

Resource Recovery – PLASTERBOARD – Centralised Sorting, Storage and Processing

This guide provides good-practice advice to maximise recovery rates for plasterboard waste from construction and demolition (C&D) sites. The guidelines cover the sorting of plasterboard, processing of plasterboard into crushed gypsum and paper and the storage of the raw and processed product at a dedicated or centralised facility.

The aim is to assist operators of mobile and centralised crushing facilities to adopt practices that:

- maximise operational efficiency and the amount of plasterboard sorted from the landfill or cleanfill
- minimise contamination and damage of the processed product
- avoid or minimise environmental and nuisance effects from processing.

This guideline covers:



Processing Plant at Crusaders Landscaping, Christchurch.

- finding good markets for crushed plasterboard
- on-site versus centralised processing
- setting up a processing facility
- operating a plasterboard recycling plant
- testing and storage of crushed plasterboard
- environmental, health and safety hurdles
- resources and contacts
- other guidelines in this series.

Read the REBRI Resource Recovery – Plasterboard – Collection and Transportation guide in conjunction with this guide. Please refer to the particular specifications for operating your machinery for full details on how to maximise efficiency and performance. These REBRI guidelines do not replace the specific instructions of the manufacturer.

Finding good markets for crushed plasterboard

Once plasterboard is crushed, the gypsum can be sold as a powder (with or without the paper) or moulded into pellets.

Use as soil and compost conditioner and other agricultural applications

- Gypsum and/or paper can be composted with other green waste.
- Gypsum can be blended with composted product.
- Gypsum (with or without the paper) can be used as a soil conditioner in agricultural applications.
- Gypsum can be added to soil in landscaping applications.
- Gypsum (with or without the paper) can be combined with sawdust and wood shavings for animal bedding, because it absorbs moisture.

- While the benefits of virgin gypsum as a soil and compost additive are well understood, the effect of plasterboard additives in recycled gypsum has not been researched comprehensively in New Zealand. Acceptable contaminant levels (including paper, foreign materials and product additives) should be confirmed with the client and/or regional council.

Industrial uses

Many industrial uses are still being researched. Some involve substituting virgin gypsum with recycled gypsum, while others are new technologies.

- Gypsum can be reused in the plasterboard manufacturing process. The manufacturer should determine specifications for gypsum quality.
- Paper can be recycled.
- Gypsum with very low contamination may be used in the cement-making process. Virgin gypsum is currently added to the clinker to control the setting time. The manufacturer should determine specifications for gypsum quality.
- Gypsum has moisture-absorbing characteristics and may be used for drying sludge from municipal and industrial wastewater treatment plants.
- Gypsum could be used to settle dirt and clay materials in turbid water.
- Gypsum could be used to absorb grease spills.

Know your markets

You won't be in business long without securing a sustainable market for your waste plasterboard. The market for waste plasterboard is new in New Zealand, and constantly changing, so it pays to do your homework. Here are a few suggestions for starting your search.

- Use local waste-recycling directories (www.branz.co.nz/REBRI_Recycling_Directory, the Yellow Pages (www.yellowpages.co.nz), The Waste Exchange (www.nothrow.co.nz) and buy recycled directories (www.zerowaste.org.nz) to identify demand for recycled plasterboard product. These change often, so it pays to keep checking.
- Network with businesses and councils with an interest in sustainability. Join organisations such as the Sustainable Business Network (www.sustainable.org.nz) or the Waste Management Institute of New Zealand (www.wasteminz.org.nz).
- Do business with recycling operators and manufacturers that follow the REBRI Guide to C&D Resource Recovery or are accredited to a nationally recognised environmental management programme such as ISO14001 or Enviro-Mark® NZ. This way, you can have greater assurance that they are working to good environmental standards and are doing what they say they do.

Understand the requirements of your clients

Each market will have its own feedstock specifications – it's best to confirm these before you start. Getting it wrong can cost you.

