Riverside Energy Park
Waste Hierarchy Scheme

In accordance with Requirement 16, Schedule 2,
Riverside Energy Park Order 2020 (as amended)

Appendix B

CORY

Compositional and Chemical Analysis of Waste Entering Riverside Resource Recovery Energy from Waste Facility

Report for Riverside Resource Recovery Ltd

Report by Alfred H Knight Energy Services Limited

ALFRED H KNIGHT

Title	Compositional and Chemical Analysis of Waste Entering Riverside Resource Recovery Energy from Waste Facility
Client	Riverside Resource Recovery Ltd
Client reference	Gordon Jack Process Engineer Riverside Resource Recovery Ltd
Project number	WRL/3690
Report number	WRL/3690.01
Revision	Final Report
Project team	Dan Robinson, Paul Hardman, Brian Oxley
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Report Issued	15/02/2021

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1. Introduction

Riverside Resource Recovery Ltd (RRRL) commissioned Alfred H Knight Energy Services (AHKES) to carry out compositional and chemical analysis to determine the calorific value and the percentage CV from the biomass fraction of the residual waste materials going to the RRRL EfW facility. The work has been carried out in accordance with guidance provided by Ofgem.

The report details the methodology used to determine representative samples and the procedures to collect and analyse the material. The report presents results for composition in weight percent (wt%) of each representative sample for each main waste stream and for the predicted combined input to RRRL, the qualifying percentage calorific value from the biomass fraction is also reported along with the calculation used.

The views and opinions expressed in this report are those of AHKES and have been drawn from experience working in the waste industry and undertaking waste composition analysis over a number of years.

AHKES would like to thank Cory Environmental for their assistance in providing tonnage data and assistance with sampling at RRRL, Smugglers Way, Cringle Dock, Walbrook Wharf and Northumberland Wharf.

2. Methodology

Sampling

The main inputs to the RRRL facility are residual household waste from the Boroughs within Western Riverside Waste Authority (WRWA), waste from Tower Hamlets, direct delivered household waste from Bexley and trade waste. WRWA is comprised of four local authorities, Hammersmith and Fulham (H&F), Kensington and Chelsea (K&C), Wandsworth and Lambeth. The waste from these authorities is delivered to the RRRL facility via the Smugglers Way and Cringle Dock transfer stations. Waste from the City of London is delivered via Walbrook Wharf transfer station and waste from the London Borough of Tower Hamlets is delivered via Northumberland Wharf transfer station. The waste streams accounting for the lowest proportions of input to RRRL (waste from the Corporation of London and various trade waste deliveries direct delivered to Belvedere) were not sampled as it was considered that the tonnages were so low there would be no significant impact on the overall result.

The WRWA transfer stations and Northumberland Wharf transfer station are operated by Cory Environmental Limited and use totally enclosed ISO type containers and barges to transport the waste on the river Thames. All containers loaded onto barges at these transfer stations are delivered to the RRRL facility, regardless of waste type.

The tonnage figures showing waste inputs to RRRL (provided by Cory Environmental) are presented in Table 2-1.

Table 2-1 2020 tonnage data used to determine the sampling plan for 2021

District / authority / other info		Delivered to:					Total t/yr
		Smugglers	Cringle	Walbrook	Northumberland	Belvedere	
WRWA	H&F	48,725	7,436				56,160
	K&C	44,925	13,707				58,632
	Lambeth	4,559	82,371				86,931
	Wandsworth	66,844	8,433				75,277
	WRWA	-	-				-
WCC							-
Trade		17,037	147,775	42,846	87,759	71,233	366,650
CoL/Tower Hamlets	Walbrook			8,987	65,397		74,384
Bexley						54,987	54,987
Total		182,090	259,722	51,833	153,156	126,220	**773,021**

In order to obtain composition data representative of the input to the RRRL facility, WRL developed a sampling matrix based on the modelled waste input tonnage to RRRL. WRL sampled at Smugglers Way on 7th January, both Walbrook Wharf and Belvedere on 12th January, Northumberland Wharf on 14th January, and Cringle Dock on 19st January 2021, as shown in Table 2-2.

