CHARACTERISTICS OF POST-CONSUMER WOOD PACKAGING INCLUDING XRF ANALYSIS FOR TIMBER PRESERVATIVES

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EXECUTIVE SUMMARY

It is estimated that 290,000 tonnes of post-consumer timber packaging is disposed of to landfill around Australia each year. In the first half of 2008, a study was conducted on post-consumer wood packaging at nine facilities in New South Wales, Queensland and Western Australia with substantial volumes of post-consumer timber packaging. These three states were targeted as they currently have the lowest recovery rates for post-consumer wood in Australia.

Over 6,600 cubic metres of wood packaging stockpiled for recycling, generation of renewable energy or disposal was representatively sampled. 342 representative samples were analysed with a handheld X-ray fluorescence analyser for the presence of 14 different elements including copper, chromium, arsenic and lead.

It was found that 99 percent of wood packaging did not contain high levels of copper, chromium or arsenic consistent with the timber preservative copper chrome arsenate (CCA). CCA treated timber was found to represent only 1% of the wood packaging sampled (+/- 0.5%). This result corroborates research based on surveys and anecdotal information that there is very little timber treated with the preservative CCA in the wood packaging waste stream.

Three of the four samples which tested positive for CCA were subsequently found to be used to import goods exclusively from New Zealand. Company representatives were contacted and information was provided about alternative and cheaper methods that the Australian Quarantine and Inspection Service accept for imported timber packaging. The companies resolved to consider these alternatives. A fourth example of CCA treated timber was unmarked and appeared to be a piece of Australian-made improvised timber packaging. This confirms anecdotal evidence that the very small quantities that exist are used to import goods from New Zealand or, if made in Australia, resulting from ad-hoc rather than systematic production.

The handheld XRF analyser used in the study was found to be easy to use, gave very speedy detection for CCA and was able to detect low levels of key target elements. The work revealed potential for XRF analysis equipment in field use for checking inputs of feedstock as well as outputs for recycling and renewable energy.

Due to the capital cost, potential use of XRF analysis is probably greater for companies and facilities that accept a range of wastes as feedstock for a range of products. That is, wastes from construction and demolition (C&D), commercial and industrial (C&I) wastes for recycling into soils, mulch, animal bedding and/or fuel products. There are potential savings in off-site analysis costs, external sample preparation and quarantine costs while waiting for stockpile testing results to come back from the laboratory as well as potential reduction in conflicts with generators of waste.

50 percent of samples were also characterised for a range of attributes including type of packaging, pallet standard, ISPM-15 markings, sterilisation method, industry source and wood type. These characteristics provide some interesting insights into wood packaging in Australia, assist in identifying potential for increased recovery for reuse, recycling and renewable energy. The information garnered will also assist in targeting future waste reduction programs.

The study finds few barriers to the increased use of post-consumer wood packaging in the production of particleboard, mulch, animal bedding or the generation of renewable energy.
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1 INTRODUCTION

1.1 Background

The National Timber Product Stewardship Group (NTPSG), which was formed in 2007, is comprised of timber industry associations and companies from across Australia and has recently developed a Product Stewardship Strategy for Post-consumer Timber (NTPSG 2007). One of the primary objectives of the Strategy is a doubling in recovery and utilisation of post-consumer waste timber by the year 2017.

As part of the development of the Strategy, wood packaging was identified as a large and quite distinct stream of post-consumer wood. Subsequent research by Hyder Consulting (Hyder 2008), commissioned by the Australian Plantation Products and Paper Industry Council (A3P) and the Timber Development Association of NSW (TDA NSW) on behalf of the NTPSG, estimated that 290,000 tonnes of wood packaging is disposed of to landfill around Australia. Hyder also found that this type of waste wood was “low hanging fruit” in terms of increased recovery for reuse, recycling and bioenergy products, where these markets exist. This was because of large volume, ease of processing and low levels of contamination.

However, one of the barriers identified in the report was that industry and government mindset towards recycling wood packaging was very poor. An opportunity to overcome this barrier involved work towards dispelling concerns about timber treatment, particularly in imported wood packaging.

