SUNSHINE YATES CONSULTING

Audit of Baled Mixed Fibre

Prepared for APCO, The Packaging Forum, and The NZ Food & Grocery Council

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1. INTRODUCTION

Sunshine Yates Consulting Limited (SYCL) was contracted by the Australian Packaging Covenant Organisation Ltd (APCO), the Packaging Forum NZ, and the NZ Food & Grocery Council to design and undertake an audit of baled mixed fibre from Materials Recovery Facilities (MRFs).

APCO, the Packaging Forum, and the NZ Food & Grocery Council requested that the audit include baled mixed fibre from several MRFs across New Zealand, to better understand levels of contamination within mixed fibre bales. APCO, the Packaging Forum, and the NZ Food & Grocery Council are particularly interested in determining the proportion of contamination due to plastic lined fibre. It is the first time, to their knowledge, that such an audit has been undertaken in New Zealand.

Between 13 February and 29 February 2024, SYCL undertook an audit of a sample of material from eight bales of mixed fibre from four MRFs located across New Zealand.

This report outlines the methodology used to audit the bales, as well as the results of the audits. Results are provided as an overall composition, based on the average results of the audit of the material from the eight bales, as well as separately for each of the MRFs (average of material audited from two bales each), and for each individual bale.

An overview of the proportion and types of contamination is also provided as well as an overview of the average number of complex fibre items found per kg of baled material.

2. METHODOLOGY

This methodology was designed to audit bales of mixed fibre to determine the proportion of contamination per bale – both composite fibre contamination and contamination consisting of other non-fibre materials.

2.1 Definition of contamination

For the purposes of this research, contamination has been defined as materials that are:

- Not fibre
- Items made from fibre and another material (e.g. an envelope or a tissue box with a plastic window, a laminated page of paper)
- Items made from fibre mixed with other materials (e.g. plastic lined fibre, liquid paper board).

2.2 Sampling strategy

A selection of five large MRFs around New Zealand were selected for the audit. The audit did not attempt to sample from all types of MRFs (e.g. automated versus manual), but instead targeted MRFs with larger output.

APCO, The Packaging Forum, and the NZ Food & Grocery Council selected the MRFs to include in the research. Unfortunately, due to a delay in transportation, no bales arrived at site on the first scheduled day of the audit. Therefore, bales from only four MRFs were able to be included.

Each MRF was asked to randomly select two bales from their stockpile of mixed fibre bales, and APCO organised to have them freighted to the audit site.

2.3 Audit methodology

The audit took place over four days between 13 February and 26 February 2024. Each day two bales from a specific MRF were audited.

Four auditors (including a supervisor) undertook the auditing. Each bale was weighed individually, and the weight recorded.

The bale was then transported to the audit area where spray paint was used to mark the centre and the quarters of the bale, as in the following photo.

Bale with quarter markings

Once these markings had been made, the bale ties were removed.

Auditing was undertaken from both ends of the bale. For each bale, the team attempted to audit up to the painted 'quarter' line. However, as two bales were to be audited per day, the team could only sort each bale for approximately 3.5 hours. It was not always possible for the audit team to reach the painted quarter line within that timeframe. Photos of the bales before and after auditing are provided in Appendix A.

A team of two auditors peeled materials off each end of the bale and sorted these materials into the categories outlined in Table 2.1 on the following page. These categories were drafted in liaison with the client before the project commenced. On the first day of the audit a representative from Stratex (a leading supplier of paper based flexible packaging material) attended the audit to assist with identifying the materials that belonged in each fibre category, particularly the complex fibre packaging materials. A couple of small changes were made to the categories at this stage to reflect the material types in the bales.

Auditors at each end of bale

Each material type was placed in an appropriately labelled bin or bucket. Once approximately half of a bale had been sorted, or the allocated time had been spent auditing that bale, the bins of materials were weighed out and the weights recorded. The materials were then disposed of (fibre to recycling and other materials to landfill), and the next bale was moved to the audit area. All weighing was undertaken with portable industrial electronic scales.

