NHS

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The Results

Using technology to help fight infection

HCAI Technology Innovation Programme
Showcase Hospitals report number 8
OTEX Laundry System

DH Department of Health

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The Healthcare Associated Infections (HCAI) Technology Innovation Programme

The basic ways of preventing and reducing healthcare associated infections (HCAIs) are largely unchanging. The principal strategies for combating HCAIs are those associated with hand hygiene/aseptic techniques, prudent antibiotic prescribing and good clinical practice. However, new technologies and equipment can support these strategies by helping get things done differently, more swiftly or more reliably.

The Department of Health has funded the HCAI Technology Innovation Programme[1]. The Programme aims to

- Speed up the development and adoption of technologies to further help combat HCAIs
- Identify which new technologies provide the best value and will have the most impact

In 2004 the Department of Health set up the Rapid Review Panel (RRP) to "provide a prompt assessment of new and novel equipment, materials and other products that may be of value to the NHS in improving hospital infection control and reducing hospital acquired infection". The RRP does not undertake any product trials itself but makes recommendations based on written evidence provided by industry[2] The highest recommendation (Recommendation 1) is

Basic research and development, validation and recent in use evaluations have shown benefits that should be available to NHS bodies to include as appropriate in their cleaning, hygiene or infection control protocols.

The Showcase Hospitals Programme

As part of the HCAI Technology Innovation Programme, technologies which have gained a RRP Recommendation 1 are being placed in Showcase Hospitals around the country whilst a detailed evaluation of their in-use and economic features along with adoption characteristics is undertaken. The current Showcase Hospitals are The Royal Wolverhampton Hospitals NHS Trust, Imperial College Healthcare NHS Trust, Calderdale and Huddersfield NHS Foundation Trust, Southampton University Hospitals NHS Trust, County Durham and Darlington NHS Foundation Trust, The Lewisham Hospital NHS Trust and Central Manchester University Hospitals NHS Foundation Trust.

These are service evaluations, as defined by the National Patient Safety Agency's National Research Ethics Service, and do not therefore require Research Ethics Committee review[3].

[1] For further information on the Programme see http://www.hcai.dh.gov.uk
[2] For more information on the Rapid Review Panel see http://www.hpa.org.uk/ProductsServices/InfectiousDiseases/ServicesActivities/RapidReviewPanel/rapAboutRRP/
[3] See leaflet on defining research at http://www.nres.npsa.nhs.uk/news-and-publications/publications/general-publications/#leaflets

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We would like to acknowledge the support of staff working at Southampton University Hospitals NHS Trust in implementing OTEX and the support of the NHS Technology Adoption Centre in the compilation of this report.

Showcase Hospitals Technology Review report number

OTEX Ozone Laundry System

Contents

Executive summary

The Department of Health has set up a Rapid Review Panel (RRP) to assess new and novel technologies and consider their potential for reducing hospital infections. As part of the Department's Healthcare Associated Infections (HCAI) Technology Innovation Programme, technologies that have received an RRP1 recommendation ("basic research and development, validation and in-use evaluations have shown benefits that should be available to NHS bodies") have been placed in selected Showcase Hospitals for review of their acceptability in everyday use and to gather information that may be useful for other hospitals.

OTEX is a patented commercial ozone laundry system developed by JLA Ltd. It uses aqueous ozone to achieve disinfection during the wash process rather than using the traditional thermal disinfection method. OTEX has been shown to be an effective method of disinfection including being effective against hardy environmental bacteria such as *Clostridium difficile* spores. It was awarded Rapid Review Panel (RRP) recommendation 1 in September 2009.

Southampton University Hospitals NHS Trust (SUHT) hotel services have adopted re-useable microfibre cloths and microfibre mops for cleaning throughout the hospital's clinical areas and prior to this evaluation had used conventional thermal disinfection laundry processes.

The majority of staff involved with the laundry thought that the installation of the OTEX system caused insignificant disruption to laundry activities. Over 80% of all staff respondents had no problems with the cleaning ability, appearance or texture of microfibre or any other difficulties with OTEX laundered microfibre cloths and mops. The majority of staff would recommend OTEX ozone laundered cloths to colleagues in the NHS.

Costs and benefits will vary between Trusts. At SUHT using only 2 x JLA 40 High Spin HF185 washing machines (18.5kg capacity) annual savings of 36.49% in water, gas and electricity costs at current prices were calculated. The cost of the OTEX system at SUHT is £238 per calendar month and £2856 annually. Additional savings include the reduced energy costs in drying the microfibre mops and cloths and the reduced use of detergent in the wash cycle. With utility prices set on an upward trend cost savings on utilities are likely to be greater in the future. The OTEX system also offers an opportunity for Trusts to support the drive within the NHS to reduce the NHS carbon footprint by 10% by 2015 from the 2007 level.

Keywords: OTEX, OTEX ozone laundry system, JLA, JLA Ltd. Microfibre, hospital laundry

Introduction

This report sets out the findings from an evaluation at Southampton University Hospitals NHS Trust (SUHT) of the implementation, in-use and economic features and adoption characteristics of the OTEX ozone laundry system provided by JLA Ltd. Due to time, logistical and cost considerations this evaluation was confined to one showcase hospital with the ensuing limitations to sample size and experiences. The Rapid Review Panel which assesses new and novel products which may help infection prevention and control has concluded that basic research and development, validation and recent in use evaluations have shown benefits that should be available to NHS bodies to include as appropriate in their cleaning, hygiene or infection control protocols.

The objective of this document is to help Directors of Infection Prevention and Control and other stakeholders to decide whether they should consider introducing the OTEX ozone laundry system as part of their trust's strategy to prevent healthcare associated infections, using a more environmentally friendly and cost effective laundry system.

The problem

Disinfection of soiled healthcare laundry, specifically microfibre mops and cloths and the need to reduce the carbon footprint of the NHS

Disinfection of hospital laundry is currently attempted using thermal disinfection in accordance with UK healthcare guidelines (HSG (95) 18). This recommends that wash cycles should be maintained at either 65°C for at least 10 minutes or 71°C for at least 3 minutes with additional time for mixing[1]. Whilst the guidelines are considered adequate for disinfection of most bacteria and also for many viruses, tests have shown that even at temperatures and contact times in excess of those stipulated by the guideline, disinfection is ineffective against hardy environmental bacteria such as *Clostridium difficile* spores[2].

