Odour Control Systems Limited

TECHNICAL DATA

OCS Peacemaker

A Modular Approach To Odour Control

peace'mak'er, n.
- One who makes peace or reconciles parties at variance
- Allays agitation, calms

Easy Installation
- Remove manhole cover and clean rim
- Place PEACEMAKER insert on frame rim and add media
- Replace cover

Summary of Advantages
- Durable, no maintenance, no corrosion
- Constant venting of line pressure
- Superior malodor control
- Three-year guarantee
- Minutes to install
- Economic

John Naylor B.Sc.(Hons.),
Odour Control Systems Limited

Malcolm Beeston B.Sc.,
Odour Control Systems Limited

James Mitchell B.Sc.(Hons.) M. I.W.E.M.,
Anglian Water Services Limited

Abstract
The aim of this paper is to introduce a new concept to odour control design strategies for Waste Water Treatment Works. This new concept involves intimately serving odour sources by application of a newly developed modular odour control system - the Peacemaker.

Traditional designs have been dictated by the use of Biofiltration methods utilising one, maybe two centralised filters to serve diverse odour sources using long runs of extract ductwork. The modular Peacemaker approach eliminates this and provides several other key benefits to designers and the client.

The installation of an odour control unit on the digester sludge feed storage tank at Colchester Waste Water Treatment Works is the specific subject considered in the second part of this presentation. The design criteria and the method of choosing the Peacemaker as the preferred option will be discussed.

Introduction
Based upon increasing legislation, together with the ever-increasing awareness of the public to odour nuisance, there is a continuing review of odour abatement systems within the Waste Water Treatment Industry. The paper introduces a newly designed abatement system and an integrated approach to design thinking.

Odour Abatement Systems - Water Industry Standards
Generally speaking, there are 4 standard types of odour abatement systems (excluding chemical dosing) currently employed throughout the Waste Water Treatment Industry.

- Adsorption Filters (e.g. carbon).
- Dry Chemical Scrubbers (using potassium permanganate).
- Biological Filters/Scrubbers.
- Wet Chemical Scrubbers.

Of these 4 types, it is fair to say for reasons of cost effectiveness, that the Waste Water Treatment Industry over the past 7 years, has invested most heavily in Biological Filter systems.

continued overleaf >>>

Odour Abatement Systems - Water Industry Standards - continued

The very nature of Biological Filters has dictated the thinking of Design Engineers in planning odour abatement systems for Waste Water Treatment Plants. The filters' requirements of long retention time, steady state odour loadings without peaks, need for water/final effluent supply (combined with the fact that the plant has a number of distant odour sources), have meant that the most cost effective design is usually that of a large centralised filter, catering for a multiple number of odour sources via extensive ductwork runs.

The result is the need for costly civils to provide a base for the filter, large capacity extract fans to provide for dilution air to ensure odour peaks from process sources do not go beyond the upper limits of the filters (i.e. 50 ppm for peat and heather types and 100 ppm for calcified seaweed types) and costly, inefficient and complex ductwork runs which can present Health and Safety problems and look unsightly above ground.

Due to these shortcomings, Odour Control Systems Ltd, and it's American associates, Syneco Systems Inc., have developed the Peacemaker Odour Filter-Scrubber together with a modular approach to odour control.

What is the Peacemaker?

Of the 4 standard types of system listed above, the Peacemaker system falls across the categories of Adsorption Filters and Dry Chemical Scrubbers, hence the term Peacemaker Filter-Scrubber.

It is a system of modular design, based upon dual chambered vessels (or modules) manufactured from corrosion resistant, heavy duty plastic and G.R.P materials. It does not utilise a water supply.

Each dual chambered vessel (or module) comprises:

(A) A Foul Air Inlet Chamber **(B)**Lower Air Diffusion Plate **(C)** Lower Odour Oxidising Media Chamber
(D) Middle Air Diffusion Plate **(E)**Upper Odour Polishing Media Chamber **(F)** Clean Air Outlet Vent

The system is completed by interconnecting ductwork, flow balancing valves and air extraction fans.

As with other fan assisted odour abatement systems, the extraction fan creates a partial vacuum via connecting ductwork to the covered odour source to avoid odour leakage. Foul air is pulled into the inlet chamber and diffused via the lower diffuser, which is designed to maximise its distribution across the surface areas of the medias. It is firstly drawn upwards through the oxidising chamber, which contains dry impregnated media granules.

