

MONITORING OF MICROBIAL CONDITIONS
IN THE EXHAUST VENTILATION AIR OF THE
SHREDDER UNIT AND HEAT DISINFECTANT SYSTEM
AT Tradebe Healthcare Ltd.,
WREXHAM.
4TH QUARTER; 17TH FEBRUARY 2021.

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- LEV testing
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Site Operator	Tradebe Healthcare Ltd.
Site Location	Wrexham
Permit No.	EPR/WP3636ZG
Monitoring Date	17 th February 2021
Monitoring Frequency	Quarterly
Monitoring Period	4 th Quarter 2020
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Introduction

TTS Environmental was commissioned by Tradebe Healthcare Ltd. to carry out monitoring of atmospheric emissions from the waste shredder unit and the heat disinfectant system process at their Wrexham Premises. The process is used to disinfect low-grade medical waste.

Monitoring of environmental emissions to air is required as part of the conditions of authorisation under the Environmental Permitting (England and Wales) Regulations 2010 (as amended). The Wrexham site is administered by the Natural Resources Body for Wales.

Monitoring for the 4th quarter period was originally carried out on 11th December 2020. The results for total bacteria and coliforms exceeded the emission limit. The reason for this was almost certainly a failure of the HEPA filter unit. Once this had been replaced, repeat monitoring was carried out on 17th February 2021.

Summary of Results.

The monitoring results are summarised as follows:

Parameter	Cfus/m ³	Emission Limit, cfus/m ³
Shredder Unit		
Total Aerobic Bacteria	40	1000
Total Coliform Bacteria	< 4	300
Total Fungi	48	1000
Holoflite		
Total Aerobic Bacteria	72	1000
Total Coliform Bacteria	< 4	300
Total Fungi	128	1000

Four samples for each parameter were taken from each discharge point. Blank reference samples were also analysed and appropriate corrections were made to the sample results.

Full monitoring data is presented in the tables on pages 8 and 9.

Discussion and Recommendations

The measured emissions from the shredder and holoflite LEV systems for Total Aerobic Bacteria and Total Coliform Bacteria were all within the respective emission limits.

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Process Description and Operating Conditions

The heat disinfectant system processes low grade medical waste, such as swabs, dressings, incontinence pads etc. for disposal at landfill sites. The process involves the shredding of waste, followed by thermal disinfection at about 110° C. Both stages are carried out under controlled conditions, i.e. under negative pressure. The treated waste is compacted for disposal.

The exhaust ventilation system for the shredder comprises a coarse pre-filter and a high-efficiency particle arrestor (HEPA) filter. The main heat disinfection unit is fitted with a small condenser unit followed by a wet scrubber, two biofilters (bark), a HEPA filter and an activated carbon filter. All sampling was carried out downstream of the filter systems.

Sampling Methods

Exhaust Gas Velocity Measurements

Preliminary measurements of the flue gas velocities were made in order to determine the rate of flue exhaust air emission and to identify the gas flow profile before sampling (to identify any stagnant or void areas).

This was carried out using a pitot-static tube and digital micro-manometer. Where the airflow was too low for this technique, a thermal anemometer was used.

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Microbiological Sampling

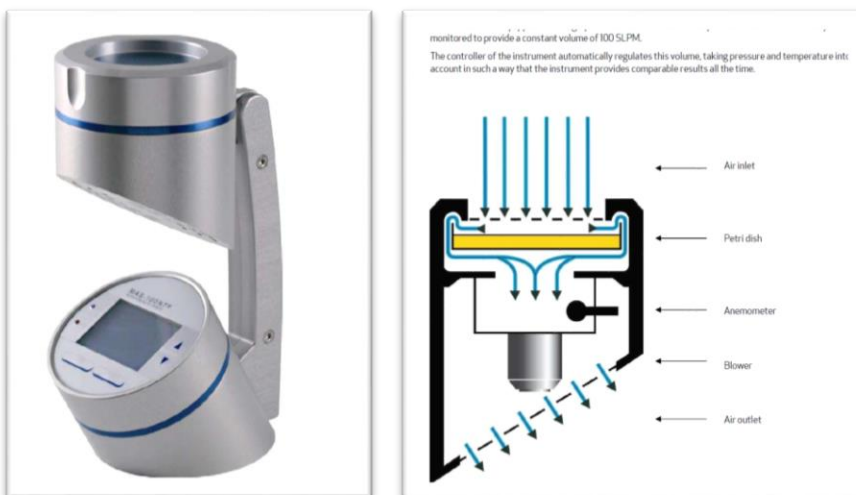
Samples were collected by drawing measured volumes of air through a Millipore MAS-100NT bio-aerosol sampler onto specific agar culture media, i.e.