Table 2-2 Sampling Matrix

bulk sample #	District / authority / other info		07/01/2021	19/01/2021	12/01/2021		14/01/2021	Number of sub samples
			Smugglers	Cringle	Walbrook	Belvedere	Northumberland	
1	WRWA	H&F	2	-	-	-	-	2
2		K&C	2	-	-	-	-	2
3		Wandsworth	3	-	-	-	-	3
4		Lambeth	-	3	-	-	-	3
5	Trade		-	6	2	3	4	15
6	Tower Hamlets						3	3
7	Bexley		-	-	-	2	-	2
	Number of sub samples		**7**	**9**	**2**	**5**	**7**	**30**
	Total / kg		**700**	**900**	**200**	**500**	**700**	3,000

To obtain representative samples at each of the waste facilities, Refuse Collection Vehicles (RCVs) delivering to the facilities were randomly selected; the drivers of the selected vehicles were instructed to discharge a proportion of the contents of their vehicle onto the floor of the reception hall rather than directly into the hopper/chute. A sample of approximately 100kg was extracted from the pile with the

remaining waste being transferred using a mechanical shovel into the hopper/chute. The extracted sample was then transferred from the loading shovel bucket into four large bulk sacks placed on the floor. Any spillage from around the bags was swept up and placed into the bags. By using this methodology a representative 100kg bulk sample consisting of four 25kg bulk sacks was taken from each vehicle selected. Individual 100kg samples obtained from each different borough/waste type were labelled and loaded into AHKES van for transport to AHKES's test centre in Rotherham where the compositional and chemical analysis was carried out.

Compositional Analysis

The individual 100kg samples were bulked together at the AHKES test centre to give seven composite samples representing each main borough/waste type. In order to determine composition, the composite bulk samples were manually sorted into the categories shown in the table 2.3. AHKES personnel transferred the sample in manageable batches onto the sorting table; the samples were sorted into the relevant material categories. The weight of material reporting to each category was manually recorded onto the analysis log sheet. Sorting was carried out on a screen table fitted with 10mm square apertures. Material passing through the screen deck was collected, weighed and entered on the analysis sheet as fines (<10mm). Following the compositional analysis representative samples of the 7 combustible fractions highlighted Table 2-3 below were analysed by AHKES's accredited laboratory to determine the calorific value of each combustible fraction. Using the compositional data derived from the hand sort analysis and the fuel properties determined from laboratory analysis the CV and the percentage CV by biomass was calculated. Following the analysis all residual waste was disposed of through licensed facilities.

Table 2-3 Material Sort Categories

No.	Material Category	
1	Paper/card #	
2	Plastic film #	
3	Dense plastic #	
4	Textiles #	
5	Miscellaneous comb.	Shoes #
		Nappies #
		Wood #
		MDF/chipboard/ composite/laminate wood #
		Carpet/underlay #
		Furniture #
		WEEE #
		Other misc comb. #
	Misc. non-comb	
	Glass	
6	Putrescibles #	
	Ferrous metal	
	Non-ferrous metal	
	Batteries	
	Herbicides and Pesticides	
	Clinical	
	Paint, varnish and oils	
	Potentially hazardous	
7	Fines #	

Chemical Analysis

Samples for chemical analysis are prepared and analysed in accordance with AHKES UKAS accredited methods. Each sample was first shredded in a slow speed shredder to obtain a particle size less than 60mm. The shredded sample was cone and quartered to extract a representative sub sample for drying. The sub sample was placed onto an oven tray the weight of the empty tray and the weight of the tray including the sample were recorded, the tray was then loaded into a calibrated oven. The sample was dried in the oven to determine the overall moisture content. The dried sample then undergoes several size reduction steps to reduce the particle size and overall volume of the sample. The preparation procedures produce a representative sub sample suitable for analysis by the laboratory instrumentation.

3. Results

Table 3-1 shows the composition in weight percent of each individual sample and the modelled input to RRRL. The modelled input shows the largest individual material category to be putrescibles at 26.87%, then paper & card at 26.03%, followed by miscellaneous combustibles at 12.87%.

