The Introductory Guide to
INDUSTRIAL ODOR CONTROL

As long as there have been industrial processes, there have been odors released into the air. It's long been a fact of life faced by industrial facility owners, municipalities and anyone within smelling distance of a manufacturing plant.

As residential and commercial developments inch closer and closer to industrial facilities that generate odors, nuisance complaints become ever more common. Industrial facility leaders know they need to eliminate odors if they want to remain good neighbors and ensure property values don't suffer. But they may not know much more about how to go about it.

Fortunately, scientific understanding of the biology of odors — and of the technologies that can eliminate them — has come a long way. This guide explains how industrial odors are identified and quantified and how odor control experts design and implement appropriate solutions.

EXAMINING INDUSTRIAL PROCESSES

The odor control scientists at BioAir Solutions are well-versed in both the mechanics of industrial processes and the science behind the odorous compounds those processes generate. A thorough examination of each is the first step in developing the right odor control solution.

We start by coming to your facility to examine the problem. We identify the raw materials used in industrial processes, as well as the methods used in converting those materials to a finished product. Odors are often produced when byproducts are generated via those processes.

We also evaluate the facility's process flow and ask the following questions:

- What raw materials are used in the facility?
- What equipment is used to convert raw materials?
- How are raw materials or products transported within the facility?
- What waste is generated during conversion?
- What odorous compounds are produced? How concentrated are these compounds in the air?
- At which points along the process flow are odors likely to escape?

Then, we determine how much odor should be removed, by looking at the proximity of neighbors to your site, any federal, state or local environmental statutes related to industrial odors, and what safety regulations are in place for your employees.

DEVELOPING A SOLUTION

Our in-house engineers will design a custom odor control solution for your site based on what we learned during our visit.

Here's a basic rundown of how odor control works: A blower forces odorous air into a treatment area, where it's dispersed through porous media. There it encounters either a biological, chemical or inorganic agent which removes the odorous compounds prior to the clean air's release into the environment.

The types and concentrations of odors or emissions emitted from your facility will help us define the best treatment technology for your application, but odor control solutions typically take the following forms:

- Activated filters, using media like activated carbon to trap odorous compounds and release clean air.
- Chemical filters or sprays that isolate and remove offending compounds from the air.
- Biofilters that force air through organic media harboring microorganisms that get their energy by consuming odorous compounds.
- Bioscrubbers that send air through organic or synthetic media in a vessel. Microorganisms reside in recirculated water and use the odorous compounds in the air for food.
- Biotrickling filters, which feature microorganisms that reside within synthetic media. Irrigation water is only used to rinse metabolized compounds away, and is not recirculated.

Later, we'll discuss some important things that a facility owner and an odor control expert will consider together when deciding on the most appropriate odor control solution. First, we should discuss and compare odor control solutions in more detail.

NON-BIOLOGICAL SOLUTIONS

The difference between biological and non-biological odor control solutions is that the former make use of microorganisms that get their energy by consuming odorous compounds in the air. The latter either trap the compounds or chemically alter them, but they are not consumed and they must be disposed of.

Chemical scrubbers — also called gas scrubbers — use chemicals that absorb or dissolve pollutants. The chemicals are formulated based on the pollutants they target. While chemical odor control solutions have been successful across industrial applications, they represent a high recurring cost since they need constant replenishment. The chemicals themselves can also be dangerous to handle. That puts workers at risk and may require additional training and compliance with environmental rules.

Activated filters are a popular non-biological odor control method due to how well adsorbents, like carbon, trap odorous compounds. They're also safe to use and handle. But performance is based on the inverse relationship between odorous compounds removed from air and the amount of compounds already trapped inside the filter. For this reason, constant replacement of adsorbent media is required to maintain high performance. That comes at a recurring cost.

BIOLOGICAL ODOR CONTROL

Biological odor control systems have seen growing favor among industrial facility managers in search of a clean, sustainable and potentially cheaper way to treat unpleasant or dangerous air. It's not a new idea, but only recently has technology improved to a point where these treatment methods can compete with — and often outperform — non-biological odor control methods.

Common biofilters have been the go-to biological odor control solution for decades. We see them everywhere, perhaps without knowing what they are — concrete pits built beside industrial or municipal facilities that look like big swimming pools but without the water.

Impacted air is forced through piping at the bottom of the pit and then dispersed upward through a layer of porous rocks or gravel. It then encounters a layer of organic material, such as wood chips or peat moss. Microorganisms that use odorous compounds as food reside in that material. The microorganisms draw on nutrients available within the organic media to supplement their diet of odorous compounds in the air. These systems are never irrigated.