Table 2.1 – Audit classifications

Audit categories			Examples of items
NON-PACKAGING	Fibre only	Fibre only	Newspapers, pamphlets, magazines, shop catalogues, envelopes without windows, letters, printouts, brochures, notebooks, fibre wrapping paper etc
	Non-recyclable fibre	Fibre multimaterial	Envelopes with windows, kids' books with pop-outs etc.
		Grease proof paper	Butter wrapper etc.
PACKAGING	Fibre only	Corrugated cardboard	Corrugated cardboard packaging (including stickers and tape)
		Paperboard	Cereal boxes, beer boxes, toilet roll cores etc
		Other fibre	Paper bags etc
	Complex fibre	Corrugated cardboard multimaterial	Corrugated cardboard with lining, e.g. chill-tainer box
		Fibre with plastic	Plastic lined paper packaging, paper bags with plastic handles, boxes with plastic windows
		Fibre with other material (except plastic)	Paper shopping bags with rope or fabric handles etc
		Composite material	Pringle boxes etc
		Paper cups	Fast food and drink packaging with food contact, including paper cups
		Liquid paperboard – F&B cartons	Beverage cartons, milk and juice cartons, including Tetra Pak
		Liquid paperboard – other	Ice cream cups, instant noodle tubs etc
ALL OTHER MATERIALS	Other materials	Sanitary paper	Paper towels, tissues, sanitary items, nappies etc
		Plastic	All items made predominantly from plastic
		Aluminium	All items made predominantly from aluminium
		Steel	All items made predominantly from steel
		Glass	All items made predominantly from glass
		Fabric	All items made predominantly from fabric
		Organics	All organic waste (i.e. food and garden waste)
		All other materials	Any materials not included above

3. RESULTS

The results of the audit of the eight bales of mixed fibre are presented in this section. The results are presented combined, as an 'average' bale; by MRF (the results of the two bales combined); and by individual bale. The individual MRF are not identified within the results, as the aim of the report is not to compare the quality of bales between the four MRF, but instead it is to determine the average amount of complex fibre and other contamination in a bale of mixed fibre, and how much this is likely to vary.

3.1 Weight of bales

The average weights of each bale, before auditing, are listed in Table 3.1.

Table 3.1 – Weight of audited bales

Bales	Weight (kg)
MRF A – bale 1	1,080 kg
MRF A – bale 2	980 kg
MRF B – bale 1	1,020 kg
MRF B – bale 2	790 kg
MRF C – bale 1	980 kg
MRF C – bale 2	960 kg
MRF D – bale 1	570 kg
MRF D – bale 2	560 kg

Bale weights vary within each MRF and between MRFs, with the heaviest bale weighing 1,080 kg and the lightest 560 kg.

3.2 Composition of average mixed fibre bale

Based on the results of the audit of a sample of materials from eight bales provided by four different MRFs, an 'average' mixed fibre bale composition is presented in Table 3.2. As this composition is based on a relatively small sample of bales from a limited number of MRFs, it should not be considered representative of bales of mixed fibre from across New Zealand. It does however, provide a snap shot of Mixed Fibre bale content.

A total of 2,077 kg of material was sorted during the audit.

The weight of materials per average bale is also provided in Table 3.2, based on an average bale weight of 868 kg. This is the average weight of the eight bales included in the audit.

