REDUCING SOLID WASTE – M11

Eco-efficiency opportunities for Queensland manufacturers

Reduce your waste line

Manufacturing processes typically produce a range of solid wastes. Depending on the type of products being manufactured, solid wastes can include:

- *metal (offcuts, faulty products, packaging)*
- *office wastes (paper, ink cartridges)*
- *plastic (offcuts, faulty products, packaging)*
- *organic wastes (Wood, sawdust, paper, fibre, food waste).*

How much does waste cost?

The cost of solid waste is more than just the transport and landfill gate fee, it includes:

- the cost of raw material lost to waste and the subsequent loss of potential product
- the cost of the resources such as water and energy used to process the waste
- labour costs
- waste treatment costs
- collection and transportation costs
- disposal costs.

What are the benefits of reducing solid waste?

The economic benefits of reducing and utilising solid waste include:

- reduced costs (see above)
- increased revenue from additional yield and improved efficiencies
- increased revenue from by-products recovered from what would otherwise be solid waste.

Environmental and social benefits include:

- reduced landfill requirements and resource consumption
- reduced transport and associated air emissions
- demonstrated social responsibility, such as charitable donations.

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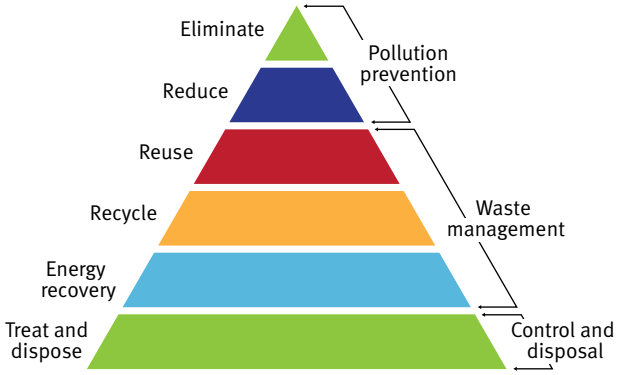
Where to start?

Undertaking a waste audit will identify the types and quantities of wastes generated by the process. Once these wastes have been identified the waste management hierarchy can be used to identify and prioritise waste efficiency opportunities.

Waste management hierarchy



Eliminate/Avoid

The best way to reduce solid waste is to avoid or eliminate the waste in the first instance. This may require:

- product and production process redesign
- substituting raw materials
- improving resource use efficiency
- improved maintenance and operation of equipment
- closed-loop recycling.[1]

Process and product redesign

Wastage or rework can be the result of the type and design of the product or poor process design, operation or maintenance. Manufacturers need to fully understand the role their product is fulfilling for a consumer and identify any superfluous components that may have a disproportionate influence on the production of waste during manufacture.

Product redesign such as simplifying the product to include fewer components, substituting input materials or altering the size, shape or weight of the product can save the manufacturer money. The overhead costs of a product can be reduced through rationalising the number of inputs required, reducing the amount of waste and simplifying the manufacturing process to improve efficiencies in activities such as cleaning. These should all be achieved while maintaining or improving the functions delivered by the product, thereby increasing the profit for the manufacturer.

Manufacturers also need to systematically assess each step of the process to identify areas that do not add value and produce waste. Good maintenance, the use of process controls and standard procedures can help to reduce waste. There are a number of useful strategies available to assist manufacturers identify and minimize unplanned waste from their processes. Table 1 summarises key strategies to maintain processes to prevent unplanned wastes from being generated.

