PULP AND PAPER SECTOR WASTE MINIMISATION – CLOSING THE LOOP

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Introduction

The Pulp and Paper Mill Solid Waste Initiative\(^2\) (the project) aimed to explore the waste minimisation opportunities in the NZ pulp and paper sector (the Sector) using a techno-economic risk assessment approach. There has previously been no Sector wide study of the solid waste stream which meant several unique challenges needed to be overcome at each stage of the project. At the conclusion of the project a Sector solid waste strategy was formed and agreed on by the Pulp and Paper Sector group, which includes representatives from pulp mill sites across NZ.

The objective of this paper is to outline the process and framework adopted for the project in order for the reader to:

- gain an insight into the process used for solving a national-scale issue created by solid waste from industrial sites (and understand its relevance for other sectors); and
- understand the key waste streams and waste minimisation opportunities from the NZ Pulp and Paper Sector.

Background

The Pulp and Paper industry in New Zealand produces a range of wood-fibre based products for use within NZ and for export markets. Collectively the industry produced approximately 2.36 million air dry tonnes (adt) of pulp, paper and paperboard product in 2012. This study collated solid waste data from the majority of pulp mills sites in NZ, namely Carter Holt

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Harvey Penrose, Carter Holt Harvey Kinleith, Carter Holt Harvey Tasman, Norske Skog Tasman\(^3\), Pan Pac Forest Products Limited, and WPI International.

With the exception of CHH Penrose each mill has its own consented landfill for the disposal of waste and whilst each has considered, to varying degrees of detail, waste management options there has been no Sector wide study conducted. A project team from Sinclair Knight Merz (SKM) and Scion gained funding from the Waste Minimisation Fund (WMF) with co-funding from industry in order to undertake a review and analysis of solid waste management and minimisation opportunities across the Pulp and Paper Sector. A number of unique challenges needed to be overcome in order to complete this project. These were:

a) No Sector level solid waste data was available (although production data is available)

b) No Sector level consideration of waste minimisation for pulp and paper solid waste had been undertaken in NZ

c) No framework existed for the evaluation of waste minimisation options

d) No Sector wide agreement on waste minimisation was in place

1.0 Methodology

The project was designed in sequential stages in order that each stage builds on and uses information gained from the previous stage. Table 1 provides an overview of the process. Each stage is described in this section.

Table 1: Overview of project methodology

<table>
<thead>
<tr>
<th>Step</th>
<th>Key Tasks</th>
</tr>
</thead>
</table>
| 1. Waste Data Collation | - Design data collection framework  
- Collate and analyse data |
| 2. Identify Management Options | - Undertake international review and assess for relevance to NZ  
- Research and document current practices in NZ |

\(^3\) Norske Skog Tasman is part of a joint venture with CHH Tasman which manages solid wastes from the Kawarau site. Norske Skog Tasman has not been directly involved with project but has allowed access to their waste data.
### Step Key Tasks

<table>
<thead>
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| 3. Evaluate Options     | - Design evaluation criteria  
                          |   - Score potential waste management options against criteria             |
| 4. Develop Waste Strategy | - Identify long, medium and short term actions to be undertaken as a sector  
                          |   - Gather industry agreement  
                          |   - Identify potential collaboration partners                              |

#### 1.1 Waste Data Collation

There are two types of pulp mills in NZ that represent the different pulping processes. These are kraft mills and mechanical mills. There are also mills that produce tissue or paperboard products from pulp but do not produce pulp. All of the NZ mills have different organisation boundaries and modes of operation. In order to ensure a consistency of data collation from each mill – five solid waste categories were developed.

Waste data was collated from solid waste streams arising from Mill operations and did not include processes that typically take place outside of Mills such as the logging of forests or the disposal of product used by consumers. The typical waste streams included are shown in Figure 1 and Table 2.