Biofilters have proved somewhat successful in eliminating odors and regulated emissions, but the persistent reliance on them is often based on the misguided use of Empty Bed Residence Time (EBRT) as a design parameter, a practice which is not backed up by rigorous scientific study.

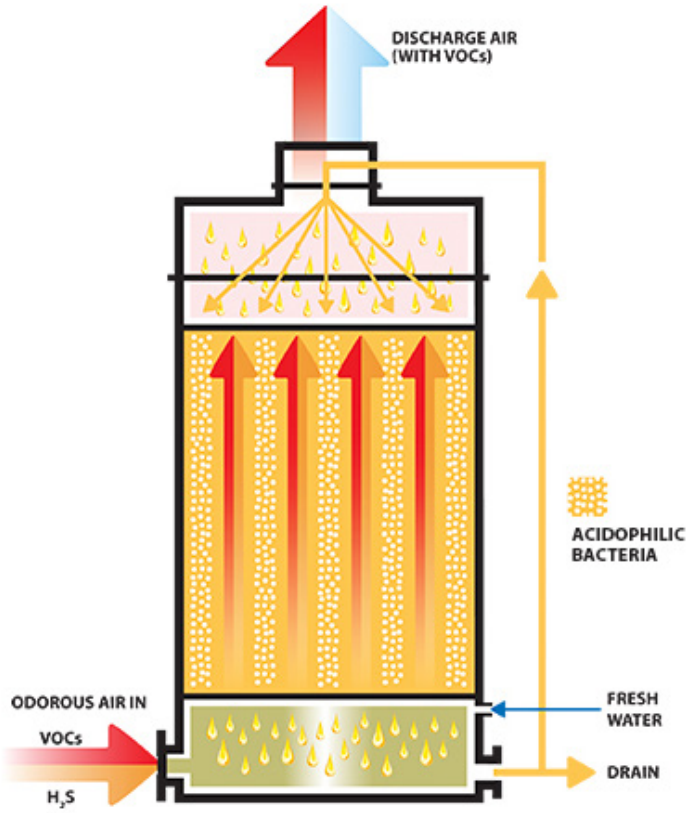
EBRT measures how long foul air is in contact with biological media before offending compounds are removed. When biofilters were first introduced, it was anecdotally recognized that a 60-second EBRT seemed to be enough time to effectively remove pollutants.

The reality is that EBRT is an overly simplistic measurement that doesn't account for the concentration of odor in the air or the surface area and other characteristics of the media through which foul air travels during treatment. It also ignores the efficiency of the media, which is the part of the system actually cleaning the air.

Aside from the inappropriate credence given to EBRT, other operational drawbacks exist:

- Common biofilters require constant replenishment — and regular replacement — of organic media.
- Depending on the type of organic media used, supplies of that media may not be reliably available. This could lead to inconsistent or unpredictable treatment.
- The porous rock beds used in common biofilters must be inspected, removed and cleaned regularly to maintain peak air flow. Clogged rocks limit air flow and increase stress on the system's ventilation.
- Constant removal and cleaning of the rock bed becomes expensive and time-consuming. The porous rock tends to solidify in the biofilter due to demineralization. Before it can be removed and cleaned, the rock must be manually broken up into small pieces. This tedious process can easily lead to damaging the biofilter container, which often then needs to be replaced.

It all adds up to inconsistent performance and an increased cost to control odors. Plus, if your facility has to adhere to strict air permit requirements, this replenishment and maintenance means unwanted, costly downtime for your plant.



Bioscrubbers rely on microorganisms present in water that's recirculated through the treatment vessel. Foul air is forced upward through the bottom of the vessel. On its way up, it's dispersed through synthetic media and contacts the water laden with microorganisms.

The microorganisms metabolize the offending compounds, leaving clean air to be released from the vessel. Nutrient-rich additives are required to round out the microorganisms' diets.