It is a current requirement of recycling and renewable energy facilities around Australia that little or no timber impregnated with the preservatives copper chrome arsenate (CCA) is accepted. In addition, CCA-treated timber offcuts and waste are not recommended for mulching or animal bedding in Australian standard guidelines (AS 5605-2007). However, they may be burned in plants specifically approved for that purpose.

The words “treated timber” in Australia is commonly used to mean timber pressure treated with the most common wood preservative copper chrome arsenate (CCA). 3% of all commercial and industrial (C&I) waste, by volume, was estimated to be ‘treated’ wood (DEC 2003). This is 17% of all the C&I waste wood identified in the audit and seems extraordinarily high proportion, considering that wooden pallets were identified as a significant source of waste wood in this audit. It is suggested that the auditors may have included sterilized and fumigated pallets as well as permanent preservative treatment.

Subsequent visual audits of the C&I stream around Australia (Waste Audit 2007a, Waste Audit 2007b) have not attempted to quantify treated wood as distinct from other wood waste in the C&I waste stream however statements such as: “some (wood/timber) had the appearance of ‘single use’ imported pallets or other timber and would be expected to have been treated…” (Waste Audit 2007b) demonstrate that some confusion in the waste industry still remains.

Some of this confusion has found its way into the companies utilising wood packaging. For example: “The company has also begun using recyclable high-density paper pallets instead of treated timber pallets, which are more difficult to recycle due to poison trace elements.” (Toshiba 2008). This confusion is being promulgated by out-of-date or badly worded information on shipping advice “It is suggested that all wooden packaging material, including cases, pallets, crates, skids or pallet cartons
with wooden skids be made from treated timber …” (Australian Trade & Shipping 2008).

The Australian Quarantine and Inspection Service (AQIS) require all timber packaging imported into the country to be sterilised, fumigated or permanently immunized to prevent the spread of pests and diseases (AQIS 2008).

These statements are evidence that sterilization, fumigation and immunisation methods are getting mixed up with permanent treatment with preservatives such as CCA or synthetic pyrethroids used to prevent the spread of the European House Borer.

1.3 Study Objectives

This study characterises post-consumer timber packaging in three Australian states - Western Australia, New South Wales and Queensland. These three states were selected because they have the lowest recovery rates for waste timber in Australia. (A3P & TDA NSW 2007).

The objectives of the study were:

- Better characterise a distinct and high volume waste timber stream
- To test the assumption that the levels of copper, chromium, arsenic (CCA) preservative and lead are very low in the post-consumer wood packaging stream
- Identify sources of timber packaging that are made with CCA preservative timber (if any) and use this information to approach and encourage companies to use alternatives where it is not necessary
- Assist those companies that already use, or plan to use, post-consumer wood packaging to address current and future concerns from environmental regulators and local communities
- Trial the use of portable XRF analyser on post-consumer timber
2 METHODOLOGY

The sampling and analysis methodology used was based on that developed for an audit of the construction and demolition waste stream by the NSW Department of Environment and Climate Change (DECC 2007).

2.1 Site Selection

The project used nine sites in total to sample and collect data. The sites were selected on the basis of throughput and availability of stockpiles, location in or adjacent to industrial and commercial zones and variety of end uses.

2.1.1 Western Australia

Two sites in Western Australia were used, both in the Perth Metropolitan Area. One was located in the southern suburbs, the other in the north eastern suburbs of the city. Both are located in industrial areas.

One site stockpiled wood for recycling into new particleboard. The second site stockpiled wood for recycling into mulch for industrial land rehabilitation.

2.1.2 New South Wales

Three sites in New South Wales were used. Two sites were selected in the middle and inner suburbs of the Sydney Metropolitan Area respectively and one site from the Extended Regulated Area. All three sites are located in or adjacent to industrial areas.

Two sites recycled wood into landscape mulch. One site recovered timber for use in the generation of renewable energy.

2.1.3 Queensland

Initially two sites were selected, one in the northern suburbs of Brisbane and one in the southern suburbs. Both were located in major industrial areas. During the sampling period it become apparent that insufficient wood packaging stockpiles were available. A third facility was selected in the northern suburbs which catered exclusively for large vehicles from commercial and industrial waste generators. A forth facility was also included in the southern suburbs in the sampling as it was identified by the participating waste company as a major source of waste pallets and packaging.