- Tryptone Soya Agar for total aerobic bacteria
- Violet Red Bile Agar for total coliform bacteria
- Sabouraud Dextrose Agar for total fungi

Air was drawn onto the agar plates mounted within the sampler, at a pre-set rate. An in-built timer was set to sample 250 litres of air for each sample. This has been found to be the optimum sample volume given the balance between the sample volume and the potential excess material on the sample media. Internal surfaces of the sampling device were sterilised before use to prevent the possibility of cross-contamination. Similarly, vinyl gloves were worn during the handling and cleaning of the sampling components.

The samples were stored in a refrigerator and delivered to the laboratory the following day.

The agar media were then cultivated and the bacteria and fungi colonies enumerated. The results are expressed as colony counts per plate. These were multiplied as necessary to express the results as colonies per cubic metre.



Quality System and Standards

TTS Environmental operates a quality system to BS EN ISO 9001; the system includes the calibration of sampling and test equipment. The company is accredited by BSI. Iain Thomson is a Chartered Environmentalist.

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Calculation of Uncertainty

The degree of uncertainty of the monitoring of microbial conditions within exhaust ventilation systems has been estimated with reference to the UKAS publication "M3003 The Expression of Uncertainty and Confidence in Measurement" and the NPL guide "A Beginner's Guide to Uncertainty of Measurement".

$$\text{Total Uncertainty} = \sqrt{(u1)^2 + (u2)^2 + (u3)^2 + \text{etc}}$$

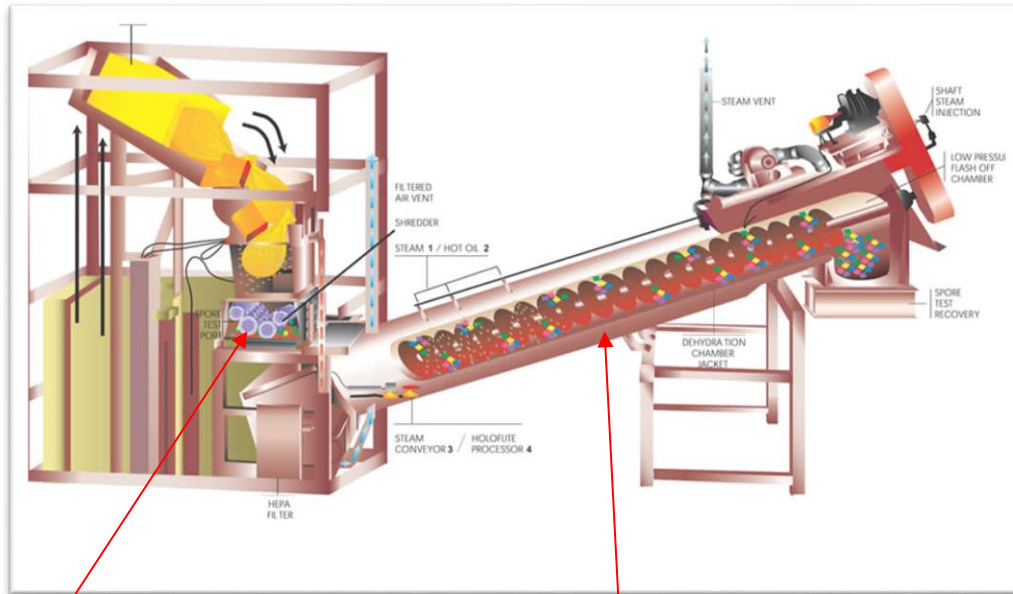
In order to calculate the total uncertainty, the uncertainty for each factor has to be calculated. The factors for consideration are:

- Accuracy of the pump used in the sampling
- Possibility of cross contamination during transport and on site
- Manufacture quality of the agar used in the sampling
- The accuracy of the analysis equipment
- Possibility of cross contamination during analysis

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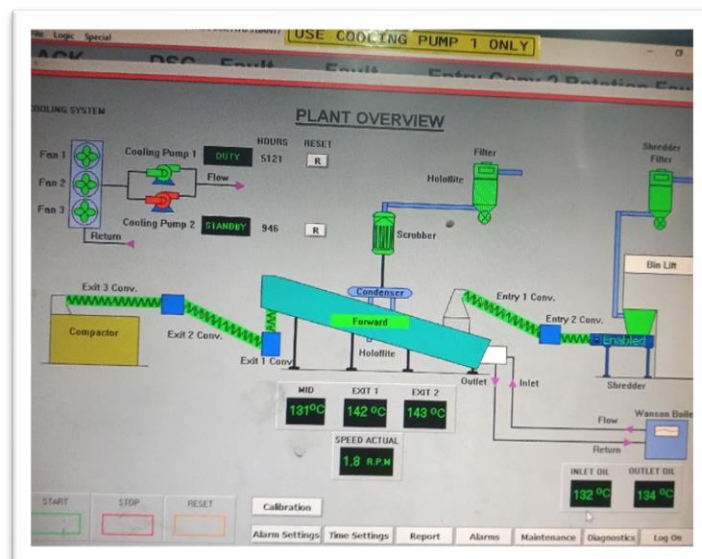
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Diagram of the Waste Treatment System



Shredder

Holoflute



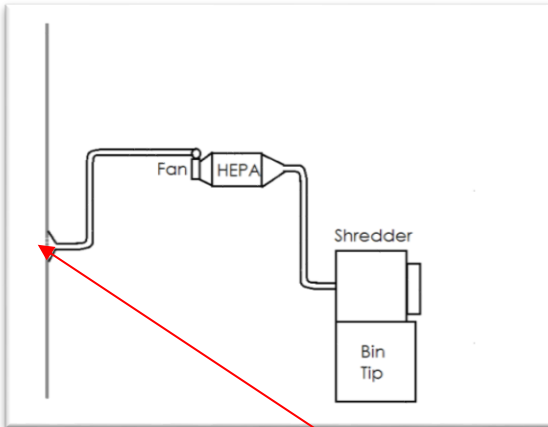
Control screen during monitoring.

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Monitoring of Microbial Conditions Illustrations of Process Plant

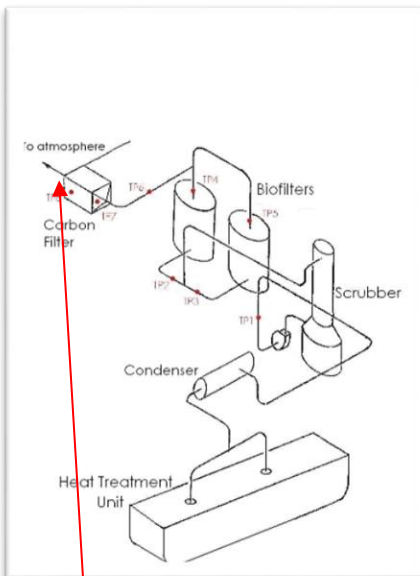
Shredder



Plant layout and sampling location.

Bin hoist and shredder in operation.

Holoflite



Plant layout and sampling location.

Biofilters.

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Monitoring of Microbial Conditions in the Exhaust Ventilation System for the Shredder.