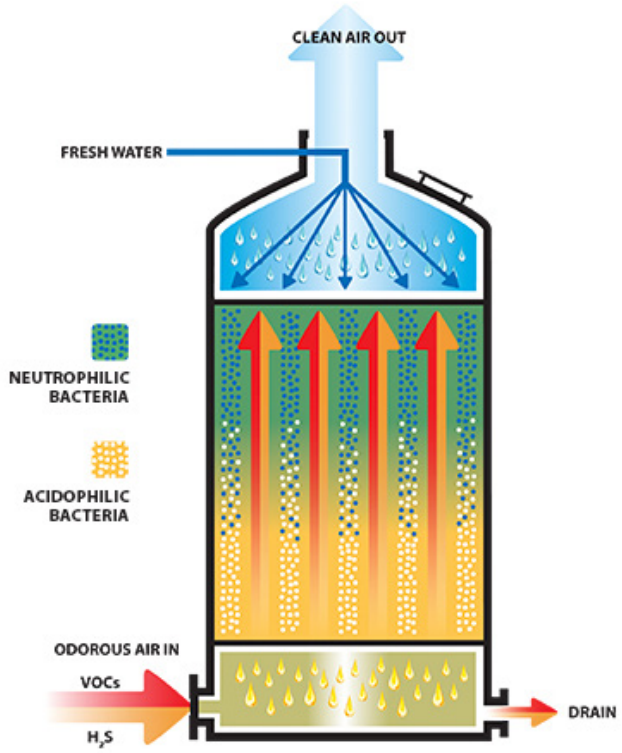
Water recirculation is the key feature of bioscrubbers. The water retains all the metabolized compounds removed from the air, often increasing its acidity. While that acidity supports the growth of some microorganisms, not all types can thrive in the acidic environment. That leads to a lack of biodiversity needed to treat complex odors.

Biotrickling filters work similarly in that they use microorganisms, media and water. Odorous air is collected and forced up through structured synthetic media within the vessel. But in biotrickling filters, the microorganisms grow on, and adhere to, the media surface.

As with bioscrubbers, nutrient supplements are required in these systems.

The key differentiator of biotrickling filters is that they do not recirculate water. The water used in these systems passes through only once. It acts mainly as a rinse to drain the metabolized compounds away, but also plays a critical role in creating the environment needed for the system to work.

Research has shown that biotrickling filters support a greater diversity of bacteria than bioscrubbbers. As impacted air is forced upward through the vessel, it encounters different types of microorganisms. That diversity has been shown to eliminate more, and more kinds, of the compounds produced in industrial processes. This is why biotrickling filters can remove a host of compounds — such as H2S, NH3, volatile fatty acids, organic odors and select VOCs — with great efficiency.



In addition to being more effective than bioscrubbers, biotrickling filters also are less expensive, have lower operating costs, and are easier to maintain because they do not include the extra pumps and piping necessary for water recirculation.

Biotrickling filters are versatile, effective, and affordable. If they're appropriate for your site, we'll recommend these efficient and sustainable systems.

WHAT TO CONSIDER BEFORE YOU DECIDE

Due to the variety of odor control solutions available, you need to consider many factors that play into deciding on the best solution for your site.

First, determine what resources you have on hand. Limited access to water may mean bioscrubbers or biotrickling filters should be avoided. Mechanical resources matter, too. Ventilation schemes in some facilities may be better suited for certain odor control solutions and may rule out others. Also, ventilation modifications could set the stage for a more effective odor control solution. Your odor control expert can help determine the best way forward.

Second, assess the scale of the odor issue in the facility. Your odor control expert will help you identify offending compounds, quantify the airflow carrying those compounds and determine how much of the odor should be removed.

Third, think about the space you have available. If space is limited and neighboring land is in development, a large biofilter may not be practical. Bioscrubbers and biotrickling filters are smaller but can typically handle higher loadings with great performance efficiency. Conversely, if you have a lot of real estate to use and don't have any close neighbors, a biofilter might be the best choice.

Finally, consider your maintenance personnel. The various odor control solutions on the market require various amounts of skill and man hours to maintain. Some even require workers to handle hazardous materials. Will you need to hire more maintenance staff or invest in additional training? Could you reduce that staff with a less labor-intensive odor control solution?

TURNKEY ODOR SOLUTIONS BY BIOAIR

BioAir Complete is a unique service that BioAir provides whereby we take ownership of a facility's entire odor or emission problem. This turnkey service starts with an on-site evaluation of your facility's processes. Our process experts examine the mechanics of your facility and identify sources and concentrations of odors that need to be removed.

Then, based on that information, we design and build an odor removal system from scratch to suit your facility's needs. After that, we start up the system and train your team on its operation and maintenance. We're also on-call for any service or support needs that may arise, with technicians in place to serve all of our installations throughout the U.S. and globally. In select locations we can even operate the system for you on a full-time basis.

Choose an odor control partner that looks at the entirety of your facility. Odor control is not about slapping treatment equipment down in each spot where odorous air is released. It requires a diligent survey of the inner workings of a facility with the goal of centralizing and then efficiently treating as much foul air as possible.

It starts with a conversation. Contact us to talk more about your industrial odor issues and schedule an on-site evaluation. We'll take it from there.