The UK government introduced the Climate Change Act in 2008 which set targets to reduce the net UK carbon account to at least 80% lower than the 1990 baseline by 2050[3]. In response to the need to take action on climate change an NHS carbon reduction strategy was developed with widespread support across NHS organisations. The NHS has a carbon footprint of 18 million tons of CO^2 per year, 22% of this being energy usage. A target has been set to reduce the NHS carbon footprint by 10% by 2015 from the 2007 level[4].

The product

OTEX ozone laundry system – the process

OTEX is an ozone disinfection laundry system, which has been developed by JLA Ltd. The system was introduced in the UK in 2004.

Microbiological data has shown the effectiveness of the OTEX system in rendering the destruction of micro-organisms including *Clostridium difficile*

spores[2][5][6]. Ozone disinfection properties are well recognised and documented and date back to the early 1900s[7] but its use as a laundry disinfectant is relatively new.

OTEX utilises an oxygen concentrator which takes in air and converts it to 90% pure oxygen. An oxygen generator uses electrical arcs to separate the paired atoms in oxygen molecules which reassemble into ozone with each molecule containing three oxygen atoms. The patented interfusor developed by JLA Ltd provides a mechanism to dissolve an effective concentration of ozone into the water automatically during the wash process allowing disinfection to be carried out at ambient temperatures. As a safeguard the OTEX equipment contains within it a manganese oxide honeycomb destruct unit which acts as an ozone scavenger converting ozone to oxygen. Background levels of ozone are monitored though the OTEX combined room monitor and validation system and comply with the Health and Safety Executive (HSE) guidelines [8].

OTEX provides a laundering process for the cleansing and disinfection of linen including microfibre mops and cloths. This allows them to be laundered without the use of damaging temperature and with reduced or no chemicals, which have been proven to have a detrimental effect on the fibre structure. Both clinical and in vitro trials have shown that the OTEX system maintains the integrity of the microfibre[9].

OTEX ozone laundry system – the equipment

SUHT is equipped with the following laundry equipment:

2 x JLA 40 High Spin HF185 washing machines (18.5kg capacity).

2 x T50 Gas Dryers.

All washing machines purchased or rented from JLA are built with components that withstand ozone disinfection. Machines at SUHT just required retrofitting with the OTEX system. Once converted to the OTEX system each wash program could be validated with the series 1 validation machine, the black box shown in figure 1, producing a ticket with the following parameters:

- Batch number
- Date
- Pass/fail validation of disinfection process
- A failed validation causes an alarm to activate which has to be acknowledged in order to stop it

Since renting these washing machines the validation mechanism has been further developed to incorporate remote (PC) and web based access to validation results.

The OTEX system does not require the washing machines to be connected to a 3 phase electricity supply to operate efficiently unlike the thermal wash system which may require it. This is because the OTEX process utilises only

cold water and does not require the use of heater elements to heat the water as thermal disinfection does.

Background ozone levels in the laundry facility are constantly monitored by the OTEX combined room monitor and validation system.

The machines at SUHT are rented from JLA Ltd. and include a servicing and maintenance contract.

The rental cost for the OTEX enabled washing machines is the same cost as the equivalent thermal disinfection washing machines with an additional cost for the OTEX system.

Machines are installed to the design and layout specified by the Trust.

The cost of the OTEX system is £238 per month for Southampton General Hospital and this includes service and maintenance.

Figure 1: The OTEX ozone laundry system

OTEX ozone laundry system – the washing program

Scans of the ozone validation during the OTEX disinfection wash cycle are shown in figure 2. A cycle is validated as achieving disinfection when the

cleaning cycle is complete. Validation requires the ozone level to be greater than 5 parts per million for 2 minutes during the second rinse.

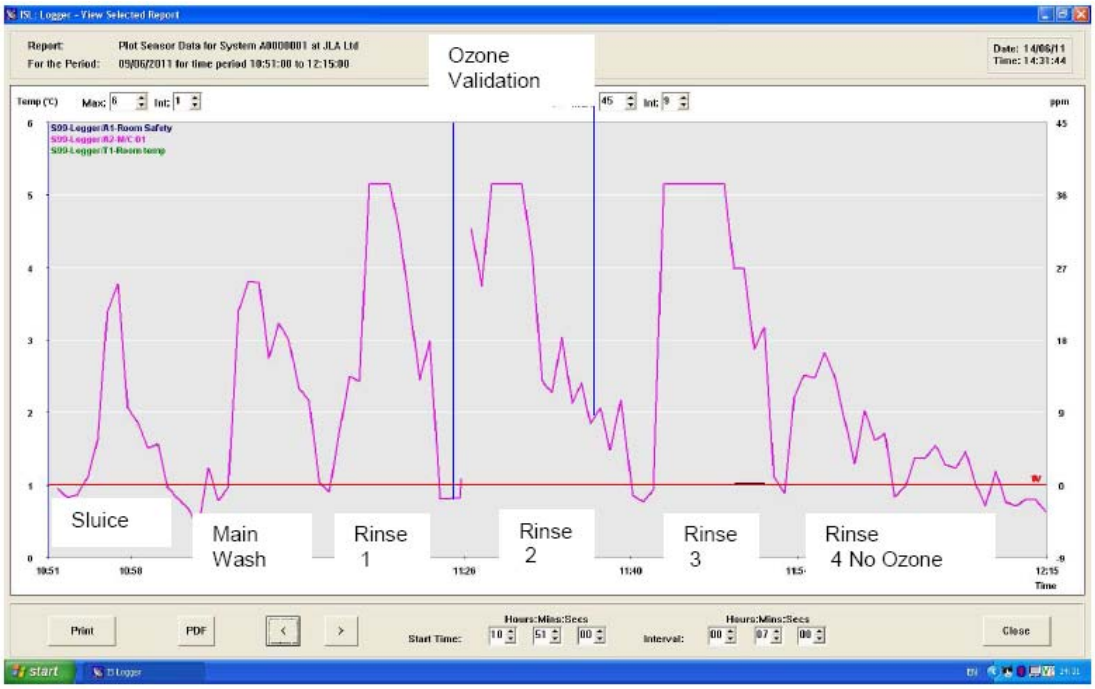


Figure 2: Scans of the ozone validation system

Details of the OTEX wash cycle used at SUHT together with the standard thermal disinfection programme details for comparison are shown in figure 3. As can be seen, the OTEX system eliminates the need to heat water to 75°C, reduces the amount of detergent needed, and shortens the wash cycle.