Plant Details

Test Date	17 th February 2021
Type of Plant	Shredder Unit - waste material is shredded in preparation for passing through the heat disinfection system. The exhaust ventilation passes through a coarse pre-filter and a HEPA filter before discharge to atmosphere.
Operating Conditions	Normal conditions; i.e. continuous processing of waste throughout the monitoring period.
Sampling Location	Exhaust vent downstream of filtration devices (see drawings).
Pressure Gauge Readings, mm Water	HEPA filter, 24 mm. Coarse filter, 16 mm.

Sampling Results

Parameter	Time	cfus/m ³	Emission Limit, cfus/m ³	Uncertainty
Total Aerobic Bacteria	09:30	16	1000	± 3.15%
	09:39	36		
	09:48	40		
Total Coliform Bacteria	09:33	< 4	300	± 13.35%
	09:42	< 4		
	09:51	< 4		
Total Fungi	09:36	28	1000	± 3.15%
	09:45	24		
	09:54	48		

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Monitoring of Microbial Conditions in the Exhaust Ventilation System for the Holoflite.

Sampling Results

Test Date	17 th February 2021
Type of Plant	Holoflite – The shredded waste is heat treated and the exhaust gases pass through a wet scrubber tower, two biofilters, a HEPA filter and a carbon filter. There were no suitable sampling points within the ducting as the carbon filter was located immediately against the external wall.
Operating Conditions	Normal conditions; i.e. continuous processing of waste throughout the monitoring period.
Sampling Location	Exhaust vent downstream of filtration devices (see drawings).
Pressure Gauge Readings, mm Water	Biofilter No. 1, 1.5mm. Biofilter No. 2, 3.5mm. Static pressure from scrubber, 20mm.

Chatted to thermo calibrator man! Try a PT100 calibrator?

Sampling Results

Parameter	Time	cfus/m ³	Emission Limit, cfus/m ³	Uncertainty
Total Aerobic Bacteria	15:49	72	1000	± 3.15%
	16:14	20		
	16:21	16		
Total Coliform Bacteria	16:08	< 4	300	± 13.35%
	16:17	< 4		
	16:22	< 4		
Total Fungi	16:10	53	1000	± 3.15%
	16:18	128		
	16:23	40		

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Exhaust Gas Velocity Measurements.

Shredder Exhaust.

Measurement	Value	Unit
Date	17 th February 2021	
Barometric Pressure	100100	Pa
Pitot Tube K Factor	1	
Average Differential Pressure	20	Pa
Average Velocity	5.77	m/sec
Average Stack Temperature	17	C
Density	1.2025	Kg/m ³
Stack Cross Section	CIRCULAR	
Stack Diameter	0.35	m
Stack Area	0.0962	m ²
Volume Flowrate at Stack Conditions	1997.9	m ³ /h
Volume Flowrate at 0° C	1880.8	m³/h
Volume Flowrate at 15° C	1984.1	m ³ /h
Volume Flowrate at 20° C	1999.0	m ³ /h
Volume Flowrate at 25° C	2180.9	m ³ /h

Terms

Pa	Pascals
m/sec	metres per second
Kg/m³	Kg per cubic metre, at the measured conditions
Kg/m³n	Kg per cubic metre, normalised
m³/h	cubic metres per hour

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Exhaust Gas Velocity Measurements.

Holoflite Exhaust.

Measurement	Value	Unit
Date	17 th February 2021	
Barometric Pressure	100100	Pa
Pitot Tube K Factor	1	
Average Differential Pressure	1.1	Pa
Average Velocity	1.36	m/sec
Average Stack Temperature	19	C
Density	1.1942	Kg/m ³
Stack Cross Section	CIRCULAR	
Stack Diameter	0.18	m
Stack Area	0.0255	m ²
Volume Flowrate at Stack Conditions	124.4	m ³ /h
Volume Flowrate at 0° C	116.3	m³/h
Volume Flowrate at 15° C	122.7	m ³ /h
Volume Flowrate at 20° C	125.4	m ³ /h
Volume Flowrate at 25° C	135.7	m ³ /h

Terms

Pa	Pascals
m/sec	metres per second
Kg/m³	Kg per cubic metre, at the measured conditions
Kg/m³n	Kg per cubic metre, normalised
m³/h	cubic metres per hour