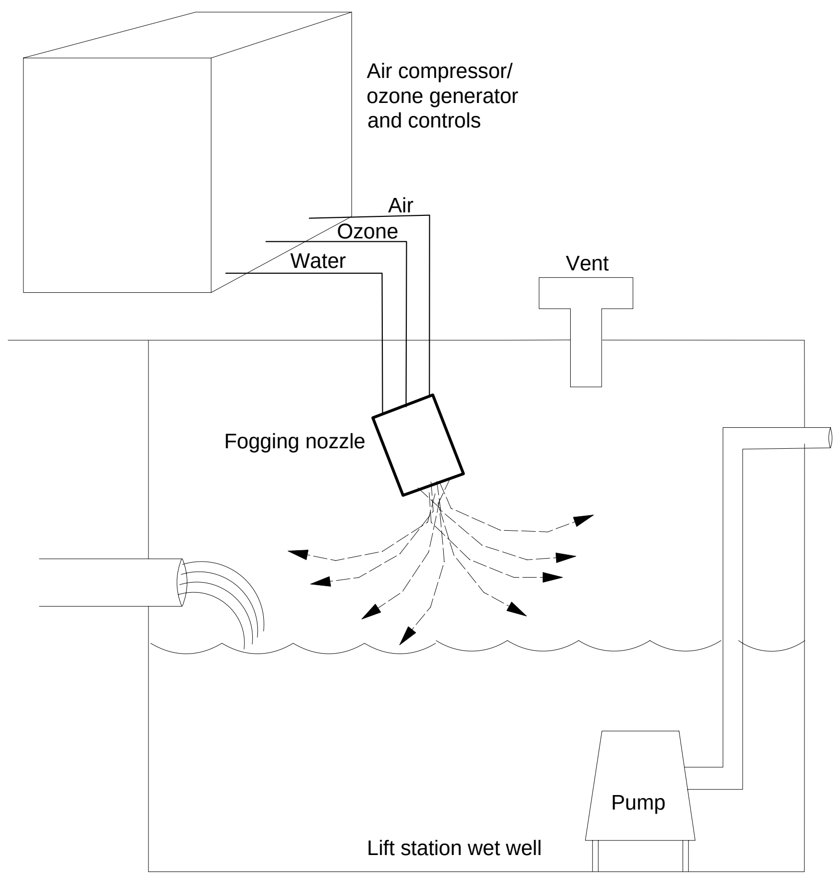


Figure 8-10. Hydroxyl Ion Fog Process

8.9.2 Application

The hydroxyl ion fog system requires water and electricity. There are units operating on pump station wet wells as well as wastewater treatment processes. The Hampton Roads (Va.) Sanitation District has several units operating at its facilities.

8.9.3 Performance

No papers were reviewed on this technology as part of the WERF project. Two papers on the subject were presented at the 2002 WEF Odor Specialty Conference. Good performance data are lacking. Limited H_2S data were presented, but no data on odor reduction or the removal of non-H_2S reduced-sulfur compounds were included.

8.9.4 State of the Art

The hydroxyl ion fog process has been in use for approximately 8 years. Unfortunately, there are very few published data on the effectiveness of the process. Without such data, it is difficult to assess the technology or its application for collection system odor control.

8.10 Cold Plasma and Photocatalytic Reactors

8.10.1 Description

Corona reactors, also called nonthermal plasma or cold plasma reactors, are being studied as a method to treat odorous air. The process involves passing the contaminated air through a reactor receiving a high-voltage electrical pulse discharge. The process does not appear to be in commercial use for odor control applications.

Another system, called a photocatalytic reactor, has also been investigated on a laboratory scale as an odor control method. Here, odorous air is circulated through a reactor containing a titanium dioxide–coated photocatalyst deposited on glass supports. The reactor contains a medium-pressure mercury lamp that activates the catalyst, which generates hydroxyl radicals that react with the odorants.

8.10.2 Application

Because of the limited stage of development, application of the technology to full-scale treatment of municipal wastewater odors is difficult to assess. The process could conceivably be used for odor treatment at both wastewater collection and treatment plants.