All sites were located in or adjacent to industrial areas. Two of the sites recovered the material for use as garden mulch. One site disposed of the wood. The last site recovered wood from the mixed waste stream for the generation of renewable energy.

2.2 Sampling

2.2.1 Stockpile sampling

The total stockpile size was estimated in cubic metres and adjusted based on an estimate of the percentage of wood packaging present in the stockpile.

Samples were taken at a rate of twenty samples per 1,000 cubic metres. It should be noted that the volume of wood has many voids due to the product nature and its stacking and the total volume does not reflect actual wood volumes.

The packaging stockpile volume was divided by 50 to obtain the total number of samples required to be taken for each batch.
The total distance around the stockpile was divided by this calculated sampling number to obtain the distance between sample points.

Example:  
- Estimate size of stockpile: 1020 m³
- Estimate of Percentage of packaging: 95%
- Estimated size of packaging stockpile: 970
- Rounded to nearest 50 m³: 950 m³
- No. of samples required in each batch (at 50 per 1,000 m³): 950/50 = 19 samples
- Distance around stockpile: 170 metres
- Distance between sample points: 170/19 = 9 metres

A starting point was located randomly at the base of the stockpile. A sample was randomly selected from an imaginary line drawn perpendicular from this point to the top of the stockpile. The sample was marked, numbered and the characteristics of the sample were recorded.

A second sampling point was located at the calculated set distance from the starting point. A second sample was randomly selected from the stockpile using the same method as described above.

Figure 1: Stockpile volume was established by estimating length, breadth and height

Subsequent sample points were located at the set distance from the previous sampling point. This sampling method was repeated around the whole stockpile.

2.2.2 Sample validation
To validate the initial batch of samples, a second and third batch of samples were taken.

These validation batches of samples were randomly selected at the same calculated set distance between sample points but offset by one third and two thirds of the set distance.

Example:  
- Set distance between sample points = 9 metres
- Offset for second batch of samples = 9*1/3 = 3 metres
Offset for third batch of samples = 9*2/3 = 6 metres

Figure 2: Samples were taken at calculated set intervals around the stockpiles

2.3 Chemical analysis

Chemical analysis of each sample was undertaken with a hand-held Niton XI-t X-ray Fluorescence (XRF) analyser. Each sample was scanned for 30 seconds for the presence of 14 elements (table 1) including arsenic, chromium, copper and lead. The results of the analysis appear in Section 3.

The XRF analyser was used in bulk sample mode. Bulk sample mode provides rapid chemical composition analysis of soil, sediment and other thick, homogeneous samples. The calibration allows for the simultaneous analysis of the elements in a bulk material. The software automatically compensates for matrix variations from sample to sample, allowing the operator to simply “point and shoot” any bulk sample without unnecessary data entry or additional calibrations.

The packaging was sampled in-situ which allowed subsequent sub-sampling if a sample was found to be have high levels of target elements.

Field Portable XRF Spectrometry analysers are commonly used in mining, recycling and environmental applications including site soil characterization remediation (JBS Technologies 2008). XRF analysers are also a widely accepted means of analysing the preservative content and retention of wood by treatment plants for many years (Greg Jensen, Technical Manager - Arch Wood Protection pers comm February 2008).

A study by Mercuro et al (2003) has shown that the analyser is an effective and accurate tool for quantifying the CCA present in wood in-use and of disposed wood.