Program	OTEX	Thermal Disinfection
	Temp	Temp
Sluice	Low Level	No Sluice
Pre Wash	No Pre Wash	Warm 40°C
Main Wash	Cold	Hot 75°C
Rinse 1	Cold	Cold
Rinse 2	Cold	Cold
Rinse 3	Cold	Cold
Cycle Time	1 hour 10 mins	1 hour 19 mins
Detergent Volumes	48 mls	96 mls

Figure 3: Programme details for OTEX and Thermal Disinfection Cycles

The knowledge base

What was known before this evaluation

The disinfection properties of ozone are well recognised and documented, dating back to the early 1900s. It is a powerful biocide and fungicide and has applications from swimming pool disinfection through to water purification and food sanitation. Whilst economics has played a key role in its introduction for commercial use, it is only recently that with the advancement in ozone technology, the size and cost of the systems has made them financially justifiable for smaller applications such as laundry functions[2]. It is being increasingly deployed in the healthcare environment, with over 1,000 sites currently using the OTEX system, including 72 NHS trusts.

Recent work carried out on *Bacillus subtilis* has identified that ozone renders the spores defective in germination due to the damage of the spore's inner membrane[10]. Bringmann (1954)[11] found that resistant spores of soil bacteria, which survived treatment with a current of steam for 20 hours and required 10mg/l chlorine with a contact time of 35 minutes to destroy them, were destroyed within 14 minutes by ozone at a concentration of 0.35 mg/l. A concentration of 0.6mg/l ozone is produced throughout the OTEX microfibre wash cycle. Bacterial sporular forms are always far more resistant to disinfection than vegetative forms, but are all easily destroyed by relatively low levels of ozone [12].

The evaluation

How the evaluation was done

The aims of the evaluation were to look at the implementation, in-use and economic features and adoption characteristics of the OTEX ozone laundry system, to include the following:-

- initial installation and staff training.
- staff perceptions of the various aspects of the process and the products

- microbiological assessment of used microfibre cloths and mops pre and post laundering using the OTEX ozone laundry system
- utility costs and other savings.

Following stakeholder meetings in September 2010, the JLA washing machines were serviced and the additional OTEX system bolt-on equipment fitted to enable the OTEX system to operate. Metering was installed to monitor usage of water and electricity using the thermal wash and then the OTEX system when it was switched on.

JLA undertook training of the laundry workers and supervisory staff and other stakeholders in the operation of the OTEX system and the safeguards in place. These included the validation system for the laundry cycles. JLA supplied information packs outlining the utility and efficacy of the OTEX system to the Showcase lead and the domestic contractor to disseminate to stakeholders. Posters on the operation of the system were supplied by the company for the laundry room.

Pre-use questionnaires were distributed to those attending the training sessions.

The four month evaluation of the OTEX system commenced on 8 November 2010. The microfibre cloths and mops had been laundered using a thermal wash prior to the introduction of the OTEX system at the start of the evaluation period..

Microbiological tests were undertaken on both used and laundered mops and cloths at the start of OTEX usage.

Two sets of in-use questionnaires were distributed during the evaluation period, to different staff groups. One set was for those staff involved with the laundry service for the microfibre mops and cloths and one set for those using the mops and cloths in domestic services.

Data was collected throughout the evaluation for each wash cycle to ensure that the cycle operated correctly with correct levels of ozone. The cycle details and pass/fail were recorded and a ticket produced using the OTEX monitoring and validation system. Details of the washing cycles can be monitored centrally by JLA Ltd.

An agreed process was in place so that if the OTEX cycle were to fail, obvious causes for this, such as overfilling the machine were looked for and then another OTEX cycle was attempted. If that also failed a thermal disinfection cycle was attempted. If this failed, JLA were contacted to investigate the problem.

By monitoring the usage of water, energy and detergent prior to the evaluation using the thermal wash cycle and during the evaluation with the OTEX cycle, we were able to examine costs and benefits.

Initial Installation and staff training

Pre-use questionnaires seeking staff opinion were distributed following the staff training given by JLA and the installation of OTEX equipment. There were 11 respondents including laundry workers and supervisory staff. Numbers of respondents were limited as very few staff are involved with the laundry service.

The overall response to training provided was positive (figure 4).

Response to training provided. **11 respondents from laundry workers and supervisory staff**	Yes	No	Don't Know
Do you feel you received adequate induction/training prior to using the equipment?	100%	0%	0%
Was the machine easy to learn how to use?	100%	0%	0%
Do you feel you had adequate training on the health and safety aspects of the system	89%	11%	0%

Figure 4: Response to training provided

When asked if the installation caused disruption to the activities of the laundry opinion was more divided with 6 staff (55%) finding it caused a little, not significant disruption, 3 staff (27%) finding it caused a lot, excessive disruption to laundry activity and 2 staff (18%) answering 'don't know' (figure 5).