8.10.3 Performance

Three papers were reviewed on laboratory testing of cold plasma reactors to treat dimethyl sulfide; methanethiol and hydrogen sulfide; and ammonia, ethanethiol, and trimethylamine. This research was conducted in Taiwan. The work evaluated the effect of inlet concentrations, applied power, and single versus mixed malodorants on performance. The laboratory-scale systems were able to achieve high destruction efficiencies for reduced sulfur compounds and nitrogen-based odorants.

The photocatalytic reactor studies in France investigated the rate of decomposition of a single odorant, 2-butanone. The presence of water vapor increased the production of hydroxyl radicals that enhanced degradation rates.

8.10.4 State of the Art

Cold plasma reactors and photocatalytic reactors are in the early stages of development, and it may be years before the technology is commercialized for municipal odor control applications. There are limited performance data available, and the economics of the processes are unknown at this time.

8.11 Summary

Table 8-2 summarizes gas phase odor treatment technologies, showing the status of development, the availability of performance data, and the applicability to treatment of odors from wastewater collection systems.

Table 8-2. Summary of Gas Phase Odor Treatment Technologies

Technology	Development Status	Availability of Performance Data	Applicability to Collection Systems
Chemical scrubbers	Fully developed	High	Limited
Activated carbon	Fully developed	High	High
Biofilters	Fully developed	High	High
Biological scrubbers	Evolving	Medium	High
Ionization	Evolving	Low	Limited
Activated sludge diffusion	Fully developed	Medium	Not applicable
Membrane bioreactors	Research	Low	Potential
Hydroxyl ion fog	Developed	Low	Medium
Cold plasma reactors	Research	Low	Potential
Photocatalytic reactors	Research	Low	Potential

8.12 Research Agenda Items

8.12.1 Identifying Compounds in Sewer Gas That Lead to Odor Complaints

Hydrogen sulfide is widely regarded as the most significant odorous compound present in sewer gas and the primary cause of odor complaints associated with wastewater collection systems. This proposition, however, has not been rigorously tested. Control of hydrogen sulfide in many circumstances may not necessarily lead to significant reduction of an odor’s intensity or its objectionable nature. Anaerobic decomposition produces a spectrum of intermediate metabolites and end products that have low odor thresholds. These products include short-chain fatty acids, ammonia, organic amines, indole-related compounds, phenolics, and organosulfur compounds. The importance of these compounds in generating odor complaints, relative to hydrogen sulfide, has never been systematically evaluated. Collection system operators have a need to know whether an odor problem they are attempting to correct is likely to be ameliorated by reducing or removing hydrogen sulfide from the sewer atmosphere or whether the odor control strategy must be targeted against other compounds.

8.12.2 Effectiveness of Treatment Methods for Odor Compounds Other Than H_2S

Measurement and odor treatment techniques are usually designed for hydrogen sulfide. However, numerous less-well-understood compounds contribute to odor and warrant attention. Since treatment technologies are geared to hydrogen sulfide, other compounds are less effectively treated and can represent the bulk of odors remaining after treatment.

Neglecting the spectrum of odor-causing compounds has led, in some cases, to the failure of odor control systems even while hydrogen sulfide is effectively treated. Likewise, success of many odor control systems may depend on the absence of other compounds in significant concentrations. A study is needed to evaluate how effectively odor compounds other than hydrogen sulfide are controlled with existing treatment systems.

8.12.3 Effectiveness of Biotechnology in Cold Climates

The effectiveness of biotechnology is somewhat dependent upon a normal range of operating temperatures. Below that range, odor compound removal efficiency can be quite sensitive to temperature. Shareefdeen et al. (2004) studied biofilter removal of hydrogen sulfide at low temperatures in a laboratory and found that removal began to decrease precipitously below 5°C. Moreover, cold weather can cause inlet air to lose humidity, due to condensation, before entering the media. This hampers the effectiveness of biofilters.

Because laboratory experiments indicate that cold temperatures hamper biotechnology effectiveness, full-scale biotechnology systems should be evaluated for their effectiveness in cold weather environments. The study should identify locations where odor control functions properly during warm weather but fails during the winter. These cases should be compared to similar cases where the systems do not fail. Also, the effectiveness of modifications such as insulation and steam addition should be evaluated.