



## Putting Order into Odour

If one were to play a word association game (the negative version) with the word compost one of the first words that would likely tumble out would be “odour.”

Odour is certainly the bane of composters the world over and the issue that can stop an operating facility composting dead in its tracks.

Composting is an industrial process. It utilizes microorganisms to facilitate the decomposition of the various constituents of the organic waste stream. True composting is an aerobic process. Untrue is that this process won't generate odours that require management. A lot can and should be done in terms of managing the process to reduce and manage the amount of odour that's generated. When composting is completed in buildings there is going to be a source of odour that will need to be managed.

One method of odour control is really a replication of the mesophilic part of the composting process. Biofiltration is decomposition of odorous constituents dissolved in or adhering to water. Composting off-gases are collected and forced through a bed or porous and biologically active media.

Biofiltration in the classical sense works by collecting composting off-gases and injecting them, typically through a grid of perforated pipes, into a bed of porous organic material. It requires an air handling system that takes these off-gases and directs them to a biofilter bed. The off-gases reside (i.e., the amount of time it takes them to move through the media)

in this media typically less than 60 seconds before being discharged to the atmosphere.

### What stinks?

Typical odorous compounds at a compost facility can include ammonia and various organic compounds. The organic compounds (50 or so different compounds) can include alcohols, aldehydes, carbonic acids and amines. In cases where a compost facility is not being operated properly these can include reduced sulphur compounds such as hydrogen sulphide and methyl mercaptan.

Dr. Calvin Pride is the owner and president of Ambio Biofiltration Ltd., an Ottawa firm specializing in developing biofiltration systems. For the last 11 years they've installed biofilters in various locations across North America. Dr. Pride points out that biofiltration works best with water soluble compounds. Decomposition of odorous compounds take place on a biofilm (i.e., a thin layer of water on organic material). Water soluble compounds in the compost off-gas can be absorbed by this biofilm. If the residence time in the biofilter is long enough, less soluble odorous compounds (e.g., H<sub>2</sub>S) can be adsorbed to the biofilm and decomposed.

### Biofilter sizing

Off-gases are collected from the composting building and sent to a biofilter. The biofilter media is typically 1-2 m thick.

The size of a biofilter is directly related to the amount of off-gas that needs to be treated.

This in turn is directly related to the size (volume) of the composting building and the number of air changes.

To illustrate biofiltration, let's assume we have a composting facility that's 75m x 15m x 7m high with three composting channels and has a capacity of 10,000 tonnes per year of various wastes. Typically, it's advised that building air be changed 5 to 10 times per hour. For this example we will assume seven changes per hour. Air removal is typically expressed in cubic feet per minute (CFM). Table 1 depicts biofilter bed sizing. (Note: This Excel Spreadsheet Template can be downloaded from [www.2cg.ca](http://www.2cg.ca))

For simplicity one can calculate the “empty bed” residence time (i.e., assuming 100 per cent porosity). In this example approximately 689 m<sup>3</sup> of biofilter bed material would be required.

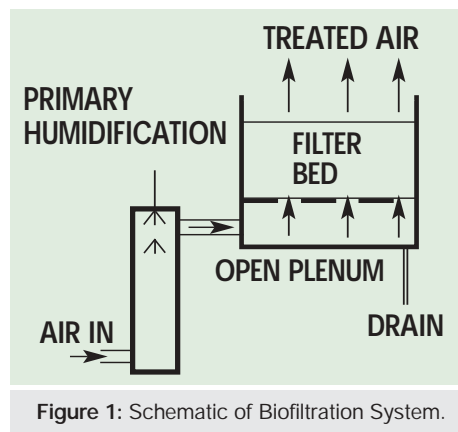


Figure 1: Schematic of Biofiltration System.

**Critical parameters**

Creating a biofilter is not about plunking down some organic material and forcing air through it.

“Many facilities I have come across have dealt with odour as an afterthought,” states Dr. Pride. “It should be odour control first, compost production second.”

That may sound counterintuitive but it makes sense. Odorous compost facilities don’t produce compost for very long.

In the first instance you need to select the appropriate media. Table 2 depicts some critical media parameters and examples of types of media that can be used for a biofilter.

Typically they are laid out over a network of perforated pipes, overlain with gravel. Dr. Pride notes that this is not the best way to evenly distribute off gases throughout a biofilter.

“All the air comes out in moves upward in a cone-like fashion. This results in dead-spots (unused areas) in the biofilter. It’s much better to build a concrete plenum with perforated slats. This facilitates better air distribution,” he says. Figure 1 depicts a schematic of a biofilter layout.

Operating a biofilter is not unlike operating a composting process, albeit the mesophilic part of the process. Table 3 depicts the critical parameters for operating a biofilter. Biofilters will fail if these parameters are not met. Compost off-gas should be humidified prior to discharge to the biofilter, otherwise the biofilter will dry out.

