

## - Case Study: Odour-removal from waste gas emissions at an anaerobic wastewater treatment plant

### I. Introduction of the Site and the System

In an anaerobic wastewater treatment plant septic conditions cause the emission of malodorous gases. These odours emissions give problems in the close neighborhood of this industrial plant. At the plant beer is made and the wastewater is treated on site at the plant. Increasing production made the emissions to the neighborhood worse and treatment of these gases were proposed.

### II. Design Comments

The following design criteria were encountered: An airflow of 1200 m<sup>3</sup>/h (phase 1) + another 6200 m<sup>3</sup>/h (phase 2) containing hydrogen sulphide concentrations up to a couple of hundred ppm. Acceptance criteria was based on the following criteria:

Criterion 1: 99% removal at 500 ppm hydrogen sulphide (phase 1) and at 82 ppm (phase 2).

Criterion 2: outlet odour concentration less than 170 MOU/h (at less than 16200 MOU/h at the inlet)

### III. Operation of the System

During the start-up a start-up vessel is used. This 3000 liter vessel contains an acid resistant pump and a water level control. The vessel is first filled with water, nutrients and biology (the biology used is a combination of prepared inoculum and activated sludge). After a period of 4 weeks the start-up kit (with the recirculation pump) was disconnected and removed and the system control was changed over from start-up operation to normal operation. During normal operation water with nutrients is discontinuously added to the bioreactor (see figure 2) operating in upflow. The water used for this biotrickling reactor was effluent water from the aerobic wastewater treatment in which the effluentwater from the anaerobic wastewater treatment system is treated. This water contained enough nutrients to operate the biotrickling reactor without a nutrient dosing system. During normal operation no special attention has to be paid to the bioreactor other than checking the blower operation, the screen filtering the effluentwater and the water valves. The pH of the discharged water is continuously monitored and the water amount is automatically adjusted by the control system.

### IV. Performance

During normal operation the plant operator checks weekly the bioreactor by visual inspection and alarm signals present. The bioreactor performance was measured by analyzing:

- Online inlet and outlet H<sub>2</sub>S-concentrations (using Odalogs; type with the range 0-200ppm for the inlet air and the type with the range 0-50 ppm for the outlet air)

- Odor concentrations of the inlet and outlet air (during approximately half hour air samples were collected in a Tedlar bag and sent to a lab (TNO, Apeldoorn, NI) for determination of the odor-concentration using the EN13725 standardized method at an airflow of 20 liter/min.

- Reduced sulphur compounds other than hydrogen sulphide were measured by Nijmegen University, using GC-MS and measures the concentrations of different organic reduced sulfur compounds.

Table 3a: Removal efficiencies of the bioreactor of hydrogen sulphide and reduced sulphur compounds after approximately 6 weeks from the start-up.

Pollutant	Unit	Inlet Concentration	Outlet Concentration	Percent Removal
<i>Hydrogen sulfide</i>	<i>ppm</i>	<i>800</i>	<i>1,7</i>	<i>98 %</i>

Organic reduced sulfur compounds:				
Methyl mercaptan	ppb	2260	145	94 %
Carbonyl sulfide	ppb	?	< 4	?
Dimethylsulphide	ppb	452	220	51 %
Dimethyldisulphide	ppb	68	20	71 %
Dimethyltrisulphide	ppb	?	10	?
<i>Total reduced sulfur</i>	<i>ppb</i>	<i>&gt; 2780</i>	<i>&lt; 399</i>	<i>86 %</i>

Table 3b: Removal efficiencies of the bioreactor of odour after approximately 10 and 25 weeks from the start-up.

Pollutant	Unit	Inlet Concentration	Outlet Concentration	Percent Removal
Odor concentration	MOU/h	7000	200	97 %
Odor concentration	MOU/h	5000	30	99 %

## V. Table

Table 3c:

<b>Reactor Type</b>	PURSPRING Bioreactors™
<b>Owner and location</b>	Brewery in The Netherlands
<b>Manufacturer</b>	Bioway bv (Ede, The Netherlands)
<b>Year of installation</b>	Spring 2002
<b>Type of air stream</b>	waste gas from an anaerobic wastewater treatment plant
<b>Reactor dimensions and construction type</b>	PURSPRING™ type PS2375 with control panel; housing material FRP with PVC lining inside for the protection against sulphuric acid.
<b>Medium type</b>	Permapac™ (structured, open, inert media, which is resistant to low pH conditions)
<b>Height and number of layers of medium</b>	3 layers
<b>Air flow rate</b>	1200 m <sup>3</sup> /h (phase 1) + 6200 m <sup>3</sup> /h (phase 2)
<b>Pressure drop</b>	< 100 Pa (< 0,4 inch WK)
<b>Average bed temperature</b>	15-25 °C
<b>Contaminants treated</b>	Hydrogen sulphide
<b>System controls</b>	Automatic water feed by PLC. Alarm generation for different unwanted situations like temperature, water pressure, water flow, low pH and air pressure.
<b>Design and acceptance criterion</b>	99% removal at 500 ppm hydrogen sulphide less than 16200 M OU/h
<b>Typical performance</b>	<ul style="list-style-type: none"> <li>➤ 99 % hydrogen sulfide-removal</li> <li>➤ 99 % odour-removal</li> </ul>



Figure 2: Biotrickling bioreactor treating odorous air from an anaerobic wastewater treatment plant.