The impregnate is chlorine dioxide, which is stabilised within the media. The impregnation and stabilisation process is patented. Chlorine Dioxide is a very powerful oxidising agent e.g. 2.5 times that of chlorine and 4 times that of potassium permanganate. The result is a media bed of high odour removal capacity.

Chlorine Dioxide rapidly oxidises the most odorous compounds found in off-gases from wastewater treatment processes.

e.g. Sulphides to Sulphates Mercaptans to Sulphonates and Sulphonic Acids Amines to Carboxylic Acids

Products of reaction are odourless and environmentally sound (e.g. no chlorinated organics are formed)

From the lower oxidising chamber, air is then drawn into the upper odour polishing chamber, which contains adsorptive media to provide further removals of any remaining non oxidisable odorous compounds.

Several adsorptive medias are used depending upon the odour polishing requirements.

This Peacemaker oxidising/adsorption or filter-scrubbing process offers large odour removal capacities per module and provides excellent odour removals performance.

Odour Removals Performance

(1) Independent testing has shown that the Peacemaker is capable of effectively removing 100% hydrogen sulphide and mercaptan compounds, even at very high peak loadings. (See table 1)

(2) T.O.N. removals in the 95 –99% range by a single module. (See figures 2 + 3)

(3) Ability to handle shock loadings of over 1000ppm H_2S without significant odour breakthrough. Whilst also maintaining media bed stability

Table 1. summarises some of this work and more odour removals performance will be discussed in the second half of this paper.

continued overleaf >>>

Table 1: Typical Peacemaker Odour Removals Performance

		Peacemaker Inlet		Peacemaker Outlet	
Day No	Time	Mercaptans ppm	H_2S ppm	Mercaptans ppm	H_2S ppm
1	10.55	60	30	0	0
1	14.45	120	102	0	0
1	23.00	120	31	0	0
2	08.30	120	117	0	0
2	14.45	60	35	0	0
2	22.35	15	6	0	0
3	03.25		5		0
3	12.00	15	28	0	0
3	20.10	10	8	0	0
4	08.45	6	3	0	0
4	22.55	100	40	0	0
4	22.55	100	52	0	0
5	09.30	10	6	0	0
5	20.00	100	52	0	0
6	08.00	120	50	0	0
6	20.10	120	200	0	0
7	15.10	100	45	0	0
7	20.10	120	200	0	0
8	08.15	135	71	0	0
8	16.30		13		0
8	20.25	50	200	0	0
9	11.55	60	18	0	0
10	09.25	8	10	0	0
10	17.20		3		0
11	01.20	2.5	1	0	0
11	09.25	80	36	0	0
11	19.00	80	39	0	0
12	02.40	60	68	0	0
12	09.40	120	46	0	0
12	17.25	65	15	0	0
12	20.15	5	3	0	0
13	09.50	120	72	0	0
13	18.45	80	33	0	0
13	20.05	120	130	0	0
14	10.10	120	99	0	0
14	14.10	120	165	0	0
14	20.30	240	115	0	0
15	19.50	85	67	0	0
16	09.25	120	41	0	0
16	20.15	240	66	0	0
16	22.50		38		0
17	09.00	20	14	0	0
18	00.59	120	88	0	0
18	03.25	120	102	0	0
19	17.40	4	1	0	0
19	20.40	60	80	0	0
20	08.05	120	28	0	0
20	19.40	10	11	0	0
21	04.30	60	80	0	0
21	12.35	30	8	0	0
21	19.50	120	21	0	0
22	09.30	20	4	0	0
22	17.00	120	31	0	0
22	19.30	55	10	0	0
23	09.00	70	9	0	0
23	19.40	23	11	0	0
24	09.15	30	3	0	0
24	21.15	120	34	0	0
25	11.40	120	39	0	0
25	20.10	120	64	0	0

NOTE: Peacemaker System treating off gases from Sludge Reception Chamber at a North West Water Ltd. Site.

continued overleaf >>>

Modular Design Provides Flexibility

There are currently 6 basic Peacemaker modules, the 500, 1000, 3000, 4000, 9000 and 18000. Their characteristics are shown in Table 2.