Table 3.2 – Composition of average mixed fibre bale, by weight and %

Composition of materials in average mixed fibre bale			Average bale (kg)	% of weight
NON-PACKAGING	Fibre only	Fibre only **Subtotal**	**454.64 kg**	**52.4%**
	Non-recyclable fibre	Fibre multimaterial	10.90 kg	1.3%
		Grease proof paper	0.30 kg	0.0%
		Subtotal	**11.21 kg**	**1.3%**
PACKAGING	Fibre only	Corrugated card	147.10 kg	17.0%
		Paperboard	168.22 kg	19.4%
		Other fibre	31.79 kg	3.7%
		Subtotal	**347.11 kg**	**40.0%**
	Complex fibre	Card multimaterial	0.00 kg	0.0%
		Fibre with plastic	12.12 kg	1.4%
		Fibre with other material	3.19 kg	0.4%
		Composite packaging	0.66 kg	0.1%
		Paper cups	1.85 kg	0.2%
		LPB – F&B cartons	3.68 kg	0.4%
		LPB – other	2.56 kg	0.3%
		Subtotal	**24.07 kg**	**2.8%**
ALL OTHER MATERIALS	Other materials	Sanitary paper	1.88 kg	0.2%
		Plastic	19.90 kg	2.3%
		Aluminium	1.85 kg	0.2%
		Steel	1.12 kg	0.1%
		Glass	1.95 kg	0.2%
		Fabric	1.96 kg	0.2%
		Organics	0.73 kg	0.1%
		All other materials	1.09 kg	0.1%
		Subtotal	**30.47 kg**	**3.5%**
		TOTAL	**867.50 kg**	**100.0%**

Figure 3.1, on the following page, provides an overview of the proportion, by weight, of each of the five secondary categories, in an average bale of mixed fibre.

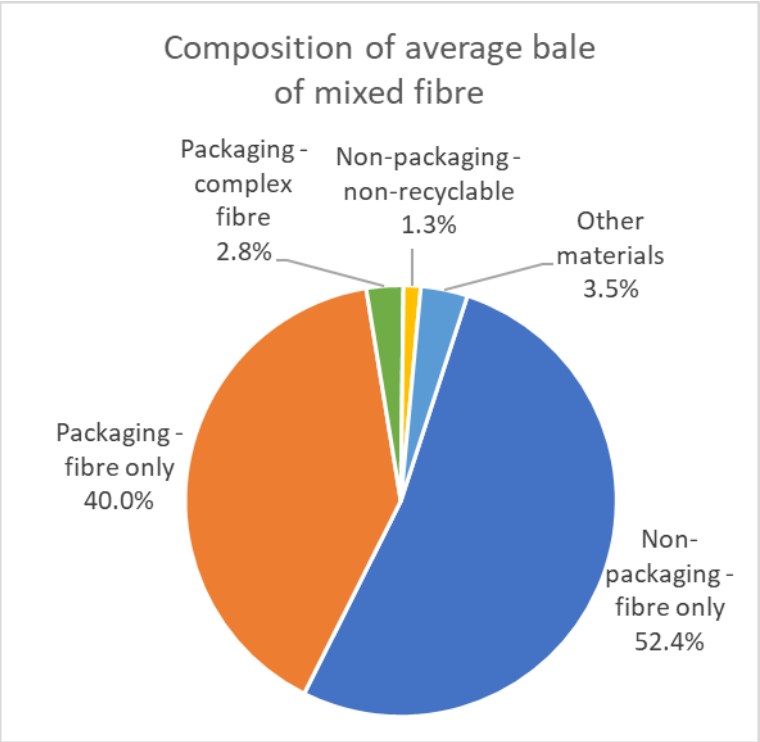


Figure 3.1 – Composition of average bale of mixed fibre

3.3 Composition of mixed fibre bales, by MRF

The following Table 3.3 provides the composition of materials in mixed fibre bale by MRF. The results of the audit of both bales audited from each MRF have been averaged to provide the composition by MRF.

The composition of each individual audited bale of mixed fibre is provided in Appendix C.