- Clients will have particular specifications for recycled gypsum, depending on their needs. Things to check:
 - whether demolition board is acceptable
 - minimum and maximum sizes of chip or powder particles
 - contamination tolerances (screws, nails, paint, glues etc.)
 - moisture tolerances
 - minimum and maximum quantities
 - gypsum with or without paper
 - any quality checks, laboratory analysis or other verification of product quality
 - sorting and handling requirements, including transportation to the client
- Use the REBRI Waste Transfer Form to confirm to clients the source and nature of the recycled plasterboard provided.

Calculate the economics of recycling

- Before setting up business, you can use a simple cost model to estimate the economics of your recycling operation compared to disposing of plasterboard to landfill (or other alternatives):

$$I = Q[l_t + rI_s - C_p - (1-r)C_d]$$

where:

- I = gross income from plasterboard recycling (\$)
- Q = plasterboard received for processing (tonnes)
- l_t = income from receiving plasterboard (\$/tonne)
- r = recovery rate of crushed product, from plasterboard received (%)
- I_s = income from product sales (\$/tonne)
- C_p = cost of processing (\$/tonne)
- C_d = disposal cost for residual waste (\$/tonne)

On-site versus centralised processing

A key decision when operating a plasterboard processing plant is whether to set up a dedicated processing facility or provide a mobile service where the plant is taken to the source of plasterboard. There are plenty of reasons why you would choose one set-up over the other, most of which would come down to the ability to make a profit for the operation.

Some things to consider:

Processing plasterboard using mobile plant at the construction or demolition site makes sense when:

- there is enough plasterboard on a site to justify setting up mobile plant (use the economic calculation above to determine this)
- the plant is easy to mobilise: the time and labour required moving the plant from site to site may override any other benefit, and again this can be answered by using the calculation above
- there is enough room to set up the plant and stockpile the plasterboard
- transport costs can be saved by reducing the cartage of plasterboard to a facility and/or the crushed gypsum and paper to the end market
- crushed gypsum can be used for landscaping on site
- the surrounding neighbourhood is not sensitive to the environmental effects of the plant.

Centralised processing makes sense when:

- economies of scale mean that it is more efficient to process long term at a centralised site, even when transportation costs are considered
- plant is not easy to mobilise (see above)
- there is not enough room on site
- it is easier to get resource consents and other regulatory approvals for a single site rather than for a mobile operation.

Setting up a processing facility

Good planning in the set-up phase will help you to develop a quality product – without the council on your back.

Factors that affect product quality and reduce the value of the product

- Moisture turns dry plasterboard into a soggy product that cannot be crushed.
- Moisture makes crushed gypsum powder form into lumps, reducing the quality of the product.
- Paper is a contaminant in some recycling options and in some cases will need to be separated from the gypsum.
- Demolition plasterboard is of lower quality for recycling presently. In particular:
 - the ingredients in demolition plasterboard are difficult to identify and may not be suitable for some recycling options
 - demolition plasterboard is often contaminated with nails, screws, wallpaper, paint (including lead-based paint) and other materials, reducing gypsum quality
 - crushed construction plasterboard material is more uniform and consistent in quality than demolition plasterboard

- Different plasterboard products have different additives to the gypsum and/or paper. The various additives may not be appropriate for a particular recycling option depending on the quantities in the final blend.

Environmental considerations

- Crushing equipment is noisy and can create a nuisance for neighbours.
- Plasterboard crushing creates dust, and stockpiles can create dust during windy, dry conditions.
- Plasterboard or crushed gypsum can contaminate stormwater run-off by raising pH levels and contributing sediment to discolour the water.
- Stockpiling can be a visual nuisance in some neighbourhoods.
- Asbestos may be found with demolition plasterboard. This is a hazardous material and should not be accepted at your facility or handled by your staff.
- You will need to consult your regional council and your city or district council before you start to identify potential environmental effects of your operation and get them consented.

Guidelines for reducing the environmental effects of processing are included below – see Environmental, health and safety hurdles.