Table 2. Characteristics of Peacemaker Modules

Module	Typical Footprint m^2	Typical Charged Weight Kgs	Typical Gas Flow Capacity m^3/Hr
500	0.5	300	250
1000	1.00	1000	1000
3000	2.50	2080	2000
4000	3.00	3000	3000
9000	5.00	4500	5000
18000	9.00	6200	10000

These modules are the building blocks of the Peacemaker Filter-Scrubber System. They can be used singly or coupled in parallel or series for treatment of a very wide range of gas flows and odour loadings; indeed the design of any system and selection of module combination is dictated by required gas extract rate from the source (i.e. flow through the unit) and odour concentrations to be handled.

This modular approach provides great flexibility in system layout design and offers several key benefits to the client when compared to existing standard technologies being used.

These Include:

(A) The small footprint requirements of systems make it possible to intimately serve odour sources

(B) This greatly reduces civils requirements, both in terms of area required & also in terms of loadings per unit area

For example, typical civils loadings requirements for Peacemaker systems are in the 0.25 – 10kn per square metre range

(C) 'Intimately serving' odour sources eliminates costly and unsightly long ductwork runs from designs

(D) Short ductwork runs improve gas removal efficiencies and increase reliability of the system's ventilation rate

(E) As a 'dry' system, it requires only an electrical supply (no water or final effluent) which is usually readily available close to odour sources such as Sludge tanks, Desludge Chambers, Inlet Wells etc

A list of Peacemaker Installations is given in Table 3. and we would, in particular, like to draw your attention to the Anglian Water sites at Bedford Sewage treatment Works and Colchester Sewage Treatment Works, as clear examples of where the approach is working.

continued overleaf >>>

Table 3: OCS Peacemaker Filter-Scrubber Reference Installation List				
Client	**Location**	**Application**	**Gas Flows m^3/Hr**	**Typical Odour Loadings H_2Sppm**
North West Water Ltd	Royton, Gtr Manchester	Sludge Tanks	400	100
North West Water Ltd	Goytside, Cheshire	Pumping Station	200	50
Anglian Water Services Ltd	Salcott, Essex	Sludge Tank	100	100
Anglian Water Services Ltd	The Boot, Bedfordshire	Pumping Station	100	50
Anglian Water Services Ltd	Leighton Linslade	a. PST Desludge Wells b. Digested Sludge. Decant Chamber	Passive 100	250 200
S. West Water Services Ltd	Camels Head, Plymouth	Sludge Tank	1000	50
S. West Water Services Ltd	Wembury, Devon	Sludge Tank	500	50
Severn Trent Water Ltd	Abermule STW, Powys	R.B.C. Works	75	10
Welsh Water	Clyne	Pumping Station	200	20
North West Water Ltd	Preston, Lancashire	a. Sludge Tanker Disch. Point & Fast Fill Sump b. Press Filtrate Wells c. Sludge Pump Wells	450 200 200	250 100 50
North West Water Ltd	Runcorn, Cheshire	Digested Sludge Decant Chamber	300	250
Anglian Water Services Ltd	Bromley, Essex	Works Inlet Well	200	10
Anglian Water Services Ltd	Bedford S.T.W.	a. PST Distribution Chambers b. Sludge Chambers c. Decant Liquor Well	100 300 200	200 300 250
Anglian Water Services Ltd	Colchester S.T.W.	Sludge Tank	200	500-750

The Colchester example will be discussed in detail later by my co-author James Mitchell of Anglian Water Services Limited.

However, at Bedford Sewage Treatment Works, the modular Peacemaker approach has been applied more cost effectively (in terms of capital installation costs and including 5 years maintenance) than Biofiltration to 5 separate odour sources across the site. Table 4 shows these sources, typical odour levels generated and Peacemaker system installed.

Odour Source	Typical Odour Level ppm H_2S	Peacemaker System m^3/hr - via
1. Primary Tank Distribution Chamber	25	2 No. 900 modules in parallel
2. Settled Sewage Flow Chamber	20	4 No. 900 modules in parallel
3. No. 1 Raw Sludge Pumping Chamber	>300	2 No. 900 modules in parallel
4. No. 2 Raw Sludge Pumping Chamber	>300	2 No. 900 modules in parallel
5. Decant Liquors Return Chamber	>200	2 No. 900 modules in parallel

continued overleaf >>>

Since it's launch into the U.K. Waste Water Treatment Sector in January 1996, well over 50 installations have been completed and the Company has orders in hand for another 50 during the next 6 months.

The benefits of a modular approach, combined with the Peacemaker odour removal capabilities are fast becoming recognised as a new industry standard for odour control.