Table 3.3 - Composition of bales of mixed fibre, % of total weight, by MRF

Classifications of materials in mixed fibre bales, per MRF			MRF A	MRF B	MRF C	MRF D
NON-PACKAGING	Fibre only	Fibre only **Subtotal**	**37.0%**	**61.4%**	**51.9%**	**55.2%**
	Non-recyclable fibre	Fibre multimaterial	0.4%	3.0%	0.2%	1.2%
		Grease proof paper	0.0%	0.1%	0.0%	0.0%
		Subtotal	**0.5%**	**3.1%**	**0.3%**	**1.2%**
PACKAGING	Fibre only	Corrugated card	22.8%	8.6%	19.8%	17.8%
		Paperboard	21.1%	15.9%	20.9%	19.9%
		Other fibre	4.6%	3.9%	4.3%	2.3%
		Subtotal	**48.5%**	**28.5%**	**44.9%**	**39.9%**
	Complex fibre	Card multimaterial	0.0%	0.0%	0.0%	0.0%
		Fibre w plastic	1.7%	1.0%	1.1%	1.8%
		Fibre w other material	0.6%	0.4%	0.3%	0.3%
		Composite packaging	0.1%	0.2%	0.0%	0.0%
		Paper cups	0.3%	0.2%	0.2%	0.2%
		LPB – F&B cartons	0.5%	0.9%	0.0%	0.3%
		LPB – other	0.5%	0.4%	0.3%	0.0%
		Subtotal	**3.7%**	**3.0%**	**1.9%**	**2.8%**
ALL OTHER MATERIALS	Other materials	Sanitary paper	0.5%	0.3%	0.0%	0.1%
		Plastic	6.9%	2.7%	0.6%	0.5%
		Aluminium	0.2%	0.5%	0.0%	0.1%
		Steel	0.2%	0.2%	0.0%	0.1%
		Glass	1.0%	0.0%	0.1%	0.0%
		Fabric	0.8%	0.2%	0.1%	0.0%
		Organics	0.3%	0.1%	0.0%	0.0%
		All other materials	0.4%	0.1%	0.0%	0.1%
		Subtotal	**10.4%**	**4.0%**	**0.9%**	**1.0%**
TOTAL			**100.0%**	**100.0%**	**100.0%**	**100.0%**

The composition of the bales provided by each MRF vary considerably. 'Non-packaging - Fibre only' varied from 37.0% of material in MRF A to 61.4% of material in MRF B. 'Packaging - Fibre only - Corrugated cardboard' varied from 22.8% of material in MRF A to 8.6% of material in MRF B.

The amount of 'All other materials' varied widely, with the bales from MRF A containing 10.4% 'All other materials', while the bales from MRF c contained 0.9% 'All other materials'.

The proportion of 'Packaging Complex fibres' was less variable, with a high of 3.7% in MRF A and a low of 1.9% in MRF C.

3.4 Contamination in bales of mixed fibre

There were many types of contamination (as defined in Section 2.1) found in the bales of mixed fibre. Table 3.4 provides an outline of the different types of contamination in the average bale.

Table 3.4 – Types of contamination in average bale of mixed fibre

Contamination in average mixed fibre bale	Average bale (kg)	% of weight
Non-packaging - multimaterial		
Fibre multimaterial	10.90 kg	1.3%
Grease proof paper	0.30 kg	0.0%
Subtotal	**11.21 kg**	**1.3%**
Packaging – complex fibres		
Cardboard multimaterial	0.00 kg	0.0%
Fibre with plastic	12.12 kg	1.4%
Fibre with other material	3.19 kg	0.4%
Composite packaging	0.66 kg	0.1%
Paper cups	1.85 kg	0.2%
LPB – F&B cartons	3.68 kg	0.4%
LPB – other	2.56 kg	0.3%
Subtotal	**24.07 kg**	**2.8%**
Other materials		
Sanitary paper	1.88 kg	0.2%
Plastic	19.90 kg	2.3%
Aluminium	1.85 kg	0.2%
Steel	1.12 kg	0.1%
Glass	1.95 kg	0.2%
Fabric	1.96 kg	0.2%
Organics	0.73 kg	0.1%
All other materials	1.09 kg	0.1%
Subtotal	**30.47 kg**	**3.5%**
TOTAL - all contamination	**65.75 kg**	**7.6%**
TOTAL - all acceptable fibre	**801.75 kg**	**92.4%**

Based on the composition of the average bale of fibre (the average of the material from the eight bales audited), 7.6% of materials were contamination. The largest proportion of the contamination was 'Other materials' (3.5%), while 'Packaging – complex fibres' comprised a further 2.8% of the bale, and 'Non-packaging – multimaterial' made up a further 1.3% of the bale.

3.5 Fibre only, multimaterial fibre, and contamination

Table 3.5 provides an overview of the material in the bales of mixed fibre that are fibre only, multimaterial fibre, and other (non-fibre) contamination.

