EAQ Consulting

OPERATIONAL ODOUR EMISSIONS IMPACT ASSESSMENT

SMARTSTREAM TECHNOLOGIES: CARDUP ROTO-MOULDING FACILITY

Smartstream Technologies: Cardup Roto-Moulding Facility

Prepared for: Smartstream

Project Ref: EAQ-21028
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EAQ Consulting

Environment | Air Quality

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Approved for Release		
Name	**Position**	**File Reference**
John Hurley	Principal Air Quality Consultant	EAQ21028-Operational OIA_Report_v1.0

Signature

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1 Background

Environmental & Air Quality Consulting Pty Ltd (EAQ) was engaged by Smartstream Technologies (Smartstream) to undertake an Operational Emissions Assessment (OEA) of Smartstream's Cardup Roto-Moulding Production Facility (the Site).

The Site is located at 17 Cardup Siding Road, Cardup Western Australia (WA) and is part of a larger existing industrial site owned by the Wormall Group which operates from the site as Wormall Civil. The Smartstream Site occupies a discrete footprint of approximately 0.3 hectares within the overall Wormall Civil industrial site area which is approximately 6.0 hectares.

The current works were commissioned in accordance with the Shire of Serpentine Jarrahdale's (the Shire) Planning and Development Approval (PA17/950: AN:wj dated 8 May 2018) requirements that require Smartstream to undertake an Operation Emissions Assessment of the Cardup Site that follows the previously undertaken Baseline Emissions Assessment in April 2019 and subsequent OEA assessments by EAQ.

This OEA details the quantitative assessment results for odour and toxics and compares those results to previous assessment periods.

1.1 Purpose of OEA

The purpose of this OEA is to confirm the quantitative emissions from the Sites' process stack and determine the Risk of offsite odour and amenity impacts on nearby sensitive receptors based on the quantitative results.

1.2 Cardup Facility (the Site)

The operations at the Site involve a roto-moulding process of Linear Density Polyethylene (LDPE) into everyday items such as containers and plumbing products (among others). The LDPE material is introduced as a powdered material with a texture similar to sand. Each batch/bag of LDPE produces one item thus eliminating waste from the process. During the process a batch/bag of LDPE is introduced to the mould which is then moved into the gas-fuelled oven where the mould is evenly spun (rotation) to disperse the LDPE to fill the mould.

Process emissions are contained and emitted during the main cooling process. Until this stage all emissions are contained within the previous process steps. During the main cooling process a fine spray mist is applied in conjunction with clean air to gradually cool the product. During cooling any emissions generated are emitted through a roof top stack of approximately 1.2 metres in height above the roofline without any treatment.

The character of the odours emitted resembles the typical smell of plastics/resin with moderate-low odour intensity (i.e. moderate-low odour strength). There are no active emission sources of dust

(particulates) emissions from the process, and therefore any dust leaving the Site is negligible and ambient in origin.

The process is not continuous and emissions to atmosphere occur during only the mould cooling stages. Odours and toxics emissions at ground level (fugitive emissions) are nil and the process itself does not emit ground level odours from any mechanical, process or thermal means.

Operational timeframes during daylight hours further increases the efficiency of odour dispersion given the atmospheric stability conditions during daytime hours, on average (seasonal), are neutral to unstable.

2 OEA Results

EAQ collected air samples from the Cardup Site on Thursday, 26th August 2021. The sampling program involved drawing air samples into Nalophan bags for odour and chemical analysis. Samples were analysed for odour concentration (ou.m^3) and further chemical speciation of the bag samples for Aldehydes & Ketones.

Both odour and chemical speciation analyses were undertaken by NATA Accredited laboratories. The laboratory NATA reports for these analyses are presented in Appendix A.

2.1 Odour Emissions Impacts

Table 2-1: Odour Sampling Data

Sample	Concentration (ou.m^3)	Roto-Mould Emission Temperature (^{0}C)	Emission Velocity (m/s)	Stack Diameter (m)	Emission Area (m^2)	Odour Emission Rate (ou/s)
Odour	640	266	6.4	0.3	0.0707	**289.59**

Table 2-1 shows that the average measured odour emission rate from the process stack at the Cardup Site was 289.59 ou.m^3/s.