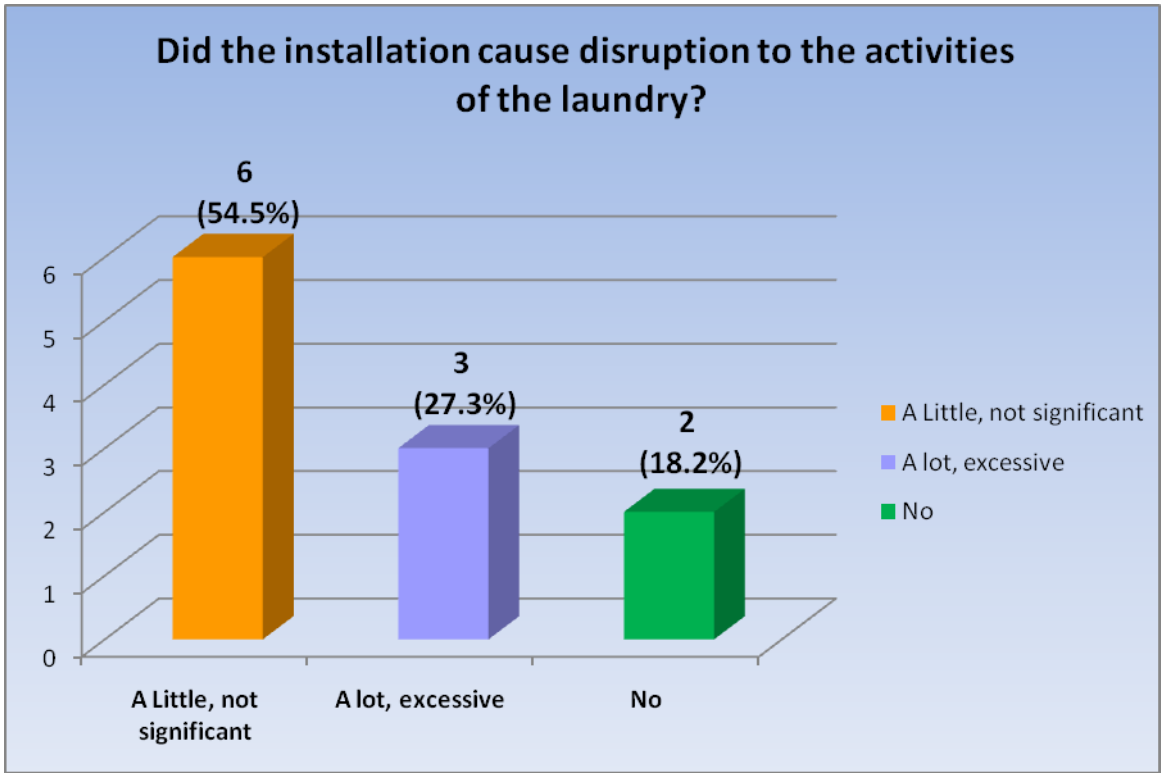


Figure 5: Staff opinions on whether installation caused disruption to the work of the laundry

Staff opinion was also divided when asked if the installation was completed in a reasonable amount of time with 6 staff (55%) answering yes and 4 staff (36%) answering no with one staff member answering 'don't know' (figure 6).

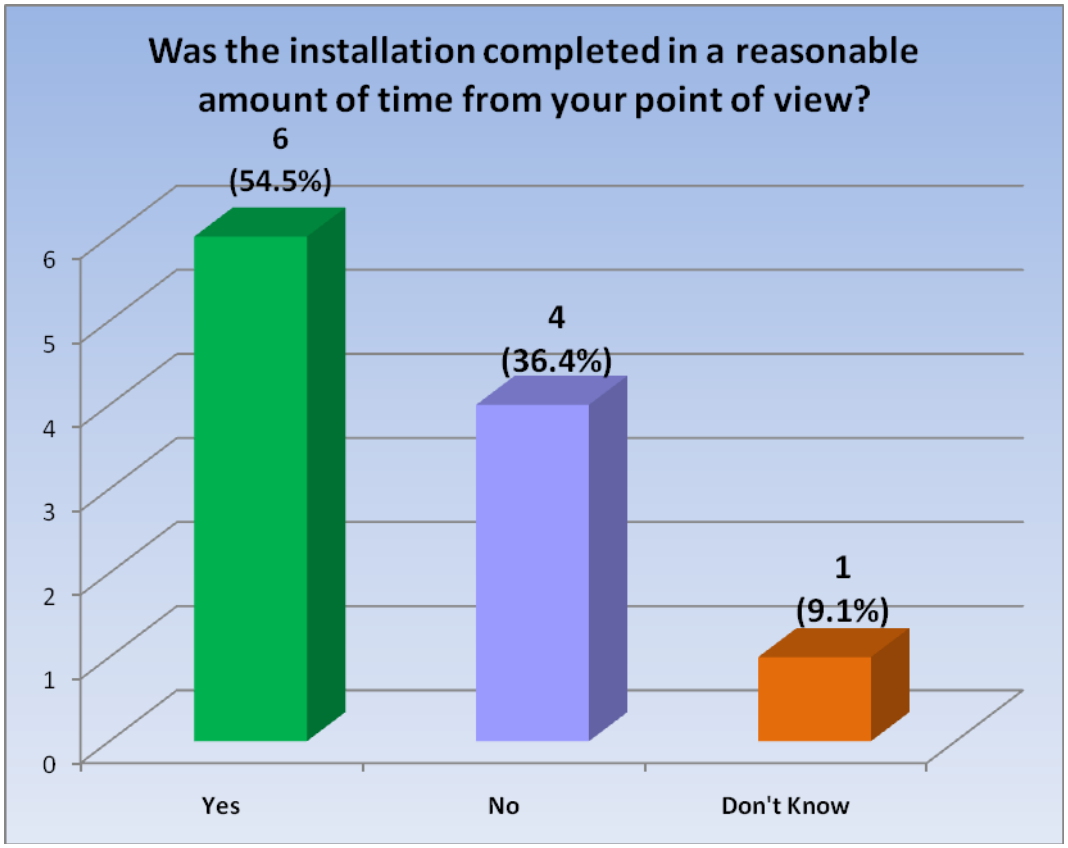


Figure 6: Staff opinions on whether the installation was completed in a reasonable amount of time

How acceptable was the process and the product to staff?

In-use evaluation surveys were carried out when the OTEX system had been operating for 4 weeks and staff were familiar with it.

Two evaluation surveys were used as follows.

- Questionnaire A) In-use evaluation for laundry staff – 13 respondents including laundry workers, supervisory staff, managers and others connected with the laundry service.
- Questionnaire B) In-use evaluation for non-laundry staff – 36 respondents all domestic staff.

Questionnaires were collected until the end of the evaluation. Some questions were common to both questionnaires so that any differences in the opinions of staff involved with different processes concerning the microfibre cloths and mops could be seen.

In both questionnaires staff were asked whether they could tell the difference between OTEX laundered and conventionally laundered microfibre (figure 7). 92% of laundry staff (12) answering questionnaire A, said they could tell the difference whilst one staff member (8%) was unsure. When asked to specify the difference between the two methods comments were that OTEX produced cleaner cloths, bacteria free, fresh smelling.