Table 3.5 – Overview of fibre only, multimaterial fibre, and contamination, in mixed fibre bales

Fibre only, multimaterial fibre and contamination in mixed fibre bales, per MRF		MRF A	MRF B	MRF C	MRF D	Combined
Fibre only	Non-packaging	37.0%	61.4%	51.9%	55.2%	52.4%
	Packaging	48.5%	28.5%	44.9%	39.9%	40.0%
	Subtotal	**85.5%**	**89.9%**	**96.8%**	**95.1%**	**92.4%**
Multimaterial fibres	Fibre multimaterial	0.5%	3.1%	0.2%	1.2%	1.3%
	Complex fibre	3.7%	3.0%	1.9%	2.8%	2.8%
	Subtotal	**4.2%**	**6.1%**	**2.1%**	**4.0%**	**4.1%**
Contamination (other materials)		10.4%	4.0%	0.9%	1.0%	3.5%
TOTAL		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

The largest variability across the four MRFs is in the proportion of contamination, which varies from 0.9% to 10.4%. Multimaterial fibres vary from 2.1% to 6.1% of material.

The weight of the Multimaterial fibres includes both the fibre and the other materials (e.g. plastic lining).

3.6 Complex fibre - numbers

The client requested that the number of items of 'Packaging - complex fibre' sorted from each bale be counted. The results of this exercise are outlined in Table 3.6, by MRF and as an average of all material sorted. The data is presented as the average number of items of 'Packaging - complex fibre' per kg of material.

Table 3.6 - Average number of items of 'Packaging - complex fibre' per kg of material

Average number of items of 'Packaging - complex fibre' per kg	MRF A # / kg	MRF B # / kg	MRF C # / kg	MRF D # / kg	Average - all bales combined # / kg	Average - all bales combined # per bale
Cardboard multimaterial	0.00	0.00	0.00	0.00	**0.00**	**0**
Fibre with plastic	0.35	0.30	0.29	0.32	**0.31**	**270**
Fibre with other material	0.08	0.04	0.07	0.05	**0.06**	**53**
Composite packaging	0.01	0.01	0.00	0.01	**0.01**	**5**
Paper cups	0.24	0.10	0.14	0.17	**0.16**	**141**
LPB – F&B cartons	0.01	0.07	0.00	0.11	**0.05**	**40**
LPB – other	0.02	0.01	0.00	0.02	**0.01**	**11**
TOTAL	-	-	-	-	**-**	**520**

Based on the results of the audit, the average bale, (weighing 867.5 kg), contained 520 pieces of 'Packaging - complex fibre', weighing a total of 24.07kg. The average piece of complex fibre therefore weighs 46 grams.

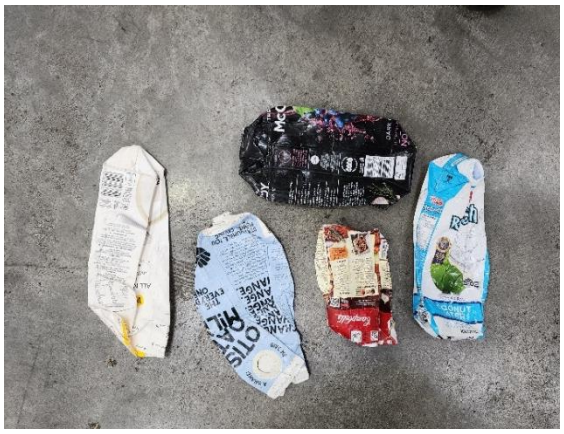
Examples of contamination are included in the photos in Appendix B. Below are detailed photos of some of the 'Packaging - complex fibre'.

Examples of fibre with plastic

Examples of fibre with other material

Examples of composite fibre

Examples of paper cups



Examples of liquid paper board – F&B cartons

Examples of liquid paper board – other

4. DISCUSSION

The research undertaken as part of this project has shown that the amount of contamination varies between bales, and even more so between MRFs. Of the 2,077 kg of materials audited, 2.8% was 'Packaging - complex fibre'. The bales from the MRF with the highest proportion of 'Packaging - complex fibre' had approximately twice as much 'Packaging - complex fibre' as the bales from the MRF with the lowest proportion (3.7% at MRF A and 1.9% at MRF C).