- This odour emission rate is negligible and would pose no Risk of offsite odour impacts.

Furthermore, the roto-mould exit temperature of approximately 266^{0}C provides a high level of thermal buoyancy, in particular during those early morning and late afternoon timeframes, further supporting improved dispersion during the colder seasonal periods.

2.2 Chemical Emissions & Odour Potential

The compounds of Acetaldehyde and Formaldehyde are those of the most interest with respect to odour impacts from the Site **(refer Table 2-2).**

Acetaldehyde is ubiquitous in the environment and in industry serves as an intermediary in the synthesis of other chemicals. It is also used as a preservative for fruits and fish, as a flavouring agent, a solvent in rubber industries (among others). Formaldehyde is also ubiquitous in the environment and mainly used to produce resins as well as an intermediary in the synthesis of other chemicals.

General exposure to both compounds typically results in irritation to the eyes, nose and throat, whereas chronic exposure can result in respiratory problems.

The odour character of these chemicals typically resembles a pungent/fruity odour for Acetaldehyde (Ethanal) and Formaldehyde (Methanal) resembles a pungent/strong odour.

Table 2-2 to follow presents the analytical results for chemical sampling of Aldehydes and Ketones.

Table 2-2: Chemical Speciation Data of Aldehydes and Ketones

Compound	Analytical Result (µg/m^3)
Acetaldehyde	680
Formaldehyde	680
Acetone	< 10
Acrolein	330
Benzaldehyde	< 10
Butyraldehyde	< 10
Crotonaldehyde	< 10
Hexaldehyde	< 10
Methacrolein	< 10
Methyl ethyl ketone	< 10
Propionaldehyde	32
Tolualdehyde	< 10
Valeraldehyde	< 10

"<" signifies a result is less than the limit of quantification for this method

The chemical odour units (ou) can be theoretically derived based on the measured concentrations of these chemical compounds. There are many reported odour thresholds for a variety of studied compounds making the exact odour threshold difficult to report with any certainty; however, the lower odour thresholds for these compounds based on the publication by Devos *et al* [1] and Safe Work Australia are reported as:

- Acetaldehyde @ 0.014ppm; and
- Formaldehyde @ 0.028ppm.

Dividing the measured concentration (ppm) by the odour threshold (ppm) gives the theoretical "chemical" odour units. The result is considered theoretical given the variability in the range of measured odour thresholds.

Additionally, the sample matrix has a considerable number of analytes in it, many of which are not analysed for, and as such the sum of the theoretical odour units rarely if ever coincides with the olfactory measured concentration. Nonetheless, the derivation of the theoretical chemical odour units (based on any given chemical compound) is a useful exercise in determining the contributing chemical odorants in the sample matrix.

[1] Devos. M, Patte. F, Rouault. J, Laffort. P and Van Gemert. L.J "Standardized Human Olfactory Thresholds" IRL Press. May 1990.

Table 2-3: Derived Chemical Odour Units

Compound	MW	Concentration		
	grams	µg/m^3	ppm	**Chemical ou**
Acetaldehyde	44.05	680	0.21	**15.0**
Formaldehyde	30.031	680	0.55	**19.6**

Table 2-3 shows that the combined derived chemical odour unit for these measurable chemical compounds is 34.6 ou.m^3 of which this concentration is insignificant.

This concentration contributes to the sample matrix measured olfactory odour concentration of 640 ou.m^3 of which the derived odour emission rate of 289.59 ou.m^3/s is also insignificant **(refer Table 2-1)**.

2.3 OEA Determination of Risk

The determination of Risk for odour impacts from the Cardup Site is considered to be Low, if not Negligible, according to the following risk matrix [2] relationship where the Consequence of an odour impact is Slight with the Likelihood Rare.

Table 2-4: Risk Rating Matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	**Low**	Low	Medium	Medium	High

The Low rating of the Cardup Site odour and amenity Risk accounts for the very low measured odour emission rate (ou.m^3/s), high exit temperature and the negligible chemical and theoretically derived chemical odour units.

The likelihood of odours and chemical emissions from the Site impacting the nearest sensitive receptor is rare to entirely unlikely.