In contrast only 40% (14) of domestic staff responding to questionnaire B said that they could tell the difference between the microfibres laundered by the different methods whilst the majority 57% (20 staff) could not (one domestic staff member was 'not sure'). Differences specified were that '*the cloths seemed better now'* and *'sometimes seem cleaner, easier and quicker mopping'.*

Question. Can you tell the difference between OTEX laundered and conventionally laundered microfibre?	**Yes**	**No**	**Not Sure**
A) In-use evaluation for laundry staff. 13 responses (Staff with connections to the laundry – laundry worker, supervisory staff, domestic/hotel services management and administration).	12 92%	0	1 8%
B) In-use evaluation for non-laundry staff 35 responses (domestics)	14 40%	20 57%	1 3%

Figure 7: Staff opinions on whether there was any difference between OTEX laundered and conventionally laundered microfibre

Staff were asked if they had any problems with the cleaning ability, appearance or texture of the microfibre laundered with OTEX or any other difficulties with microfibre laundered this way. As Figure 8 shows, 82% to 100% of respondents to questionnaires A or B had no problems or difficulties in this respect.

Questionnaire A. **In-use evaluation for laundry staff.** **Total number of respondents -13.**	Yes Number and%	No Number and %	Don't Know
Any problems with the cleaning abilities of microfibre laundered by OTEX?	2 15%	11 85%	0
Any problems with the appearance of microfibre laundered by OTEX?	1 7.7%	12 92.3%	0
Any problems with the texture of microfibre laundered by OTEX?	1 8.3%	11 91.7%	0
Any problems with the durability of microfibre laundered by OTEX?	0 0%	12 100%	0
Any other difficulties in using microfibre laundered by OTEX?	0 0%	11 100%	0

Questionnaire B. In-use evaluation for non-laundry staff. **Total number of respondents – 36.**	Yes	No	Don't Know
Any problems with the cleaning abilities of microfibre laundered by OTEX?	3 8.6%	30 85.7%	2 5.7%
Any problems with the appearance of microfibre laundered by OTEX?	6 17.6%	28 82.4%	0
Any problems with the texture of microfibre laundered by OTEX?	5 15.2%	28 84.8%	0
Any problems with the durability of microfibre laundered by OTEX?	3 15%	17 85%	0
Any other difficulties in using microfibre laundered by OTEX?	4 11.1%	32 88.9%	0

Figure 8: Cleaning ability, appearance, texture and durability of microfibre laundered with OTEX.

When asked if there were any problems with the durability of OTEX laundered microfibre 100% of respondents to questionnaire A (12 staff) and 85% of respondents to questionnaire B (17 staff) responded that there was no problem. Respondents to questionnaire B commented that they do not dispose of cloths and '*don't know because no responsibility for disposing of worn cloths'.* This highlighted a need within the Trust to review the process in place to replace microfibre cloths and mops.

Staff were asked if there were any advantages to OTEX laundered microfibre compared to conventional laundering (figure 9). Opinion was equally divided amongst respondents to questionnaire A with 50% (6 staff) saying yes and an equal number saying no. Comments were '*mops and cloth cleaner / it smells cleaner / microfibre are cleaner and better to use'.* 76.5% of respondents to questionnaire B (26 staff) thought there were no advantages to OTEX laundered microfibre with only 23.5% (8 staff) responding yes. Positive comments included '*cheaper, cleaner, better more effective cleaning, quicker mopping more effective'.*

Question. Are there any advantages to microfibre laundered by OTEX compared to that laundered in the usual way?	Yes	No
Respondents to questionnaire **A** 12 respondents	6 50%	6 50%
Respondents to questionnaire **B** 34 respondents	8 23.5%	26 76.5%

Figure 9: Staff opinions on whether there were any advantages to OTEX laundered microfibre.

65% of the total respondents to both questionnaires (30 staff) staff would also recommend OTEX washed cloths to colleagues in the NHS (see figure 10). Some reasons given were '*think ozone cleans better'* and '*good that OTEX saves energy'.*

Question. Would you recommend OTEX washed cloths to colleagues in the NHS?	Yes	No
Respondents to questionnaire A 12 respondents	8 67%	4 33%
Respondents to questionnaire B 34 respondents	22 65%	12 35%
Total respondents	30 65%	16 35%

Figure 10: Recommendations to NHS colleagues.

Staff answering questionnaire A were asked if the OTEX system damaged any fabrics, 92% (12 staff) responded no with one staff member (8%) answering yes but when asked to specify which items and the extent of damage, none were specified.

Towards the end of the active evaluation the following survey was carried out:

- End of evaluation laundry survey – 6 respondents in total all laundry supervisors.

The Trust has a long standing problem with drain blockages causing frequent washing machine breakdown within the laundry room. This problem precedes the OTEX evaluation. The problem was highlighted when staff were asked

whether there were any mechanical problems/breakdowns with the machine during the trial period. 4 staff (67%) gave a positive response. Records show that during the evaluation period all machine breakdowns were caused by blockages leading to drainage problems related to the Trust drainage plumbing from the laundry room rather than any fault with the JLA machinery. The Trust is now looking to re-site the laundry room in order to resolve the plumbing and drainage problems associated with the current laundry room.

Staff were asked if problems were resolved satisfactorily by JLA. Staff were equally divided in their response with 3 staff giving a positive response and 3 staff a negative response. Staff were asked to specify problems and responses included '*had to wait for parts'* and '*do not come out quickly to fix machine'.* JLA have an 8 hour response time to get an engineer on site during working hours over a seven day week. If they do not respond within that period they pay a penalty to the trust. During the evaluation there were no penalties paid.

When asked if there was any need to repeat OTEX cycles or rewash, 5 of the 6 respondents answered no. One person answered yes but qualified this by adding '*in case of failure'.*

Figure 11 shows responses when staff were asked about detergent, power and labour requirements using the OTEX system. All respondents (6 staff) agreed that less detergent was used and 2 of 3 respondents thought that less power was used. Staff were divided as to whether the OTEX system required less labour, although there is no reason why the OTEX system should require less labour. The laundry staff undertake the same tasks for both OTEX laundering and conventional laundering although wash cycle times are shorter.