A further 3.5% of all material audited was 'Other materials'. The amount of 'Other materials' present in a bale varied considerably between MRF, with the bales from MRF A containing almost 12 times as much 'Other materials' than MRF C (10.4% to 0.9%).

All results in this report are based on the auditing of a small sample of material from a limited number of MRFs. As such, these results should be seen as indicative only, and not necessarily representative of mixed fibre bales in New Zealand.

APPENDIX A – PHOTOS OF BALES

Bale before audit

MRF A – bale 1 – 13 February

Bale after audit

MRF A – bale 1 – 13 February

MRF A – bale 2 – 13 February

MRF A – bale 2 – 13 February

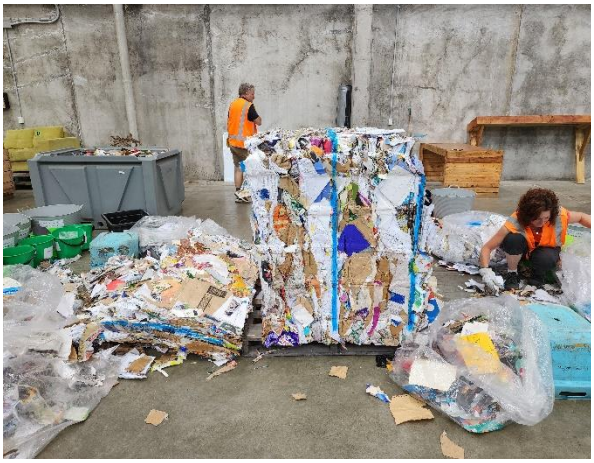
MRF B – bale 1 – 14 February

MRF B – bale 1 – 14 February

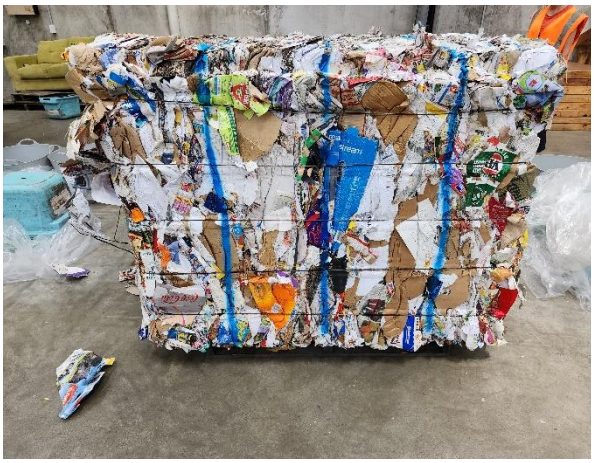
MRF B – bale 2 - 14 February

MRF B – bale 2 – 14 February

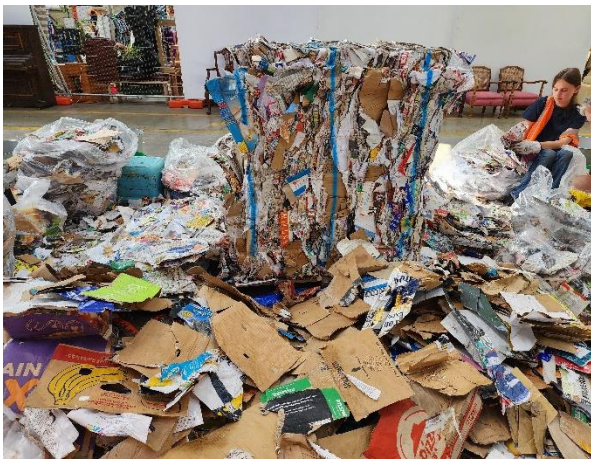
MRF C – bale 1 – 19 February



MRF C – bale 1 – 19 February



MRF C – bale 2 – 19 February



MRF C – bale 2 – 19 February

MRF D – bale 1 – 26 February

MRF D – bale 1 – 26 February

MRF D – bale 2 – 26 February

MRF D – bale 2 – 26 February

APPENDIX B – PHOTOS OF MATERIALS

NON-PACKAGING

Fibre only

Non-recyclable fibre – Fibre multimaterial

PACKAGING

Fibre only – Corrugated cardboard

Fibre only - Paperboard

Fibre only - Other fibre

Complex fibre – Plastic with fibre

Complex fibre – Fibre with other material

Complex fibre - Composite material

Complex fibre - Paper cups

Complex fibre – LPB – F&B cartons

Complex fibre – LPB - other

ALL OTHER MATERIALS

Sanitary paper

Plastic

Aluminium

Steel

Glass

Fabric

APPENDIX C – COMPOSITION OF INDIVIDUAL MIXED FIBRE BALES

Composition of bales of mixed fibre, by % of total weight

Composition of materials in mixed fibre bales			MRF A Bale 1	MRF A Bale 2	MRF B Bale 1	MRF B Bale 2	MRF C Bale 1	MRF C Bale 2	MRF D Bale 1	MRF D Bale 2