1 QLD Government, Environmental Protection (Waste) Management Policy 2000.

Table1 –Strategies to reduce waste

Lean manufacturing	Lean manufacturing is a strategy to help plant operators identify waste in their processes. The strategy identifies seven types of process waste: • **overproduction** – producing more than is required • **transport** – movement of product or materials that does not add value • **motion** – excessive searching, walking, bending • **idle time** – raw material, equipment, information or people not ready • **over processing** – effort that does not add value • **inventory** – more raw materials or information than is needed that costs to order, transport, store and dispose • **defects** – mistakes requiring rework.
5S	5S is a systematic framework for good housekeeping practices. The strategy was developed in Japan and is based on five words starting with the letter 'S'. The English equivalents are: • **Sorting** – removing all items not needed • **Setting in order** – placing items for easy access and return • **Shining** – cleaning and inspection to keep items in good condition • **Standardising** – standards and rules that are easily recognised (visual management) • **Sustaining** – continuous improvement.

For more information visit QMI Solutions, www.qmisolutions.com.au

Total productive maintenance is another strategy to help prevent the generation of process waste. This strategy is based on no longer regarding maintenance as a non-profit activity. Preventative and corrective maintenance is scheduled as part of processing with the aim of minimising unscheduled breakdown maintenance. For more information visit: Plant Maintenance Resource Centre, www.plant-maintenance.com/articles/tpm_intro.shtml

AUSTICKS REDUCES WASTE[2]

Austicks in Gladstone manufactures wooden ice-cream sticks and coffee stirrers for the global market. Austicks has been able to reduce the quantity of solid waste produced by up to 339 tonnes per year by investing in best practice technologies and innovative processes. By retrofitting the wide, high speed chainsaw blade with thin kerf saw blades, Austicks was able to improve wood recovery and subsequently reduce the quantity of premium wood lost to sawdust by 50%. This avoided the loss of valuable resources and reduced the cost of sawdust disposal. In addition, Austicks developed an 'intelligent' ice-cream stick pneumatic punch machine which is able to avoid knots and other wood defects increasing the number of ice-cream sticks produced from raw timber by 176 tonnes, saving over $60,000 per year. A further $140,000 of savings was realised through reduced manual labour requirements for sorting and inspection.
(Austicks is an ecoBiz participant.)

Reduce

If waste appears unavoidable and there is no feasible way to substitute, avoid or eliminate the production of this waste, reducing the quantity of waste is the next preferred step in the waste management hierarchy.

Elimination and reduction of waste can be achieved through:

- reviewing plant layout
- product and process redesign (see above)
- reviewing supply chain relationships
- reducing packaging requirements.

2 QLD DERM ecoBiz, Austicks setting a precedent in the wood processing industry, www.derm.qld.gov.au/environmental_management/sustainability/ecobiz_queensland/partner_profiles_and_case_studies/ecobiz_case_studies.html

Review plant layout and building design

Efficient plant layout with adequate storage and processing space can reduce waste whilst improving operator safety and hygiene, and saving time and space. Key principles for improving plant layout include:

minimising

- material handling – as a general guide handle raw material only once after it reaches the plant
- the distance travelled by raw material or product to reduce likelihood of damage and contamination
- clutter to decrease the likelihood of accidents such as spills
- storage area through effective inventory management.

maximising

- smooth flow – eliminating bottle necks or complicated processes
- utilisation of plant by removing any non-value-adding activities
- flexibility so the layout can be quickly adapted to change
- visibility – have a clear line of vision in areas where problems occur
- use of visual cues to aid movement and storage such as signs, lines and colours.

Supply chain management

Often poor management of raw materials leads to waste that costs in raw materials, storage and disposal. Ensure all raw materials are:

- delivered at the correct time, in the correct quantity and the right quality and form to ensure materials are not wasted
- stored under appropriate conditions to prevent damage
- delivered in appropriate packaging
- recorded on arrival in an efficient inventory management system
- not damaged in transit, storage or while being handled.

Inventory management systems incorporating computer programs and barcodes can assist large companies track the movement of materials before, during and after processing. 'Just-in-time' manufacturing is a lean manufacturing concept that enables raw materials to move directly from the delivery dock onto the factory floor for immediate use, minimising storage requirements. When successfully implemented, 'just-in-time' manufacturing can significantly reduce waste.