[2] Government of Western Australia Department of Environment Regulation Guidance Statement. *Risk Assessments*: Part V, Division 3, Environmental Protection Act 1986. February 2017

2.4 Comparison to Previous Annual Assessment Periods

Table 2-5 lists a comparison of the most recent odour and primary chemical results to previous assessment periods for the Smartstream Roto-Mould odour emissions. **Figure 2-1** illustrates the ongoing annual assessment trends.

Table 2-5: Comparison of Results for previous Assessment Periods

Assessment Period	Sampling Time (24hr)	Odour Concentration ($ou.m^3$)	Odour Emission Rate (ou/s)	Acetaldehyde (ppm)	Formaldehyde (ppm)
2018 (Kewdale)	n/a	181	**79.3**	**0.19**	**0.55**
July 2019	10:00	270	**118.35**	**0.09**	**0.08**
July 2020	07:35	155	**72.31**	**0.03**	**0.05**
August 2021	11:15	640	**289.59**	**0.21**	**0.55**

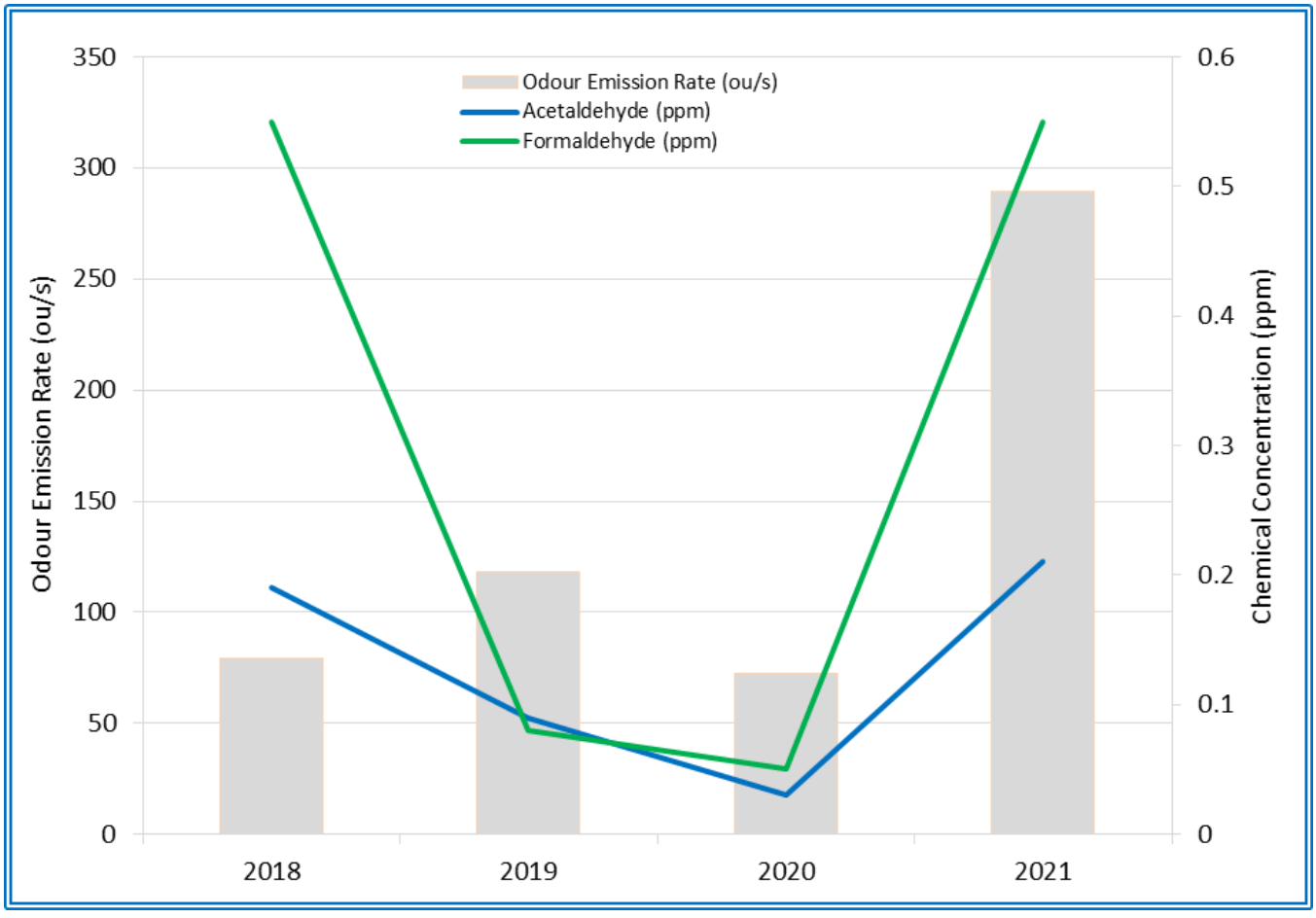

Figure 2-1: Annual Trends of Odour & Chemical Concentration Emissions

3 Conclusions

EAQ's Assessment of the Cardup, Smartstream Roto-Moulding Facility for odour, amenity and toxics (chemical emissions) has shown that the measured odour concentration from the process stack and subsequent odour emission rate very is low and the risk assessment of this emission for ground level nuisance odour impacts is also Low.

The chemical analysis of the emissions to atmosphere has also shown that the detectable chemical compounds emitted are also insignificant in their concentrations, with many targeted compounds not detectable above the laboratory lower detection limits.

The process stack characteristic of high temperature also provides a further level of protection by providing thermal buoyancy on the emissions' stream in particular during cooler atmospheric conditions and cold seasonal periods.

It is the opinion of EAQ that the current Cardup Site operations pose a Low-Negligible Risk for any offsite odour, amenity and/or toxic impacts.

Appendix A

NATA Odour & Chemical Analysis Laboratory Reports

Ektimo

Address (Head Office)
7 Redland Drive
MITCHAM VIC 3132

Postal Address
52 Cooper Road
COCKBURN CENTRAL WA 6164

Office Locations
VIC NSW WA QLD

Freecall: 1300 364 005
www.ektimo.com.au