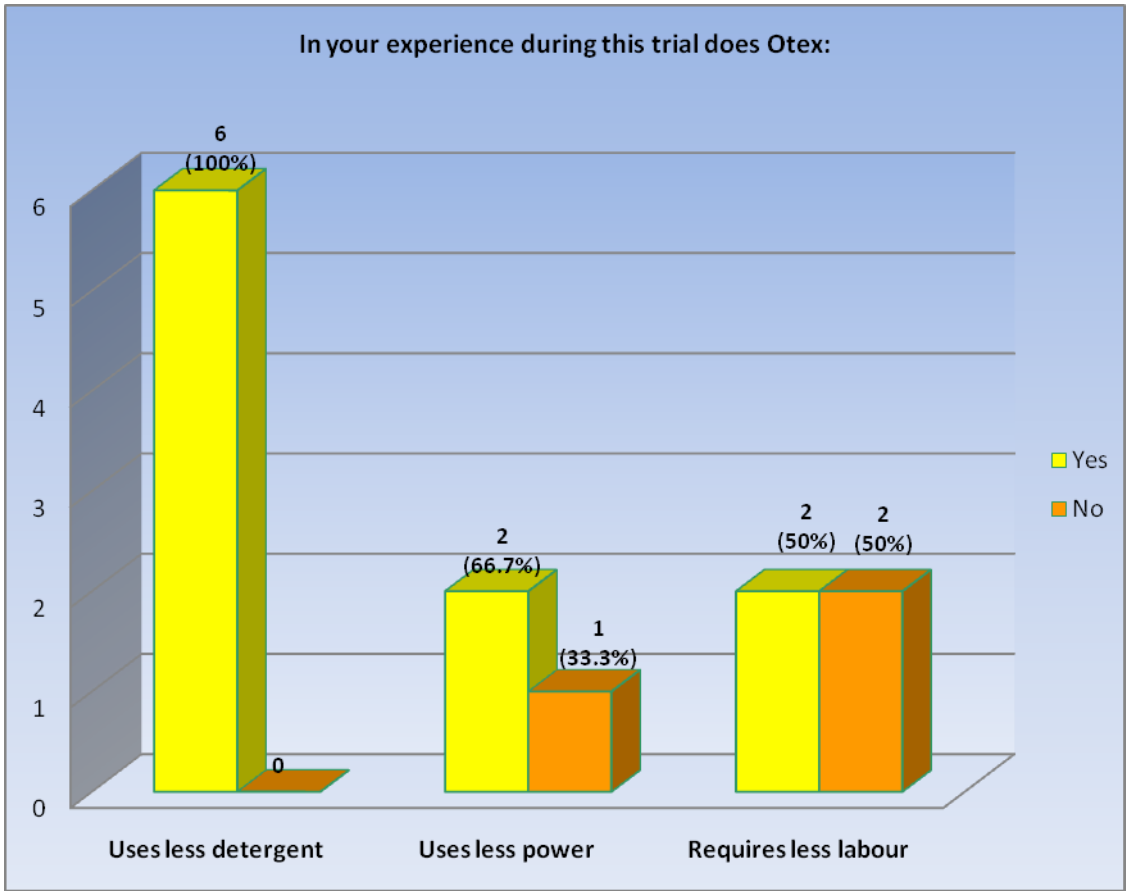


Figure 11: Use of detergent, power and labour

4 of the laundry supervisors (80% of respondents) thought that the maintenance of the OTEX system was acceptable to the laundry service whilst 1 respondent did not but gave no reason why they disagreed.

The OTEX system allows the wash cycles to be validated and pass/fail cycles to be recorded and audited. Staff were asked if they had utilised this audit facility. 4 (80%) of the 5 respondents said yes to this question. 1 respondent said no but offered no comment.

Microbiological evaluation

Microbiological tests were undertaken on both used and laundered mops and cloths during the first week of OTEX usage. 2 mops and 2 cloths were tested independently pre and post laundering at Huddersfield Royal Infirmary Microbiology Department. The results are shown in figure 12. There was no evidence of *Clostridium difficile* either pre or post OTEX wash.

Samples	Lab number	Total Viable Count (TVC)	C difficile Culture
1 Mop pre	164345	>1000	Not Isolated
2 Mop pre	164346	>1000	Not Isolated
3 Cloth pre	164347	340	Not Isolated
4 Cloth pre	164348	160	Not Isolated
5 Mops post	164349	2	Not Isolated
6 Mops post	164350	1	Not Isolated
7 Cloths post	164351	3	Not Isolated
8 Cloths post	164352	2	Not Isolated

Figure 12: Microbiological samples taken pre and post laundering November 2010.

Health and Safety

Background ozone levels were monitored throughout the evaluation using the OTEX validation system and, as shown in figure 13, remained well below levels specified by the Health and Safety Executive (2006).

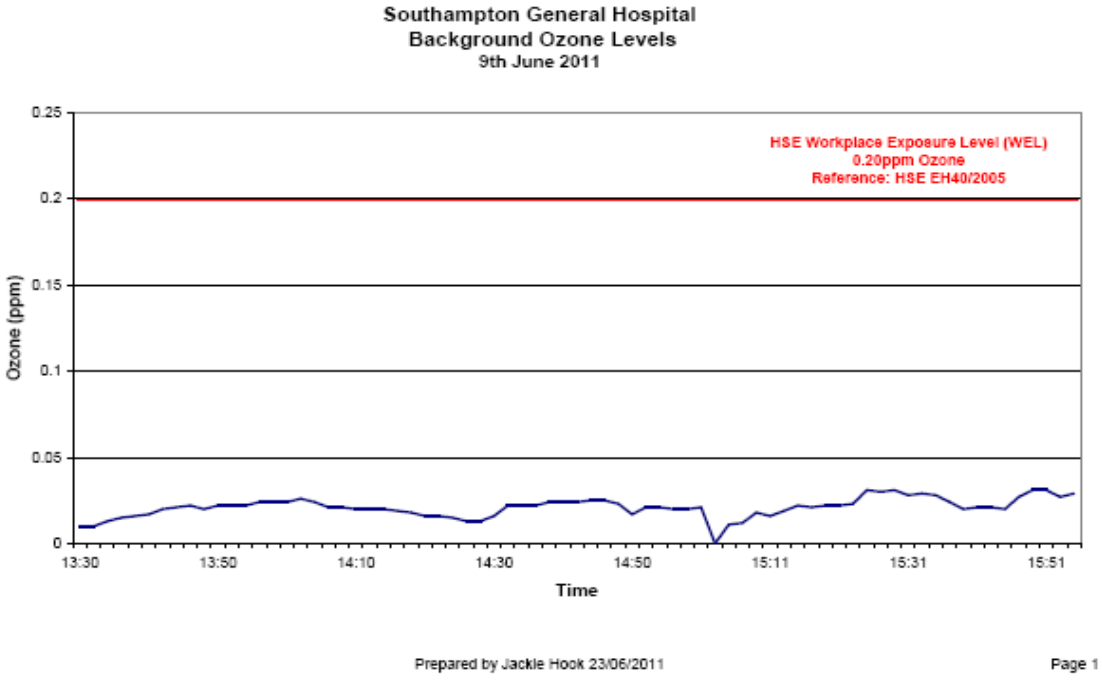


Figure 13: Background ozone levels

Issues and Limitations of the evaluation

At SUHT most laundry services are contracted out to off-site companies and only domestic microfibre cloths and mops are laundered on-site. The laundry room is small and consequently there are only two washing machines to launder cloths and mops at the Southampton General Hospital site. Very few staff are needed to work in the laundry room which limited the number of respondents to some of the questionnaires. Any breakdown of one of the two washing machines was more disruptive to services than in a larger laundry facility. Staff employed by the contractors for the in-house laundry and domestic services were involved in industrial action at the time of the evaluation so that domestic staff from other sites were employed at the