Colchester W.W.T.W; A Working Example

The 1990 Environment Protection Act, in tandem with our desire to exceed customer expectations, has persuaded Anglian Water to respond by making additional investment in odour treatment at some treatment sites. There is constant drive to find both preventative and control treatment strategies, that both satisfy our legal obligations and our customers. The use of the Peacemaker is increasingly becoming an important and useful way of reducing the odour problems experienced at some of our sites.

There are 7 No. installations using this technology across the Anglian Region, however, the installation at Colchester Wastewater Treatment Works has been chosen as the location for discussion.

History

In 1992, the anaerobic digestion capacity at Colchester was extended; as part of this, a 200m^3 primary cosettled sludge holding tank was installed. The odour control on this tank consisted of an activated carbon unit on the waste air vent. The tank acts as a buffer tank between the main primary cosettled sludge tanks and the feed pumps to the new digester, providing 3 days storage of raw sludge at normal feed rates.

In 1997, a further anaerobic digester was constructed also taking its' primary cosettled sludge from this buffer tank. As part of the scheme, the decision was taken to replace the odour control unit with a more robust treatment option. The option chosen was that of the Peacemaker, which was installed and commissioned in September and is working efficiently.

Method of Operation of the Buffer Tank

The primary sludge is automatically pumped to the 3 No. original digesters and the buffer tank 18 times per day. The feed from the buffer tank is then controlled to each of the two new digesters via another set of pumps operated on an integrated timer regime. The volume of sludge pumped is set to maximise the treatment capacity of each of the digesters. Thus, the buffer tank is filled with between 8 and 11 m^3 sludge per pumping cycle, depending on feed rate to the digesters and this volume is withdrawn on a feed cycle of 48 operations per day to the digesters. Thus, there is frequent regular movement of sludge within the buffer tank.

Design Criteria for Odour Control Unit

The effectiveness of other types of odour control units at Colchester has been variable. Thus, a very stringent set of criteria was needed for this location. It was imperative that a worse case scenario be used, due to some previous poor experiences, to ensure the control of odour. The data logging of aerial hydrogen sulphide in the sludge cycle over the last two years has indicated peaks of 500+ ppm whenever the sludge was disturbed.

The parameters that were set for performance of the odour control unit were:

Minimum 99% reduction of hydrogen sulphide with 18 peaks of 500 ppm per day.

Other Considerations

The land area available for siting the unit was also at premium and so a process with a small footprint was needed.

There was not a supply of final effluent washwater available within reasonable distance.

The buffer tank was within the 6m radius of special operations surrounding digestion plant and so intrinsically safe electrical equipment was stipulated.

The use of oxygen enriched methods of treatment were not appropriate at this location due to the close proximity to the digesters.

Options Considered (Table 5):

A range of options were considered and discarded:

Covering of the tank - already exists so no added value to considering this further.

Activated carbon and iodine enriched activated carbon was briefly reviewed, but was excluded due to high level of sulphides. The costs of operation and frequency of change of medium ruled this technology out of the considerations.

The use of Biofilters containing various mediums, such as peat and heather, coya fibre etc., were discounted due to the high peak sulphide levels. Also, the land footprint and washwater were not available. A secondary consideration was the ultimate disposal of the medium when it was sent after c.5 years.

A similar exercise was undertaken to investigate the viability of using calcified seaweed as a Biofilter medium. This showed promise in dealing with the high sulphide loads, however, it still had many of the problems of Biofilters already highlighted and was taken out of the considerations.

The use of Bioscrubbers, with and without secondary polishing were investigated. They were capable of dealing with higher loadings of sulphide than conventional Biofilters but were still inadequate to provide treatment for the design criteria.

All the above biological methods of treatment had, as a general guide rule, a limiting factor of 100 ppm sulphide peak loading for successful operation. This can be managed in certain circumstances by dilution with clean/less polluted sources, but not at this location.

The use of three wet stage scrubbing techniques were not considered beyond a very preliminary discussion. They were ruled out as being too expensive for this application, as well as requiring too large a footprint.

The Peacemaker system is a known technology with a proven track record. It had already been successfully used by the Works Manager elsewhere and the previous chairman of the Anglian Water Odour Practitioners Group supported their use. Thus it was considered for this location and it was able to be engineered to meet all the design criteria.