Design your processing facility to maximise efficiency

- Locate plant and store plasterboard under cover or indoors to prevent moisture damage from rain.
- If plant must be located outside, consider storing plasterboard in covered bins before and after processing to prevent moisture damage.
- Locate and operate plant away from site boundaries, dwellings, places of work etc. to reduce noise and dust impacts.
- Provide signage and directions for processed and unprocessed plasterboard storage areas.
- Provide safe access for the public, if appropriate.
- Check the city, district and regional council requirements under environmental and building legislation (see 'Environmental, health and safety hurdles).

Typical equipment includes:

- grinders to crush plasterboard – various plant types are available, ranging from large stationary plant to small one-person mobile chippers (a hammer mill is often used)
- screens to sort particle sizes and paper from gypsum
- a baghouse or air vacuum system to capture dust
- front-end loaders and excavators to move processed and unprocessed product.

Operating a plasterboard recycling plant

Have clear operating systems and procedures

If you want a quality product, every stockpile, every shift, it makes sense to document your procedures and let everyone know what they need to do and how they should do it.

- Specific considerations include:
 - staff training (who trains, who needs to be trained, what information needs to be passed to which staff etc.)
 - manuals for operating and maintaining equipment
 - emergency procedures, including spill responses
 - health and safety procedures
 - materials handling procedures
 - quality and environmental monitoring.
- Check documentation regularly and keep a record of training.
- For comprehensive details on designing and operating sorting facilities, consult the *Guide to Best Practice at Resource Recovery and Waste Transfer Facilities* (www.zerowaste.sa.gov.au/upload/transfer-station-design-guidelines/guide_waste_transfer_resource_recovery_station.pdf).

Make sure you get quality plasterboard from C&D clients, waste transporters or sorting facilities

- Have a written contractual agreement with plasterboard suppliers to help them to understand your particular requirements and maximise resource recovery.
- Provide clear written instructions to your suppliers to ensure they can meet your specifications for such things as demolition and/or construction plasterboard, percentage of specialty product etc.
- Request the delivery of pre-sorted loads to reduce sorting time and increase product quality.
- Consider preferring suppliers who use the REBRI Guide to C&D Resource Recovery or are accredited to a nationally recognised environmental management programme such as ISO14001 or Enviro-Mark® NZ. You can have greater assurance that they are working to good environmental standards and are doing what they say they do.
- Document preferred delivery arrangements, including site access locations (and any associated traffic issues), site access times, volumes that can be accepted, types of bins, skips etc. and handling procedures.
- Consider imposing penalties for contaminated loads.
- Do not accept asbestos for recycling, crushing or reuse.
- Insist on the use of the REBRI Waste Transfer Form so that you can be sure of the source of plasterboard.
- Consider a 'three strikes you're out' policy for the delivery of heavily contaminated loads, after which penalties are issued or business with the supplier is stopped.

Get endorsement from your peers and give your clients confidence

- Use the audit sheet at the end of this guide to show clients that you are operating in accordance with the REBRI Guide to Resource Efficiency.
- Use the REBRI Waste Transfer Form to validate the source and destination of waste to your building and recycling clients.
- Join the Enviro-Mark® NZ programme for external accreditation of your environmental management.
- Consider Environmental Choice certification for your product.
- Check with your city or district council that you meet any licensing requirements under the Local Government Act 2002 for the handling of waste.
- Join industry organisations such as the Waste Management Institute of New Zealand to network with peers (see Links, resources and contacts.)

Good sorting and storage practices are necessary to ensure efficiency with materials handling and to protect product quality.

Refer to the REBRI –Resource Recovery – All Waste Types – Centralised Sorting and Storage guidelines for details on:

- receiving and sorting plasterboard from mixed waste loads
- setting up a tipping area
- bulk sorting with excavators with grip attachments
- manually sorting for quality control and contamination removal.