hospital for some periods of the evaluation. Questionnaires were only given to those who normally worked at the Southampton site. This was a limitation on the number of respondents during the evaluation period.

The evaluation benefitted the Trust by revealing weaknesses within the laundry facility itself and within the method for monitoring the life cycle of microfibre cloths and mops. This enabled facilities and processes to be reviewed and ongoing changes to be made to the site of the facility and the systems in place.

Advice for Trusts considering introducing the OTEX ozone laundry system

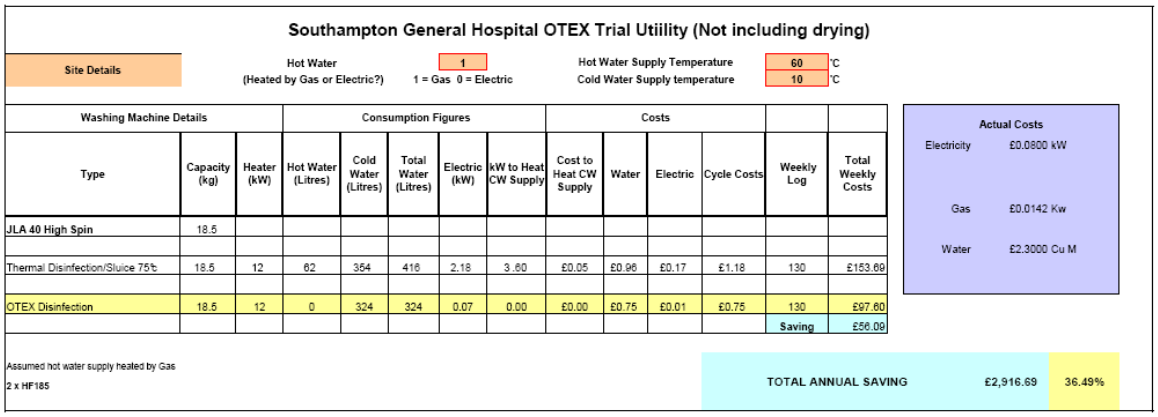
Important points to consider

Trusts considering introducing the OTEX ozone laundry system would need to consider whether to purchase or lease suitable washing machines from JLA. Costs would be individual to the Trust and the usual maintenance/service contracts would need to be purchased. The OTEX system can also be retrofitted to other suitable previously bought or leased machines supplied by JLA. The OTEX system has ongoing costs associated with it which include a service and maintenance contract. Retrofitting the OTEX system to washing machines supplied by other manufacturers may not be possible due to incompatibility with programs and validation and would need to be discussed with JLA.

Costs and Benefits

Costs and benefits will vary between Trusts. Water and energy usage was monitored at SUHT pre evaluation using the thermal disinfection cycle and during the evaluation using the OTEX disinfection cycle in order to examine costs and benefits. Figure 14 shows that water and energy costs per cycle were £1.18 using the thermal disinfection wash. The average number of wash cycles per week was 130. This gives a total weekly water and energy cost of £153.69 for thermal disinfection washes. Water and energy costs for the OTEX disinfection system for a single wash cycle were £0.75 giving a weekly total of £97.60 for 130 cycles.

These calculations indicate an annual cost saving for water and energy at SUHT of £2,916.69 at current energy prices if the OTEX disinfection system is used rather than the thermal disinfection method. This is a utility saving of 36%.



Southampton General Hospital OTEX Trial Utility (Not including drying)

Site Details

Hot Water (Heated by Gas or Electric?) 1 = Gas 0 = Electric: 1

Hot Water Supply Temperature: 60 °C

Cold Water Supply temperature: 10 °C

Washing Machine Details			Consumption Figures					Costs					
Type	Capacity (kg)	Heater (kW)	Hot Water (Litres)	Cold Water (Litres)	Total Water (Litres)	Electric (kW)	kW to Heat CW Supply	Cost to Heat CW Supply	Water	Electric	Cycle Costs	Weekly Log	Total Weekly Costs
JLA 40 High Spin	18.5												
Thermal Disinfection/Sluice 75°c	18.5	12	62	354	416	2.18	3.60	£0.05	£0.96	£0.17	£1.18	130	£153.69
OTEX Disinfection	18.5	12	0	324	324	0.07	0.00	£0.00	£0.75	£0.01	£0.75	130	£97.60
												Saving	£56.09

Actual Costs

Electricity £0.0800 kW

Gas £0.0142 Kw

Water £2.3000 Cu M

Assumed hot water supply heated by Gas

2 x HF185

TOTAL ANNUAL SAVING £2,916.69 36.49%

Figure 14: Utility cost savings using OTEX

Details of the wash cycle (figure 3, page 11) show that detergent used with the OTEX system at SUHT is half that used with the thermal system, giving further cost savings.

Energy savings may also be observed when the energy used to tumble dry OTEX washed microfibre cloths is compared to energy used drying the thermal disinfection washed microfibre cloths. Laboratory tests carried out by JLA Ltd show that moisture retention is 26% greater using the thermal disinfection cycle. The same dry weight of cloths was used for both types of cycle, OTEX and thermal, and other parameters such as length of and revolutions of the final spin of the wash cycle and the size and type of washing machine were the same for both types of cycle. Drying following the thermal disinfection wash would therefore take more time and energy thus incurring more costs. More detail is shown in figure 15. Unfortunately the tumble dryers at SUHT were not monitored for drying time and energy usage during the evaluation.