Table 3-1 Composition in weight percent of each sample plus modelled input

Sample from:		H&F	K&C	Wandsworth	Lambeth	Tower Hamlets	Bexley	Trade	Modelled input to RRRL
Weight % split		6.84	6.30	9.38	11 55	9.17	7.71	49.04	100.00
Category		Weight %							
Paper/card #		21.87	13 95	20.40	11.83	24.37	13.48	34.87	26.03
Plastic film #		5.99	6 07	5.47	8.21	9.54	5.54	10.45	8.68
Dense plastic #		6.72	7 59	8.91	6.05	9.56	6.37	11.72	9.59
Textiles #		5.16	1.70	6.36	4.87	2.82	19.36	2.94	4.82
Miscellaneous comb.	Shoes #	1.14	0.41	0.68	0.91	0.44	3.21	0.41	0.76
	Nappies #	3.68	2 23	3.39	4.50	2.60	1.63	1.17	2.17
	Wood #	0.20	0 07	0.09	0.27	0.58	0.19	2.00	1.11
	MDF / chipboard / composite / laminate wood #	0.04	8 03	0.03	1.17	0.40	0.09	0.44	0.90
	Carpet/underlay #	0.00	0 00	0.74	1.52	3.43	0.54	0.98	1.08
	Furniture #	0.00	0 27	0.00	0.00	0.00	0.00	0.00	0.02
	WEEE	1.91	0 64	0.50	0.33	0.59	0.64	0.40	0.56
	Other misc comb. #	4.20	5.18	3.15	4.57	5.06	14.54	6.63	6.28
Misc. non-comb		0.13	0 00	0.19	0.37	1.19	0.16	3.19	1.76
Glass		10.66	6 83	9.82	2.61	6.99	2.27	1.98	4.17
Putrescibles #		32.71	41 92	35.64	48.29	26.83	25.83	17.58	26.87
Ferrous metal		2.21	1 69	1.06	1.40	2.42	1.99	1.50	1.63
Non-ferrous metal		1.15	2.79	1.50	1.32	1.66	2.13	1.56	1.63
Batteries		0.17	0 07	0.04	0.08	0.07	0.08	0.07	0.08
Herbicides and Pesticides		0.00	0 00	0.00	0.00	0.00	0.00	0.00	0.00
Clinical		0.00	0 00	0.31	0.07	0.00	0.20	0.18	0.14
Paint, varnish and oils		0.00	0 00	0.00	0.00	0.00	0.00	0.00	0.00
Potentially hazardous		0.06	0 00	0.00	0.00	0.00	0.00	0.00	0.00
Fines #		1.99	0 56	1.71	1.63	1.46	1.76	1.92	1.73
Total		100.00	100 00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3-2 shows the chemical analysis and fuel properties calculated for the modelled input material to RRRL. The results are calculated from the compositional analysis and the chemical data obtained from laboratory analysis of each main combustible material category. The results show the calculated net CV to be 10.98 MJ/kg, the moisture content to be 32.93% and the ash to be 16.25%.

Table 3-2 Chemical analysis including fuel properties of the modelled input

Sample Reference	Modelled RRRL Input waste 2021	
Analyte	**Units**	**Results**
Moisture	% Wt	32.93
Ash	% Wt	16.25
Gross CV	MJ/kg	12.57
Net CV	**MJ/kg**	**10.98**
Oxygen	% Wt	16.42
Carbon	% Wt	29.41
Hydrogen	% Wt	3.79
Nitrogen	% Wt	0.75
Sulphur	% Wt	0.08
Chlorine	% Wt	0.38

Using the compositional data derived from the hand sort analysis, the corresponding biodegradable factors and the CV data determined from laboratory analysis, the qualifying percentage of electricity generated from renewable sources can be calculated. Table 3-3 shows the calculated qualifying percentage of energy derived from biomass using the methodology described in Ofgem's guidance. The results show that 52.90% of the energy produced by the waste entering the RRRL facility is derived from biomass.

Table 3-3 Calculated qualifying percentage of energy derived from biomass

Primary Category	% by weight	Gross Calorific Value MJ/kg	Weighted CV	% by CV	Biodegradable Content	Qualifying %
Paper and card	26.03	12.38	3.22	25.63	1.0	25.63
Plastic film	8.68	21.68	1.88	14.97	0.0	0.00
Dense plastic	9.59	26.78	2.57	20.42	0.0	0.00
Textiles	4.82	17.52	0.84	6.71	0.5	3.35
Misc. combustible	12.87	15.29	1.97	15.65	0.5	7.83
Misc. non-combust ble	1.76	0	0.00	0.00	0.5	0.00
Glass	4.17	0	0.00	0.00	0.0	0.00
Putresc bles	26.87	7.28	1.96	15.57	1.0	15.57
Ferrous Metal	1.63	0	0.00	0.00	0.0	0.00
Non-ferrous metal	1.63	0	0.00	0.00	0.0	0.00
Batteries	0.08	0	0.00	0.00	0.0	0.00
Herbicides & pesticides	0.00	0	0.00	0.00	0.0	0.00
Clinical[1]	0.14	5	0.01	0.06	0.5	0.03
Paint, Varnish and oil[2]	0.00	43	0.00	0.00	0.0	0.00
Hazardous	0.00	0	0.00	0.00	0.0	0.00
Fines	1.73	7.20	0.12	0.99	0.5	0.49
Total	100.00		12.57	100.00		**52.90**

1, Clinical waste GCV from published data, Defra report “Biodegradability of municipal solid waste” June 2012. AHP GCV figure from report has been used as instructed by Ofgem and adjusted to as received from a dry basis GCV on a dry basis is 22.2 MJ/kg and dry matter content is 24.4%.

2, Paint, Varnish and oil GCV figure from published data, Non-fuel products (notional value) https://www.gov.uk/government/statistics/dukes-calorific-values