Receipt of plasterboard at the processing plant

- Feedstock control is important.
- Weigh and inspect each load you receive – a camera can be positioned to view the contents of the skips and trucks.
- Ensure you receive plasterboard types that you have a market for and have the appropriate skills and facilities to sort and store.
- Ensure your supplier has met your contract specifications (for example, for contamination, demolition and/or construction-sourced plasterboard).
- Match the consignment with the description on the waste transfer documentation.
- Reject any loads with asbestos.
- Reject loads that do not meet your specifications.
- Keep records of incoming materials.
- Direct approved loads to the sorting and storage area prior to processing.

Sort and store plasterboard prior to crushing

- Use excavators with grab attachments and/or manual methods to sort plasterboard into stockpiles.

- Remove contamination during sorting. Likely contamination includes:
 - wood
 - nails, screws etc.
 - wallpaper
 - plastic wrap or strapping
 - paint
 - tape.

Note that joint compound is made primarily of limestone or gypsum so should not contaminate the product. If the structure was built before the mid-1970s, asbestos may be found in the joint compound. Ask the waste supplier for details on the source of the plasterboard.

- Removing contamination prior to crushing reduces equipment damage and is easier because the particle sizes are larger.
- Recycle or otherwise dispose of all contaminants.
- Store different grades of plasterboard separately – this may mean keeping demolition board separate from construction board.
- Stockpile plasterboard indoors or under cover or store in enclosed containers (such as skips with lids) to prevent moisture damage and to control dust.
- Provide clear signage for all storage areas.

Operating the crushing and screening plant

- To protect the quality of the processed product, minimise the amount of processed product stockpiled on site and only process as orders are received. Keeping plasterboard in the unprocessed form will reduce the amount of moisture damage because less surface area is exposed to rain.
- Always operate machinery according to the manufacturer's recommendations and any resource consent conditions.
- Process different plasterboard grades separately.
- Position the plant where the stockpile of processed product will be located, to avoid moving stockpiles unnecessarily. Plant will need to be moved periodically as the stockpiles reach the height of the conveyor. Some plant is self-propelling, whereas others have to be moved manually.
- Where skips or bins are used for product storage, set these up at the end of the plant.
- Attach screens for paper separation if required, and set up a separate bin for paper collection.
- Where installed, check that dust collection systems are working.
- Use front-end loaders or excavators to feed plasterboard into the plant.
- Plant should be staffed to check for blockages, spills, contamination in feedstock, and other problems during processing.
- Staff should do quality checks of the final product during processing to make any alterations to the process on the spot and to remove any further contamination from the final product.
- Keep stockpiles of various grades separate (see storage guidelines below).
- Recycle or otherwise dispose of all contaminants.

Testing and storage of crushed plasterboard

Certifying batches for compliance with specifications

- Each batch of crushed gypsum (with or without paper) should be tested to show compliance with specifications.
- Stockpiles may be certified for later use but must have clear signage indicating the certification and results.
- It is the responsibility of the supplier to provide test certificates to clients prior to delivery. Maintain records of tests, and provide these to clients with other delivery documentation.

Storage management

Good storage practices are necessary to ensure efficiency with materials handling and to protect product quality.

- Where stockpiling is feasible:
 - large areas are generally needed to stockpile product
 - stockpiles should be stored on hard stand, under cover or indoors.

- When storing crushed gypsum and/or paper in skips or containers:
 - use skips or containers with lids or covers
 - containers can be stored indoors or outdoors but should be sheltered from wind.
- Different products and certified batches should be stored separately to avoid cross-contamination.
- Provide clear signage for all storage areas, including test results and product type.
- No further materials should be added to a stockpile or container of tested materials.

Crushed plasterboard at Crusaders Landscaping, Christchurch.



Environmental, health and safety hurdles

Good practice wouldn't be complete without considering the effects of your operation on the neighbourhood, local environment and the health and safety of you and your workers. This is not a comprehensive guide but should give you enough information to start talking with your city, district or regional council or occupational safety and health adviser.