![Figure 1: Waste Streams from the Pulp and Paper Sector](image)

**Table 2: Waste Stream Descriptions**
<table>
<thead>
<tr>
<th>Waste Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood yard debris</td>
<td>Material from wood storage and processing yard unusable for pulp production e.g. yard scrapings, barker and chipper waste.</td>
</tr>
<tr>
<td>Boiler and furnace ash</td>
<td>Bottom and fly ash from the on-site power boiler. Wide range of composition (see Table 5) depending on fuel (wood waste, coal) and boiler operation.</td>
</tr>
<tr>
<td>Pulping and papermill rejects</td>
<td>Rejects from the pulping process e.g. knots, over size chips, clay/fillers and out of spec product.</td>
</tr>
<tr>
<td>Causticizing residuals</td>
<td>Residuals from treatment/recirculation of causticizing chemicals – this includes lime mud, lime, slaker grits and green liquor dregs.</td>
</tr>
<tr>
<td>Wastewater treatment plant (WWTP) residuals</td>
<td>Primary and secondary sludge from wastewater treatment processes. Primary sludge is predominantly fibre and gross contaminants (e.g. ash, grits, dregs, and lime mud) and settled prior to biological treatment. Secondary sludge is a mix of fibre and biomass generated during the treatment process.</td>
</tr>
</tbody>
</table>

The use of this data collection framework has meant that data from each mill can be compared with others and some confidence can be given to the Sector level summary which is used to identify key waste streams.

The data collation process found that the biggest source of waste generated is WWTP residuals (36%) followed by Wood yard debris (29%) however alternatives to landfill are being utilised at some sites for most waste categories except for Boiler ash and causticizing residuals. This is shown further in Table 3 and Figure 2.

Table 3: Waste categorisation by Category (rounded)

<table>
<thead>
<tr>
<th>Estimated Totals (wet tonnes per annum^4)</th>
<th>Boiler ash</th>
<th>Wood yard debris</th>
<th>Causticizing residuals</th>
<th>Pulping rejects</th>
<th>WWTP residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>56,000</td>
<td>119,000</td>
<td>31,000</td>
<td>55,000</td>
<td>148,000</td>
<td></td>
</tr>
<tr>
<td>14%</td>
<td>29%</td>
<td>8%</td>
<td>13%</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>0.02</td>
<td>100</td>
<td>38</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>55,600</td>
<td>20</td>
<td>31,000</td>
<td>20,900</td>
<td>41,500</td>
<td></td>
</tr>
<tr>
<td>37%</td>
<td>&lt;1%</td>
<td>21%</td>
<td>14%</td>
<td>28%</td>
<td></td>
</tr>
</tbody>
</table>

^4 Wet tonnes was used as this is a common measurement for the disposal of waste at mill sites
As a result of alternatives to landfilling being utilised, the largest proportions of waste being sent to landfill are Boiler Ash (37%) and WWTP residuals (28%). A comparison of waste generation versus waste placed in landfill is shown in Figure 3.

**Outcome**

The process used has given confidence to a Sector level aggregation of the data. It is repeatable year on year across the Sector and still allows a level of confidentiality between each mill. The data gathered has allowed specific waste streams to be identified for initial waste minimisation efforts.

1.2 Identify management options

Globally there are practices and technologies in place to minimise the quantities of Pulp and Paper Sector solid waste to landfill. These differ according to the scale of mill operation, surrounding land and industry, local regulations and resources available. Overseas examples could be introduced into NZ but need to be tested against local operational and regulatory requirements as they may not suit the NZ context.
A review of overseas practices and technologies was undertaken before identifying those that may be applicable to NZ. Summary sheets were produced on these practices that described their operation; waste materials relevant; examples of use in NZ (if any); infrastructure and waste requirements; capital and operating cost; end product produced; operating capacity; potential consenting issues; and the technology, commercial and market risks associated with the practice in NZ.

**Outcome**

The initial identification of waste minimisation practices and technologies in use overseas and a consideration of their applicability to the NZ Sector has resulted in a good understanding of what options are worth further consideration for the Sector.

**1.3 Evaluate Options**

A risk assessment of the identified waste minimisation options was undertaken. In order to complete this consistently a techno-economic framework was developed. This allowed each option to be scored against set evaluation criteria with a score of 1 equalling a high risk and 3 a low risk. The categories used were:

**Risk – Technology**

A qualitative assessment of the likelihood of failure of the option or scenario due to issues related to the technological solution e.g. equipment failure, unable to achieve output standards.

**Risk – Commercial**

A qualitative assessment of the likelihood of failure of the option or scenario due to issues related to the commercial arrangements e.g. supplier unable to maintain operations, increase in cost of process, transport or on-going site management exceed those able to be reasonable recovered or those for comparable options.