The limits of detection for instrument are very low for some elements, in particular arsenic, mercury and selenium (table 1). It can also detect reasonably low levels of copper and lead.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Limits of Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>60 secs</td>
</tr>
<tr>
<td>Arsenic</td>
<td>As</td>
<td>20</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Co</td>
<td>300</td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td>275</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>50</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>300</td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td>15</td>
</tr>
<tr>
<td>Element</td>
<td>Symbol</td>
<td>Limit mg/kg</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>275</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Mo</td>
<td>30</td>
</tr>
<tr>
<td>Nickel</td>
<td>Ni</td>
<td>120</td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>40</td>
</tr>
<tr>
<td>Rubidium</td>
<td>Rb</td>
<td>50</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>15</td>
</tr>
<tr>
<td>Strontium</td>
<td>Sr</td>
<td>25</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td>50</td>
</tr>
<tr>
<td>Zirconium</td>
<td>Zr</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 1: NITON XLt 700 Series – Elemental limits of detection in soils, mg/kg (ppm)

To ensure the XRF analyser was providing accurate results if high levels of copper, chromium or arsenic were found, before representative sampling of the stockpiles took place pieces of CCA and copper azole preserved timber to hazard level H3 were analysed.

Figure 2: Chemical analysis was done for each sample with a handheld Niton XRF analyser

2.3.1 Hazard level of positive samples
The levels of copper, chromium and arsenic of positive samples were analysed to ascertain the hazard level as defined in AS1604.1-2005 Specification for preservative treatment - Sawn and round timber.

2.4 Other issues and data quality
During the course of the fieldwork operational issues were identified that had the potential to affect the quality of the data collected. Where possible, the sampler and the site operations staff resolved these issues.

2.4.1 Safety issues
The movement of vehicles adding to stockpiles was a significant hazard. Work method statements were prepared. Personal protection equipment was utilised in the form of high visibility vests, safety boots and gloves.

On-site safety inductions where conducted and facility staff advised that work was taking place on the stockpile. Where appropriate and available electronic two-way communication was established with excavator drivers to allow contact regarding truck and people movements.
The height of the packaging on some stockpiles meant that extreme caution needed to be used to obtain a representative sample. However, instability of some of packaging meant that it was unsafe to clamber up and down at some sample points. There would be some error from the sampling based on these safety considerations. However, the large number of samples across a large number of sites minimises these errors.

2.5 Characterisation

A range of characteristics were recorded for 165 of the samples. For the purposes of this study timber packaging was defined as falling into the following types:

- Pallets
- Skids
- Boxes
- Crates
- Cable reels
- Dunnage
- Other timber packaging

Figure 3: Pallets
Figure 4: Skids
Figure 5: Crate components
Figure 6: Cable reel
Figure 7: Dunnage

Figure 8: Boxes
3 FINDINGS

3.1 Chemical Analysis

3.1.1 Metal-based preservatives

All the samples were analysed for the presence of high levels of copper, chromium and arsenic (>500 mg/kg in total) for thirty seconds.

Wood has been shown to contain very low natural background levels of these elements (1 to 3mg/kg) in a study conducted by the Department of Environment and Climate Change (DECC 2007).

The vast majority (~99%) tested negative. A small quantity of timber packaging (four individual samples or ~1% of all samples) was found to high levels of copper chrome and arsenic. It was obvious within two seconds that the timber had very high levels of these elements.

In each of the four samples that had high levels of one of these elements, it also had very high levels of the other two. The ratios detected were consistent that required in the Australian and New Zealand Standard AS/NZS 1604.1-2005 for timber preserved with CCA (copper: 23-25% chromium 38-45% arsenic 30-37%). Therefore the cause of these elevated levels is very likely to be the timber preservative CCA.

These elevated levels were all found in four samples of softwood timber pallets. No positive samples where found in the timber crates.

![Chart 1: Results of XRF analysis for presence of metal-based timber preservatives CCA, ACQ and copper azole in wood packaging](chart1.png)

3.1.2 Sample and measurement error

Given the large number of representative samples, it is estimated that the sample error is +/-0.5%. Given that the analysis is based on and large concentrations, measurement error for chemical analysis for metal-based preservatives is negligible.
3.1.3 Hazard level of positive samples

Two samples were ascertained as being treated to hazard level H3, one to hazard level H4 and one to hazard level H5.

The three pallets treated to H3 or H4 hazard level had markings which allowed identification of the company pallet owner. The pallet treated to hazard level H5 level (total copper + chrome + arsenic levels >1%) was an unmarked partial pallet.

Figure 9: Positive samples for CCA

3.1.4 Average concentration levels

The four samples were analysed a total of eleven times and an average level of concentration of copper, chrome and arsenic found (table 2).