Reduce packaging

Packaging is material used for the containment of raw materials or processed goods. Although packaging contributes to waste prevention by protecting product and reducing spoilage, it requires resources and if not reused or recycled must be discarded.

For further information regarding packaging reduction initiatives refer to Avoiding, reusing and recycling packaging (M10) fact sheet in this series.

Reuse

If a waste cannot be eliminated and all efforts have been made to reduce the quantity of waste generated, there may be opportunities for its reuse either onsite or by external businesses, customers or community groups. Reuse is re-using waste without first significantly altering its physical form. This can be achieved onsite through direct recovery of process waste materials to be reused with virgin raw materials as inputs to the process.

Reuse of waste or by-products on site

Onsite reuse of waste or by-products (other products produced incidental to the production process) can reduce raw material costs and waste disposal. The quality and form of the material should be assessed to ensure it is appropriate for reuse.

Reuse of waste or by-products by other businesses or community groups

Slightly off-specification but usable product can be donated to charity or other organisations. The types of waste that are considered unsaleable but may be suitable for donation include:

- incorrect or damaged labelling
- incorrect packaging (e.g. wrong weight)
- over-production runs
- discontinued products or end-of-season stocks
- off-cuts, damaged or unattractive product.

As well as investigating the reuse of waste materials beyond the plant, businesses should also consider if they could reuse wastes from another business.

Product recovery from solid waste

Recovering product during processing

Recovering product by process modification can result in considerable savings in product, as well as reduction in the volume of solid waste and associated disposal costs.

Extracting valuable product

Marketable products can be extracted from manufacturing by-products or waste streams. Some examples of saleable products extracted from manufacturing waste include metal scraps, wood scraps and saw dust.

FERRA ENGINEERING[3]

Ferra Engineering previously sent 130 tonnes of aluminium swarf each year to an off-site recycling plant. By realizing the potential value in the waste aluminium, Ferra Engineering now manufactures swarf briquettes by compressing the aluminium shavings into 500 g blocks which can then be sold and reused. Between 90-95 per cent of all waste metals are now converted to swarf briquettes representing significant economic and environmental benefits both on and offsite.

Recycle

Recycling is the process of treating waste that is no longer useable in its present form and using it to produce new products. The potential for recycling includes wastes generated onsite as a substitute for virgin materials in a separate production process or recycling wastes generated offsite.

Recycling opportunities include: packaging and office waste (See Avoiding, reusing and recycling packaging (M10) fact sheet), scrap metals and metal offcuts, plastics, organic materials (such as wood, food scraps and saw dust), ash from fuel burning processes and used chemicals.

Key issues that need to be considered when determining the potential for recycling wastes include:

- availability of processes to accept waste for recycling
- impact on product and process equipment by using recycled material
- cost of recycling (against cost of disposal)
- quantity and quality of waste (and reliability of supply if substituting for virgin materials)

3 QLD DERM ecoBiz, Ferra Engineering - Efficiency overdrive good for business, **www.derm.qld.gov.au/register/po2112aa.pdf**

NEW PRODUCTS FROM OFFCUTS[4]

Northstate Carpet Mills were able to convert a waste stream of carpet backing into an income generating resource. Previously, annual wastage of discarded natural and synthetic carpet backing was estimated to be 12 m^3 or 2200 kg. The challenge was to identify potential uses for the waste and locate customers and/or recyclers. Carpet backing is now used in a variety of applications such as weed matting, or carpet underlay generating $1800 in revenue.

Scrap yarn was also a major waste problem for Northstate Carpets with unusable, discontinued yarn stocks totalling 80,000 kg. The business units within the company worked together to identify alternative products and outlets for the waste yarn. It was estimated that 300 m^3 of waste yarn was diverted from landfill saving $4400 in disposal costs.