ABN: 86 600 381 413

210706

CERTIFICATE OF ANALYSIS

Testing Laboratory:	Ektimo ABN 86 600 381 413
Laboratory Location:	52 Cooper Road, Cockburn Central WA, 6164
Report Number:	WO-00197
Job Number:	R011521
Date of Issue:	1/09/2021
Attention:	John Hurley
Company Name:	EAQ Consulting
Address:	PO Box 897 Joondalup DC, WA 6919
Date Samples Received:	26/08/2021
Number of samples received:	16
No of samples analysed:	16
Test Method(s) Used:	Odour Analysis: AS4323.3 (NATA accredited) Hedonic Tone and Odour Character: Direct observation (Not NATA accredited)
Olfactometer Calibration Date:	January 2021

Comments
Nil

QUALITY CONTROL / QUALITY ASSURANCE INFORMATION

QC Acceptance Criteria:

Parameter	Criteria	Result	Pass/Fail
Panel Butanol Threshold	20-80 ppb	46.3	PASS
r	≤ 0.477	0.268	PASS
10^r	≤ 3.00	1.854	PASS
A	< 0.217	0.147	PASS
Max Room Temperature	< 25°C	22	PASS
Temperature Variation	< 3°C	0	PASS

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.
NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised world –wide.
A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate; the sampling reproducibility, analytical method, accuracy, precision and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

REPORT AUTHORISATION

Tom Manton

Ektimo Signatory

NATA Accredited Laboratory 14601

Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports

RESULTS

Date received: 26/08/2021
Date and time of analysis: 27/08/2021, 0830-1030
Date of last calibration: January 2021

Sample ID	Sample Location	Dilution ratio Pre	Post	Total	Odour concentration (ou)	Confidence Interval (ou)	Hedonic Tone	Odour Character
1115	**Res**	-	-	-	**640**	440 - 940	ND	ND

Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2).
A dash '-' in the dilution columns represents no dilution (dilution ratio = 1).
The pre dilution ratio has been been supplied by the client and taken into account when calculating odour concentration results. ***No pre dilution has been assumed if the pre dilution was not stated.***
If post dilution ratio has been reported, this was done by Ektimo to bring samples within the working range of the olfactometer and taken into account when calculating odour concentration results.