<table>
<thead>
<tr>
<th>Element</th>
<th>As</th>
<th>Cu</th>
<th>Cr</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (mg/kg)</td>
<td>1747</td>
<td>1541</td>
<td>3041</td>
<td>6328</td>
</tr>
<tr>
<td>Proportion of Total (%)</td>
<td>28%</td>
<td>24%</td>
<td>48%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2: Average levels of arsenic copper and chromium in positive CCA samples

3.1.5 Source of positive samples

One positive sample was found in a stockpile in WA, two in one stockpile in NSW and one in a stockpile Queensland.

Of these four samples, three were marked with enough information to source the industry they were from. One pallet was marked with the company name Nutrimetics while two pallets were marked with Dominion Breweries. A forth sample, a non-
standard piece of packaging had no markings. Both companies whose names were on the CCA pallets were contacted to ascertain further information.

Nutrimetics is a supplier of premium natural cosmetics in Australia and New Zealand and source their cosmetics from New Zealand (Peter Archer – Logistics Manager, Nutrimetics pers comm., 10th June 2008). Dominion Breweries, a New Zealand beer company, operate a distribution business in Australia called Drinkworks. Drinkworks also source their entire product range from New Zealand (Judd Michel pers comm. 13th June 2008).

Both companies advised that treated timber was specified to be used in their pallets as it was their understanding that this was the only way that timber packaging could be imported into Australia due to quarantine requirements.

Information about current AQIS requirements and the ISPM-15 standard was forwarded to both companies for consideration. Both companies advised that they would explore alternatives with their suppliers.

3.1.5 Other chemicals

Other elements were part of the analysis but were usually below the limits of detection of the XRF analyser. However, a very small number of examples where found with very high levels (>500ppm) of other elements. One pallet (figure 13) was almost black in colour and had a distinctive hydrocarbon odour. It was found to have very high concentrations of lead, copper, zinc, iron and chromium.

Another small group of pallets were found to have very high levels of iron and zinc (figure 14). These pallets were obviously from some sort of metal manufacturing or processing industry.

One example was found in Perth of wood packaging that was dyed mauve to signify immunisation against infestation with European House Borer (EHB). The synthetic pyrethroid preservative, commonly used to protect house framing from termites and other pests, is used (Kevin Gallagher - TGA Pallets pers comm. 02 Feb 2008).
3.2 Characteristics

3.2.1 Type of packaging

Pallets, skids and crates made up the majority (~87%) of the timber packaging surveyed with 30%, 16% and 41% of the waste stream respectively.

(n=165)

3.2.2 Physical integrity

The majority of the packaging (60%) was broken however 40% was intact. Partial packaging was more common at the NSW and QLD sites.
3.2.3 Pallet standards

Of the 76 pallets and skids, 44% were also non-standard sizes. A similar proportion (41%) were manufactured to one of the ISO standard pallet sizes (listed in Appendix C). A small percentage of pallets and skids were manufactured to non-ISO standard pallet sizes which had the same dimensions as those used in North America. All the crates were non-standard sizes.

3.2.4 Dimensions and density

The dimensions, volume, mass and density of timber packaging varies enormously. For example, components of individual crates up to 9 metres by 2 metres in size were recorded.
Maximum, minimum and average values for volume, mass and apparent density are given below (table 2).

The average apparent density of 130 kg/m$^3$ is much less than the density of solid wood, as would be expected due to large air gaps within the pallets and crates. Radiata pine which has an average air-dried density (ADD) of 500 kg/m$^3$ (Bootle, K. 2005).

One facility advised that the delivered density of wood packaging averaged only 30 kg/m$^3$ due to the large volume of air in the skip bins. The density of offcuts from manufacturing averaged 250 kg/m$^3$. The density for all chipped wood was ~250 kg/m$^3$.