**Risk – Market**

A qualitative assessment of the likelihood of failure of the option or scenario due to issues related to the ‘market’ for the product e.g. a use for the product cannot be found due to concerns about trace contaminants.
**Risk - RMA/Environmental**

A qualitative assessment of the likelihood of failure of the option or scenario due to issues related to the RMA (consent and compliance) or environmental issues e.g. unacceptable odour from processing, failure to gain consent to apply product to land.

The framework was overlaid on the key waste streams in order to identify which options were the most attractive for each waste stream. Figure 4 provides an example of one of the outputs (risk is labelled as ‘feasibility’ on the y axis). This demonstrates the most attractive option and the factors that have made up the score. For each Mill the high level costs for each option were also calculated. This allowed to the cost effectiveness of the options to be used as part of the overall evaluation process.

![Feasibility graph](image)

**Figure 4: Summary of Option techno-economic risk assessment**

**Outcome**

This allowed the Sector to understand the risk profile of each option and therefore what waste management options carried the least/most risk. This has helped to direct the near term resources into appropriate practices whilst the high risk practices can be further analysed to understand how the risk may be reduced to a level where it is also a viable option.
1.4 Pulp and Paper Sector Solid Waste Strategy

In order to capitalise on the information gained, and the momentum underway from the project, a Solid Waste Strategy for the Sector was developed. The vision (long term), objectives (medium term) and actions (short term) set out in the strategy were formed on some underlying principles/philosophy that became apparent from the project. Namely that

- The beneficial (diversion from landfill) management of the waste may depend more on the use of the material (market demand) rather than the availability (market supply);
- The focus of the Sector must be on collaboration with other industry groups to create a sustainable market rather than focusing on a particular technology solution;
- The initial waste streams common to all mills were WWTP sludge and Wood Ash.

The Vision contained in the Strategy is

*The Pulp and Paper Sector will maximise resource efficiency and explore opportunities to divert waste material generated by its own and other industry activities.*

The vision recognises that the Sector needs to take a resource efficiency approach to its operations and waste management. This will enable the Sector to both reduce the amount of waste generated whilst becoming more productive with the resources it does use. This will result in economic, social and environmental benefits.

The vision also recognises that the Sector must take responsibility for the wastes it does generate to ensure that they do not cause harm (to human health, the environment or the economy) throughout its life cycle. This is applicable regardless of who manages the waste.

In addition the vision recognises that the Sector is able to help other industries with waste minimisation activities such as the recycling of domestic waste paper, forestry residuals etc. On-going efforts can be made to enhance these practices.

There are three objectives which reflect the medium term focus of the Sector. These are

*Objective 1: Identify Beneficial Uses for Wood Ash*
To reduce the amount of ash disposed of to landfill and to maximise the useful life of existing disposal facilities by seeking/developing beneficial use options for wood ash.

**Objective 2: Optimise Sludge Treatment Options**

To reduce the amount of sludge disposed of to landfill and to maximise the efficiency of processes where sludge is not landfilled such as combustion and vermi-composting.

**Objective 3: Enable Business Opportunities**

To enable business to identify uses for the waste material and gain economic benefit whilst still applying effective stewardship principles.

There are actions against each of the objectives that help set out the short term initiatives that will be undertaken to give effect to the objectives. These will be revisited in one year and updated as necessary.

**Outcome**

The waste strategy provides a common document for the continued management efforts made at each mill and also provides a catalyst for the Sector to work together in a coordinated manner on wastes of common concern.

**2.0 Conclusion**

This project has found that across the Pulp and Paper Sector in NZ there are waste streams that could be more effectively managed from a Sector wide focus. The newly formed Pulp and Paper Sector Waste Strategy is the first step to addressing these through Sector collaboration on waste matters.

The strategy could not have been developed without a robust process of understanding waste at a sector level, identifying potential technology solutions and evaluating sector level opportunities. This process of effective participation of organisations from across the sector means that the strategy lays the groundwork for practical collaboration actions.

The process for identifying and evaluating opportunities for action is transferable to other sectors. Effective collaboration means more can be achieved at a sector level then with organisations taking action individually.