DEFINITIONS

The following symbols and abbreviations may be used in this test report:

~	Approximately
<	Less than
>	Greater than
≤	Less than or equal to
≥	Less than or equal to
ND	Not determined
Odour Emission Rate	The product of the odour level of the waste discharged and the volume rate of the discharge (in wet cubic metres per minute referred to a temperature of 0°C and a pressure of 101.325 kilopascals). Expressed as Odour Unit Volumes per Minute, ouv/min.
Odour Threshold	The concentration of a substance, or of a mixture of substances, which is distinguished from odourless air at 50% panel response. By definition, the odour threshold corresponds to an odour concentration of 1 odour unit per m^3.
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
Dilution ratio	Dilution ratio = (Volume sample gas + Volume dilution gas) / Volume sample gas. Pre-dilution values received from the client are asumed to be calculated in this manner for the purposes of calculating reported the sample odour concentrations.
r	Precision, expressed as repeatability; implies that the factor that expresses the difference between two single measurements, performed on the same testing material in one laboratory under repeatability conditions, will not be larger than a factor of 3 in 95% of cases.
A	Accuracy of the odour concentration measurement. The accuracy is a reflection of trueness (expressed as bias) and the precision (r) .
ITE	Individual Threshold Estimate: The detection threshold applying to an individual estimated on the basis of one dilution series.

ChemCentre
Scientific Services Division
Report of Examination

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Purchase Order: None
ChemCentre Reference: 21S0854 R0

Environmental & Air Quality Consulting Pty Ltd
PO Box 897
JOONDALUP DC WA 6919

Attention: John Hurley

Report on: 2 samples received on 26/08/2021

LAB ID	Material	Client ID and Description
21S0854 / 001	Air	CH-RES
21S0854 / 002	Air	CH-RES Dup

LAB ID				001	002
Client ID				CH-RES	CH-RES Dup
Sampled				26/08/2021	26/08/2021
Analyte	Method	LOR	Unit		
Acetaldehyde	ORG199AU	0.001	ug/m3	680	640
Acetaldehyde	ORG203AT	0.05	ug	1.4	1.3
Acetone	ORG199AU	0.001	ug/m3	<0.48	<0.48
Acetone	ORG203AT	0.05	ug	<0.1	<0.1
Acrolein	ORG199AU	0.001	ug/m3	330	75
Acrolein	ORG203AT	0.05	ug	0.7	0.2
Benzaldehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Benzaldehyde	ORG203AT	0.05	ug	<0.1	<0.1
Butyraldehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Butyraldehyde	ORG203AT	0.05	ug	<0.1	<0.1
Crotonaldehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Crotonaldehyde	ORG203AT	0.05	ug	<0.1	<0.1
Formaldehyde	ORG199AU	0.002	ug/m3	380	680
Formaldehyde	ORG203AT	0.1	ug	0.8	1.4
Hexaldehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Hexaldehyde	ORG203AT	0.05	ug	<0.1	<0.1
Methacrolein	ORG199AU	0.001	ug/m3	<0.48	<0.48
Methacrolein	ORG203AT	0.05	ug	<0.1	<0.1
Methyl ethyl ketone	ORG199AU	0.001	ug/m3	<0.48	<0.48
2-Butanone	ORG203AT	0.05	ug	<0.1	<0.1
Propionaldehyde	ORG199AU	0.001	ug/m3	32	<0.48
Propionaldehyde	ORG203AT	0.05	ug	0.1	<0.1
Tolualdehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Tolualdehyde	ORG203AT	0.05	ug	<0.1	<0.1
Valeraldehyde	ORG199AU	0.001	ug/m3	<0.48	<0.48
Valeraldehyde	ORG203AT	0.05	ug	<0.1	<0.1

Method	Method Description

Method	Method Description
ORG199AU	Calculation of air concentration from sorbent tubes, badges and filters. Results in ug/m3.
ORG203AT	Analysis of sorbent tubes and/or badges for carbonyl compounds by UPLC

"<" signifies a result is less than the limit of quantitation for the method.

These results apply only to the sample(s) as received.

Results may not be reproduced except in full.

Unless requested otherwise, sample(s) will be disposed of after 30 days of the issue of this report.

Leif Cooper
Team Leader
SSD Organic Chemistry
9-Sep-2021

Santusha Pandra
Chemist
Occupational Health Investigations