<table>
<thead>
<tr>
<th>DIMENSION</th>
<th>unit</th>
<th>MAX</th>
<th>MIN</th>
<th>AV</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>m$^3$</td>
<td>3.81</td>
<td>0.00</td>
<td>0.25</td>
<td>0.51</td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
<td>100.00</td>
<td>0.01</td>
<td>11.38</td>
<td>16.04</td>
</tr>
<tr>
<td>Apparent Density</td>
<td>kg/m$^3$</td>
<td>981.8</td>
<td>4.0</td>
<td>130.1</td>
<td>163.2</td>
</tr>
</tbody>
</table>

Table 3: Dimensional statistics of measured packaging

Waste Audit (2007b) in waste audits for the South Australian government utilise an average density of 156 kg/m$^3$ for waste wood timber and packaging that is low, medium or compacted density. Presumably, these same densities were used in the study for the Western Australian government (2007a).

Given the large range in density found in this study, depending on the form and compaction level, there is considerable doubt about the reliability of disposal tonnages attributed to wood that rely on visual assessment methods.

### 3.2.5 Markings

The majority of packaging (~56%) had markings of some kind. 61 samples (~37%) had an ISPM-15 mark identifying country, sterilisation or fumigation method as well as the sterilisation/fumigation company code.

![Figure 13: Typical ISPM-15 marking](image)

![Figure 14: Other marking included delivery dockets](image)
3.2.6 Sterilisation/fumigation method
Of the ISPM-15 marked packaging or where the sterilisation/fumigation method was marked independently of the ISPM-15 mark, sterilisation with heat was by far the most popular method.

3.2.7 Region of origin
Based on country specific identification codes or other markings that indicated the country of origin, 80 samples were able to be confirmed their county of origin. These samples were found to come from 21 different countries. A full list of countries is provided in Appendix D. Chart 6 below shows the regions from which the packaging originated.
3.2.8 Industry source

There was very little information to allow identification of the generators of the great volume of packaging. Only 24 samples had sufficient markings or, as material was dropped off, had the driver available for questioning about the origin of the packaging. Markings included manufacturer, product branding and/or delivery dockets.

This information was used to classify the packaging into broad industry divisions consistent with the Australian and New Zealand Industrial Classification (ANZSIC) system (for details refer to Appendix D).
3.2.9 Wood type
Wood type was assessed visually. The majority of packaging was softwood, mainly pine species with smaller quantities of Douglas fir (Oregon). Of the smaller proportion of hardwood packaging, rubber wood was common species. The majority of the engineered wood product (EWP) found was plywood.

![Chart 9: Wood type of packaging](image)

3.2.10 Designed life
Only a small proportion of the packaging (~11%) was assessed as being designed and manufactured with the intention of being used a number of times (reusable). The vast majority of the packaging (~89%) sampled was designed and manufactured for single trip use.

The majority of the packaging identified as reusable appeared to be being disposed of as it could no longer be used. This included packaging such as decommissioned CHEP pallets which had been sold and used again before disposal (figure 15). Other multi-use pallets identified were non-standard dimensions that precluded repair and use by other industries.

![Figure 15: Decommissioned hardwood CHEP pallets](image)
3.2.11 Physical contamination

The majority (~97%) of the packaging contained metal fastenings such as nails but often also heavier nail plates or bolts. These can be a significant problem as removal requires additional risk, equipment, i.e. rotating magnets, and are considered expensive to remove. Heavy metal fastenings was cited by one company as the most significant contaminant when dealing with packaging.

Other contaminants were present but only in small quantities. Dirt and sand are very significant contaminants where the packaging is recycled into particleboard as it can damage very expensive manufacturing blades and is not readily detected by magnets and is difficult to remove.

Paint, plastic and even paper can be a contaminant when processing the packaging into bioenergy, particleboard and mulch products.
Chart 11: Physical contaminants in characterised samples

(n=165)
4 DISCUSSION

The vast majority of the wood samples had levels of most elements below the limits of detection. A very small proportion of the samples (~1%) had high levels of copper, chromium and arsenic.

These results appear to corroborate anecdotal evidence given by those sourcing packaging timber for recycling (Joe Cullity, Wood Supply Manager – Laminex Group pers comm. February 2008) that some very small quantities of packaging made with CCA treated timber is imported from New Zealand. The results also corroborate enquiries made with major timber packaging manufacturers utilising softwood in Australia and their wood suppliers that the use of any CCA treated timber manufacturer of packaging is very unusual (those asked include manufacturers Pinetec, TGA Pallets, Ubeeco and suppliers Pine Solutions Australia and Wespine).