Table 5: Comparison Between Odour Control Systems for this Location

Technology	Peak Load Capacity	Footprint	Washwater Needed	Restricted Operational Demands	Health & Safety Implications
Biofilter Peat/Heather	1 - 2	1 - 2	1	10	10*
Biofilter Calcified Seaweed	3 - 4	1 - 2	1 - 2	10	10*
Bioscrubber	1 - 2	1 - 2	1 - 2	10	10
Bioscrubber & Biofilter	2 - 3	2 - 3	1 - 2	>10	10*
3 Stage Wet Scrubbing	10	3 - 4	not applicable	3 - 4	3 - 4
Oxygen Enriched Methods	1 - 10	1 - 10	1 - 10	not applicable	1 - 10
Covers Only	1	not applicable	not applicable	not applicable	1
Carbon Filters	1	1	not applicable	10	10*
Peacemaker	10	10	not applicable	10	10**

continued overleaf >>>

This is a comparative table to highlight the technologies against the key criteria. It is extremely difficult to do an exact cross comparison due to the number of variables in force. However, it is based on a sliding scale with 1 being the lowest and 10 being the highest rating e.g. carbon filters have a low effectiveness (1), but a very high ability to meet the restricted operational requirement near to digestion.

* means that the rating in normal operation is shown but when the medium has to be changed, this will change and become a lower rating during that operation.

** means the rating is high at all times, but the supplier has to take note of the special needs when he replenishes the active unit.

Results

The assessment of the unit has been undertaken on several occasions and these have always shown compliance with, and exceedence of the design criteria. (see Table 6.) In addition, assessment of mercaptans reduction has been shown that the unit effectively reduces these other odiferous compounds.

TABLE 6	Sample	Peacemaker Inlet		Peacemaker Outlet	
Date	Reading No.	Mercaptans ppm	H_2S ppm	Mercaptans ppm	H_2S ppm
Session 1 - 4/11/97	1 2 3 4 5 6	0 0.5 1.5 2.5 2 2	12 18 56 112 84 49	<0.1 <0.1 <0.1 <0.1 <0.1 <0.1	0.0 0.0 0.0 0.0 0.0 0.0
Session 2 - 18/12/97	1 2 3 4 5 6	3.5 3 14 16 15 17	192 156 269 460 302 368	<0.1 <0.1 <0.1 <0.1 <0.1 <0.1	0.0 0.0 0.0 0.2 0.1 0.1
Session 3 - 19/1/98	1 2 3 4 5 6	5 1.5 17 20 2 1	192 156 269 460 302 368	<0.1 <0.1 <0.1 <0.1 <0.1 <0.1	0.0 0.0 0.0 0.2 0.0 0.0
Session 4 - 19/2/98	1 2 3 4 5 6	3 6 25 16 2 0	192 156 269 460 302 368	<0.1 <0.1 <0.1 <0.1 <0.1 0	0.0 0.0 0.5 0.3 0.0 0.0

Notes

1. Testing Equipment Used: a) Hydrogen sulphide measurement via Crowcon Meter and Dräger Tubes.
   b) Mercaptan measurement via Dräger Tubes.

2. Samples/measurements taken at 15 minute intervals during each session.

continued overleaf >>>

Conclusion

The Peacemaker has proven to be the right technology and process for this location. It has achieved the design criteria and exceeded it and is continuing to effectively reduce the overall odour from the site.

Acknowledgments

The opinions expressed here are those of the author and are not in any way attributable to Anglian Water Services Ltd.

Our thanks to North West Water Ltd., Clifton Marsh W.W.T.W. Preston, for the use of performance data.

References

(1) Odour Control and Prevention in the Water Industry – IWEM Symposium, Bristol October 1994

(2) Control of Odours in Sewage Treatment - Elvidge A., Water and Waste Treatment December 1991

(3) Odour Nuisance in Waste Water Treatment - Causes and Control - Hobson J.A. and Toogood S.J., WRc Report UM 1025, 1989

(4) Odour Control - A concise Guide - Valentin F.H.H. *et al* Warren Springs Laboratory, 1980

(5) Odour Control for the 1990's - Hit or Miss? - Toogood S. J., J. IWEM 1990

preserving the environment

Odour Control Systems Ltd
33a Castle Close, Manor Lane
Hawarden Industrial Park
Hawarden, Flintshire CH5 3QX

Phone: +44 (0)1244 536700
Fax: +44 (0)1244 535184
E-mail: mail@odourcontrolsystems.ltd.uk
Web: www.odourcontrolsystems.ltd.uk