NON-PACKAGING	**Fibre only**	Fibre only **Subtotal**	**39.0%**	**35.0%**	**62.0%**	**60.8%**	**50.7%**	**53.5%**	**53.8%**	**56.2%**
	Non-recyclable fibre	Fibre multimaterial	0.8%	0.1%	2.0%	4.0%	0.3%	0.2%	1.5%	1.0%
		Grease proof paper	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
		Subtotal	**0.8%**	**0.2%**	**2.0%**	**4.0%**	**0.3%**	**0.2%**	**1.5%**	**1.0%**
PACKAGING	**Fibre only**	Corrugated cardboard	21.2%	24.2%	8.0%	9.1%	17.7%	22.4%	20.9%	15.3%
		Paperboard	21.1%	21.1%	16.5%	15.4%	24.0%	16.9%	17.7%	21.6%
		Other fibre	4.1%	5.0%	4.3%	3.6%	4.3%	4.3%	2.1%	2.4%
		Subtotal	**46.5%**	**50.4%**	**28.9%**	**28.1%**	**46.0%**	**43.6%**	**40.7%**	**39.3%**
	Complex fibre	Cardboard multimaterial	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Fibre with plastic	1.6%	1.8%	1.0%	1.1%	1.0%	1.2%	1.5%	2.1%
		Fibre with other material	0.7%	0.4%	0.5%	0.3%	0.3%	0.3%	0.4%	0.2%
		Composite packaging	0.1%	0.1%	0.2%	0.2%	0.0%	0.1%	0.1%	0.0%
		Paper cups	0.3%	0.3%	0.1%	0.2%	0.2%	0.1%	0.3%	0.2%
		LPB – F&B cartons	1.0%	0.0%	1.0%	0.9%	0.0%	0.0%	0.6%	0.1%
		LPB – other	0.5%	0.5%	0.4%	0.4%	0.3%	0.4%	0.0%	0.0%
		Subtotal	**4.2%**	**3.1%**	**3.1%**	**3.0%**	**1.9%**	**2.0%**	**2.8%**	**2.7%**
ALL OTHER MATERIALS	**Other materials**	Sanitary paper	0.6%	0.4%	0.3%	0.2%	0.1%	0.0%	0.1%	0.1%
		Plastic	6.3%	7.5%	2.5%	2.8%	0.7%	0.4%	0.5%	0.5%
		Aluminium	0.2%	0.2%	0.5%	0.5%	0.0%	0.0%	0.1%	0.1%
		Steel	0.3%	0.2%	0.2%	0.2%	0.0%	0.0%	0.2%	0.0%
		Glass	1.0%	1.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
		Fabric	0.5%	1.1%	0.2%	0.1%	0.2%	0.0%	0.0%	0.0%
		Organics	0.3%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
		All other materials	0.2%	0.6%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
		Subtotal	**9.5%**	**11.3%**	**4.1%**	**4.0%**	**1.2%**	**0.6%**	**1.1%**	**0.8%**
TOTAL			**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**