The handheld XRF analyzer was very successful in detecting the presence of CCA treated timber and other problematic elements in this waste stream. If the timber did have high levels of target elements, a positive response was detectable within three seconds.

During the sampling and testing, a number of companies, particularly in New South Wales, were very interested in the application of portable XRF analysis as a site tool to analyse a range of soils and products. Sampling, analysis and the costs of holding the stockpile while results came back from the laboratory (quarantine costs) were cited as very significant and a quicker method which reduced these costs was seen as attractive.

A number of parties could also see an application in testing input materials where there was doubt or disagreement about the recyclability of waste material (and resulting costs of disposal). For example, some operators had almost come to blows over disagreements with people dropping off material and them having it rejected. Having an objective tool was seen as a positive step.

Due to the capital cost (from ~$45,000 for a second-hand model of the one used in this study), potential use of XRF analysis is probably greater for companies and facilities that have site remediation issues or accept a range of wastes as feedstock for a range of products. That is, wastes from construction and demolition (C&D), commercial and industrial (C&I) wastes for recycling into soils, mulch, animal bedding and/or fuel products.

The very low level of CCA treated timber is reassuring. The information gained in this study will assist in assessing risk for those companies utilising, or considering using waste packaging as a feedstock for a recycled or energy product.

However, this level of CCA treated timber is higher than zero and hence, could be a problem for end-users that specify a zero level of tolerance for CCA treated timber (such as particleboard or fuel). This information could thus be useful in developing specifications for recycled feedstock based on post-consumer wood packaging that have set limits for elements such as arsenic, copper, chromium and lead as opposed to impractical, and unachievable, zero limits.
5 CONCLUSIONS

This study has served to better characterise this significant timber waste stream. The major conclusions that can be drawn from this study are:

- The vast majority of timber packaging is made with wood that is not preserved with the permanent wood preservative copper chrome arsenate (CCA). These results corroborate previous knowledge.

- Three quarters of the wood packaging treated with CCA was from New Zealand. These companies importing goods from New Zealand were not aware of cheaper and just as effective alternatives and have resolved to explore these alternatives.

- XRF analysis is a very quick and accurate method of detection for a range of elements and has direct application in the waste management and recycling field where end-users and/or environmental regulators require the extra level of quality assurance.

- Most of the post-consumer packaging is non-standard, single-use softwood pallets and crates.

- The dominant method for wood packaging using the ISPM-15 standard marking to prevent spread of pests and diseases is sterilisation with heat.

This information can be used as a baseline for future studies to understand trends in waste generation as well as sterilisation, fumigation and immunisation methods to further underpin the reuse, recycling and energy sector in increased utilisation of this resource.
REFERENCES


Waste Audit (2007b) ZeroWaste South Australia Disposal Based Survey 2007, Waste Audit and Consultancy (Aust) Pty Ltd. Available at
## APPENDIX A  CHARACTERISTICS DATA SHEET

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## APPENDIX B  PALLET STANDARDS


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APPENDIX D    INDUSTRY CODE LIST

Australian and New Zealand Standard Industrial Classification (ANZSIC) is a standard classification developed by the Australian Bureau of Statistics (ABS) for use in Australia and New Zealand for the analysis of industry statistics. More information on the ABS Website at www.abs.gov.au

ANZSIC Divisions
A  Agriculture, Forestry and Fishing
B  Mining
C  Manufacturing
D  Electricity, Gas, Water and Waste Services
E  Construction
F  Wholesale Trade
G  Retail Trade
H  Accommodation and Food Services
I  Transport, Postal and Warehousing
J  Information Media and Telecommunications
K  Financial and Insurance Services
L  Rental, Hiring and Real Estate Services
M  Professional, Scientific and Technical Services
N  Administrative and Support Services
O  Public Administration and Safety
P  Education and Training
Q  Health Care and Social Assistance
R  Arts and Recreation Services
S  Other Services