Before you set up a processing facility, check waste handling and environmental regulations.

- Check with your city or district council:
 - that you meet any waste management licensing requirements under the Local Government Act 2002
 - regarding resource consent requirements under the Resource Management Act 1991 to operate a processing plant, including (but not limited to) any noise and dust issues, operating hours, stockpiling, trade waste discharges, signage and traffic movements
 - regarding requirements to alter, demolish or construct sheds and other buildings under the Resource Management Act 1991 and the Building Act 2004.
- Check with your regional council regarding:
 - requirements for stormwater discharges and stormwater protection measures
 - requirements for discharges to air of dust and odour
 - requirements for storage of hazardous materials
- Seek professional help to obtain the relevant resource consents.
- Ensure all staff are aware of environmental obligations by documenting procedures and providing regular training.

Avoid noise and dust disturbances

- Noise and dust are considered adverse environmental impacts under the Resource Management Act 1991 and must be managed to avoid impacts on people and wildlife. Noise and dust are also a health and safety in employment issue.
- Considerations for noise management include:
 - operate in typical business hours (check with your city or district council)
 - maintain plant to perform at the manufacturer's specification or use low-noise emissions plant
 - modify plant by enclosing it or adding noise mitigation parts
 - turn equipment off when not in use
 - provide protective equipment and reduce the time staff are exposed to noisy equipment (for example, by swapping tasks).

- Considerations for dust management include:
 - minimise handling stockpiled material – the more you move materials around, the more chance there is of releasing dust
 - spray stockpiles lightly with water to suppress dust during dry and windy weather or stop working in extreme conditions
 - moisten materials during loading or moving, where dust may cause a nuisance
 - water should not be applied in a manner that causes run-off
 - have a speed restriction for vehicles to reduce dust disturbance
 - provide wheel and truck washes to prevent dust and dirt migrating off site
 - provide protective equipment.

Manage run-off from the site to prevent contamination of soils and streams

- Stormwater can be contaminated by high pH (basic conditions) from gypsum and by particles of gypsum and paper.
- A resource consent may be required for any discharge of stormwater to ground or waterway (check with your regional council).
- Cover stockpiles and plant from rain where possible.
- Do not stockpile plasterboard or gypsum within at least 10 metres of a natural waterway or stormwater drainage system nor in a manner where stormwater run-off may reach a natural waterway without settlement and treatment. Greater than 10 metres may be required in areas with high rainfall or sloping ground.
- Create earth or concrete bunds around the site (or stockpile area) to prevent untreated stormwater from flowing to streams.
- Where stormwater cannot be absorbed on site, provide ponding areas for stormwater run-off for settlement of fine particles, prior to discharge to stormwater systems or natural waterways.
- Check the quality of stormwater before discharging water from the ponds. The pH can be checked using a pH meter and clarity can be checked using a clarity tube. Resource consents will have additional stormwater monitoring and management requirements. Ask an environmental professional or regional council officer about appropriate monitoring for your site.
- Consider a recycled water system, and use the stormwater for dust and stockpile damping down. Ensure that the stormwater does not contain contaminants that might affect the end product.

Health and safety procedures

- Write a plan that has procedures for the safe handling of plasterboard waste and plant operation for you and staff to follow. Consider addressing:
 - a list of hazards on the property and methods to manage these
 - safety training
 - procedures for handling waste
 - procedures for operating machinery
 - personal protective equipment.
- Have the plan checked by WorkSafe New Zealand, your lawyer or a consultant to ensure you comply with the Health and Safety in Employment Act 1992.
- All staff and subcontractors should be regularly trained in the procedures.

Resources and contacts

Relevant legislation and regulations

- Health and Safety in Employment Act 1992
- Local Government Act 2002
- Building Act 2004
- Hazardous Substances and New Organisms Act 1996
- Resource Management Act 1991
- Regional and district plans
- District bylaws.