Humidification can be provided through a water scrubber or by injection with water nozzles. The former also facilitates the removal of dust from the off-gases. It’s not satisfactory to supply moisture through the use of

**Table 1: Biofilter Sizing Example**

<b>Facility Size</b>			
l (m)	75		
w (m)	15		
h (m)	7		
<b>Annual Capacity (t)</b>	<b>10,000.0</b>		
<b>Air changes/hour</b>	<b>7</b>		
<b>Residence Time (s)</b>	<b>45</b>		
<b>Biofilter thickness (m)</b>	<b>1</b>		
<b>Capital Cost/CFM (\$)</b>	<b>\$10.00</b>		
<b>Facility Volume</b>		<b>m<sup>3</sup></b>	<b>Cu. ft.</b>
		7,875	278,145
		<b>m<sup>3</sup>/hr</b>	<b>Cu. ft./hr</b>
<b>Off-gases Requiring Treatment</b>		55,125	1,947,015
		<b>m<sup>3</sup>/min</b>	<b>Cu. ft./min (CFM)</b>
		919	32,450
		<b>m<sup>3</sup></b>	<b>Cu. ft.</b>
<b>Volume of media</b>		689	24,338
		<b>m<sup>2</sup></b>	<b>Sq. Ft.</b>
<b>Surface Area</b>		689	7,414
		<b>m</b>	<b>ft</b>
<b>Length of Square bed</b>		26	86
<b>Estimated Cost/CFM (\$)</b>	\$324,502.50		
<b>Estimated Capital Cost/Tonne (\$)</b>	\$32.45		

sprinklers on top of the biofilter.

The operating temperature is a function of the temperature of the off-gases. Winter operation can be compromised if the temperatures start to fall below 12°C. In some cases supplying supplemental heat may be required.

The pH of the media should remain between 6 and 8. Reduced sulphur compounds can result in the acidification of the media. Ammonia can, over time, result in the alkalization of the media. In general, ammonia can be scrubbed out of the off-gases fairly readily through wet-scrubbing and fitting the biofilter media with an internal sprinkler system.

**Costs**

Odour control should be a “low cost” not a “no cost” part of compost facility development says Dr. Pride.

“Too often corners are cut. Most often that involves not humidifying the off-gases or using an incorrect medium. In terms of operation it means not keeping an eye on the temperature of the off-gases or letting the biofilter bed get too dry.”

The cost of not controlling composting odours are pretty clear. Not dealing with it proactively at the facility design and construction phase has resulted in facility failure over and over.

# COMPOSTING MATTERS

Biofilter at Island Waste Management Commission  
Centralized Composting Facility, Prince Edward Island.

Photos and Figure courtesy of Ambio Biofiltration Ltd.



So what are the costs for installing a good biofiltration system” Dr. Pride points out that as a rule of thumb for larger facilities the cost of a biofiltration system will typically be in the order of \$10/CFM of air removed from the composting hall.

In the case of our earlier example this would be CD \$320,000. These costs would include fans, humidifica-

**Table 3: Critical Parameters for Operating a Biofilter**


Critical Parameters	Comment
Humidity	• 95-100%
Temperature (off-gases)	• 12-35°C
Moisture (off-gases)	• 95-100%
Moisture (media)	• 50-55%
pH	• 6-8
Porosity (media)	• 70%

**Table 2: Critical Parameters and Examples of Media**

Critical Parameters	Comment
Biologically Friendly	<ul style="list-style-type: none"> <li>• Media that will facilitate microbial growth.</li> </ul>
Maintains Loft	<ul style="list-style-type: none"> <li>• Media that will not decompose too quickly and will maintain porosity</li> </ul>
Types of Media	
Shredded wood	<ul style="list-style-type: none"> <li>• Should not be kiln dried wood (e.g. pallets) because it does not hold moisture</li> <li>• Root wood (i.e., from shredded tree stumps) works well</li> </ul>
Chipped Brush	
Bark	
Compost	<ul style="list-style-type: none"> <li>• Biologically active</li> <li>• Little porosity. Media does not last a long time</li> </ul>
Soil	
Peat	<ul style="list-style-type: none"> <li>• Little porosity</li> </ul>

tion unit, possible heating unit, biofilter bed and filter media. Translating these costs on a per tonne basis would mean an approximate capital cost of \$30/processing tonne. These costs would be higher for smaller facilities and less for larger facilities.

In addition the costs to operate the biofilter are not insubstantial. Costs will include electricity costs for fans, water costs, heat costs and biofilter media costs.

However, it really is a case of pay now or pay later. A proactive approach can help avoid a future reactive approach that is accompanied with the headaches of dealing with annoyed neighbours and anxious regulators. 

*Paul van der Werf is principal of composting and waste management consultancy 2cg, based in London, Ontario. To contact Paul, visit [www.2cg.ca](http://www.2cg.ca)*