Theoretical Savings Associated with Drying OTEX Washed Microfibre Cloths		
	Thermal wash cycle	**OTEX wash cycle**
Initial weight of dry cloths (g)	1310 (25 cloths)	1310 (25 cloths)
Weight following wash cycle (g)	1714	1609
Moisture retained following wash cycle (g)	404	299
Moisture retained as % of total wet weight	31%	23%
Difference between moisture content of the wet cloths processed using the two types of wash process is 25.9%		

Impact on Drying Times & Energy		
Dryer Evaporation Rate	0.3kg/min	
Time taken to remove moisture	12.5 mins	Thermal
	9 mins	OTEX
Number of cycles per week	130	
Saving per week	7.5hrs	Machine running time

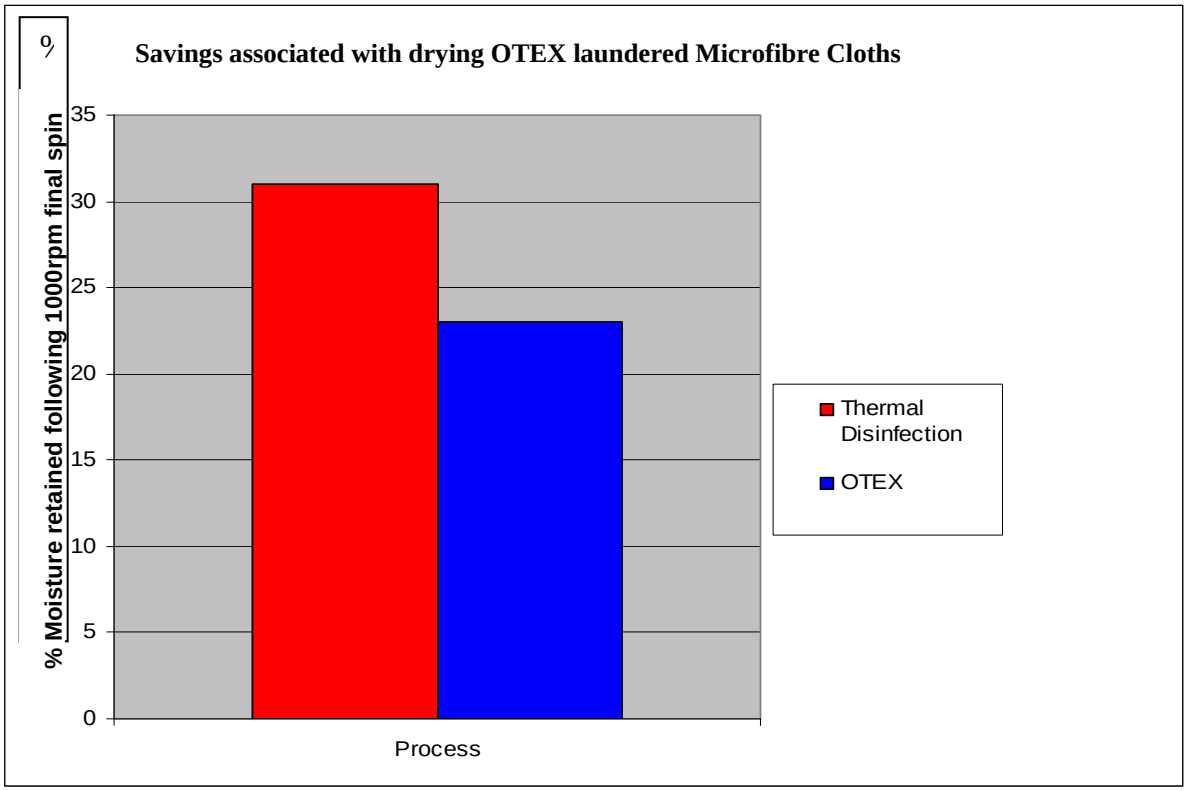


Figure 15: Savings associated with drying OTEX washed microfibre cloths.

With utility prices set on an upward trend cost savings on utilities are likely to be greater in the future.

The OTEX system also offers an opportunity for Trusts to support the drive within the NHS to reduce its carbon footprint in a sustainable manner and supports the target set to reduce the NHS carbon footprint by 10% by 2015 from the 2007 level.

References

1. Health Service Guidelines(1995) Hospital Laundry Arrangements for Used and Infected Linen HSG(95)18. NHS Executive

2 . Rice, R. DeBrum, M. Cardis, D. Tapp, C. The Ozone Laundry Handbook: a comprehensive guide for the proper application of ozone in the commercial laundry industry. Ozone:Science and Engineering. 2009; 31: 339-447

3. Climate Change Act 2008. (c.27), London: HMSO

4. NHS Sustainable Development Unit (2009) Saving Carbon, Improving Health: NHS Carbon Reduction Strategy For England. http://www.sdu.nhs.uk/documents/publications/1237308334_qylG_saving_carbon,_improving_health_nhs_carbon_reducti.pdf

5. Rice, R. DeBrum, Hook, J. Cardis, D. Tapp, C. Microbiological Benefits of Ozone in Laundering Systems. Ozone: Science and Engineering. 2009; 31: 357-368

6. Allison, K. Hook, J. Cardis, D. Rice, R. Quantification of the Bactericidal, Fungicidal, and Sporicidal Efficacy of the JLA Ltd. Ozone Laundering System. Ozone: Science and Engineering. 2009; 31: 369-378

7. Disinfection of hospital laundry using ozone: microbiological evaluation C. C. Cardoso, J. E. Fiorini, L. R. Ferriera, J. W. Gurjao and L. A. Amaral Infection Control and Hospital Epidemiology Vol. 21, No. 4 (April 2000) (p. 248)

8. Health and Safety Executive (1996) Ozone: health hazards and precautionary measures Guidance Note EH38 http://www.hse.gov.uk/pubns/priced/eh38.pdf

9. Hook, J. Cardis, R. Condition Monitoring of Microfibre Cloths Within Healthcare Environments. 2007 amended 2009. Report reference OTEX LD17 JLA Ltd

10. Young, S. Setlow, P. Mechanisms of *Bacillus subtilis* spore resistance to and killing by aqueous ozone. Journal of Applied Microbiology. 2004; 96: 1133-1142

11. Bringmann, G. Determination of the lethal activity of chlorine and ozone on *E. Coli*. Z. F. Hygiene. 1954; 139: 130-139

12. EPA (1999). Alternative Disinfectants and Oxidants Guidance Manual. United States Environmental Protection Agency. Ch. 3 p24