Links, resources and contacts

- Resource Efficiency in the Building and Related Industries (REBRI) www.rebri.org.nz
- Yellow Pages www.yellowpages.co.nz
- The Waste Exchange www.nothrow.co.nz
- Zero Waste www.zerowaste.org.nz
- Sustainable Business Network www.sustainable.org.nz
- Waste Management Institute of New Zealand (WasteMINZ) www.wasteminz.org.nz
- Enviro-Mark® NZ www.enviro-mark.co.nz
- Environmental Choice New Zealand www.enviro-choice.org.nz
- Buy Recycled' Directory www.zerowaste.org.nz
- *Guide to Best Practice at Resource Recovery and Waste Transfer Facilities*
www.zerowaste.sa.gov.au/upload/transfer-station-design-guidelines/guide_waste_transfer_resource_recovery_station.pdf

Other guidelines in this series

All Waste Types

- Collection and Transportation
- Centralised Sorting and Storage

Timber

- Collection and Transportation
- Processing into Mulch and Chip

Plasterboard

- Collection and Transportation
- On-site Sorting, Storage and Processing
- **Centralised Sorting, Storage and Processing**

Concrete

- Collection and Transportation
- Processing and Storage

Metal

- Collection and Transportation

PLASTERBOARD – Centralised Sorting, Storage and Processing – Audit Sheet

Use this sheet to check the practice of your service provider against the good practice guidelines in this guide. If you are a plasterboard recycler, you can use this sheet to do your own checks of your performance against the guides. Just consider each point and put a tick for compliance, cross for non-compliance or NA for not applicable. Put any comments at the bottom of the sheet, then sign and date it. Keep these sheets for your records and any discussions between you and your clients or suppliers.

Sorting and storage

1. A list of specifications is obtained from clients and provided to waste suppliers. This includes such things as:
 - contamination tolerances
 - minimum and maximum quantities
 - whether demolition board is acceptable
 - moisture tolerances
 - sorting requirements.
2. The REBRI Waste Transfer Form is used to trace the source and destination of plasterboard to and from the sorting or processing facility.
3. A designated central tipping and sorting area is provided.
4. Each consignment is inspected prior to tipping and accepted or rejected based on:
 - meeting specifications
 - meeting skills and operating capacity of the sorting or processing facility
 - matching the description on the REBRI Waste Transfer Form.
5. Records are kept of waste accepted, sorted and sold.
6. Plasterboard is sorted into grades according to recycling operator specifications.
7. Contamination (such as wood, nails, screws and wallpaper) is removed during the sorting process.
8. Plasterboard is stored inside or covered with canvas, plastic or other material where necessary to protect from weather.
9. Clear signage is provided for all storage areas, including information on grades of product, and any instructions for product protection (for example, keep dry).
10. Contaminants are recycled or otherwise disposed of to disposal facilities that are consented by the regional council or have met the permitted activity status in regional plans.

Processing

11. Crushing equipment is set up at the location where processed gypsum and paper can be stored to prevent double handling of materials.
12. Plasterboard is processed on demand to reduce the exposure of crushed gypsum and paper to weather, which can damage the product.
13. Equipment is staffed while in operation and contamination and quality checks are frequent.
14. Procedures for operating and maintaining equipment are documented and staff are trained.
15. Each batch of crushed gypsum is tested to show compliance with specifications.
16. Plasterboard paper is recycled.

Internal procedures and compliance

In addition to the procedures above, consider whether the following apply to the operation:

17. Documented emergency procedures, including spill response.
18. Documented health and safety procedures.
19. Documented quality and environmental monitoring.
20. Current resource consents or other approvals for land use and discharges to the environment.
21. External accreditation (for example, Enviro-Mark[®] NZ).
22. Prefer clients and supplier that work to good environmental standards by using the REBRI guides and/or have external accreditation.
23. Licensed under district bylaw.

Comments

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Signed

Person, company and responsibility

Date

Signed

Person, company and responsibility

Date