Recycling of packaging, office and maintenance/repair waste

Effective recycling requires monitoring and careful separation of wastes to avoid cross contamination. Some suggestions to assist in solid waste recycling include:

- clearly label general and recycle bins, for example, use of signage or colour coding to increase distinction
- locate recycle bins near to where waste is generated
- involve staff in planning the recycle system and provide training on implementation. Refresher courses can encourage staff commitment and ownership.
- provide information on recycling outcomes including environmental and economic benefits to motivate staff
- ensure waste management contractor has the appropriate licences and capacity to dispose of the waste as agreed
- regularly consult with the waste contractor to identify irregularities
- regularly audit bins and keep records of quantities of recyclables and general waste collected to provide valuable information on the effectiveness of the system. The results of these audits can also be used to promote the success of the recycling program.

SUPERIOR PLASTECH REDUCES PLASTIC WASTE[5]

Superior Plastech manufactures roto-moulded polyethylene pontoons, floating docks, boatlifts and a variety of other products for the marine industry in Queensland. The company's major raw material is polyethylene, which is delivered in polyethylene bags.

The company disposes of around eight tonnes of these bags per year. Previously, these bags were being disposed of in mixed waste skip bins. An environmental consultant put Superior Plastech in touch with a register of plastic recyclers, and now the company is paid $3200 per year for its polyethylene waste, as well as saving $1170 per year on mixed waste disposal—a total saving of $4370 per year, with no capital cost.

'Although we would prefer not to produce the waste in the first place, it's a bonus to receive money for something that we used to pay to get rid of.' Mat Caniffe, Manager, Superior Plastech.[6]

Recycle waste from wastewater treatment systems

Sludge produced from wastewater treatment systems is also a potential avenue for resource recovery and recycling. For further information regarding wastewater product recovery in wastewater treatment systems and minimising sludge disposal costs through dewatering practices refer to the Wastewater treatment technologies and resource recovery (M8) fact sheet.

4 QLD DERM ecoBiz, Northstate Carpet Mills - Textile manufacturing industry – Reducing manufacturing costs by reducing waste, **www.derm.qld.gov.au/register/p00394aa.pdf**
5 Queensland Government, Eco-efficiency for the marine industry factsheet: 8 Recycle, **www.ecoefficiency.com.au/Portals/56/factsheets/marine/ecomarine_fsm8.pdf**
6 **www.superiorjetties.com**

Energy recovery

Solid waste recovered from manufacturing processes can sometimes be used as a substitute for fossil fuels. This can be achieved through biochemical or thermochemical conversion to fuels or through direct combustion. Potential wastes that can be utilised include organic wastes (food scraps, wood, sawdust etc.), plastics (shopping bags, packaging etc.), rubber (waste tyres) and textiles.

The two main biofuel conversions are:

- **Biochemical** – for example, anaerobic digestion which treats organic material in the absence of oxygen to produce biogas
- **Thermochemical** – for example, direct combustion, gasification (where waste is heated with air to produce syngas) or pyrolysis (where wastes are converted to fuels such as gas or oil).

CEMENT AUSTRALIA[7]

Cement Australia operates one of the largest cement kilns in Australia at their Fishermans Landing facility in Gladstone. A number of eco-efficient practices have been adopted covering energy efficiency, recycled material use and energy recovery from solid waste. Waste materials from the surrounding aluminium, steel and power generation industries are used in the cement production process, whilst aluminium smelter wastes such as tyres, solvent based fuels and spent cell linings displace 5% of the coal required in the cement production process.

Treat & Dispose

Treatment and disposal of waste should be adopted as a last resort. The treatment and disposal of waste carries numerous burdens which may not be realised by a company. Treatment and disposal should be carried out in a way that causes the least harm to the environment. Manufacturers should discuss potential options to reduce environmental impacts and disposal costs with their waste management contractors. Examples of possible treatment options to convert waste into a compact non-hazardous form include:[8]

- physico-chemical treatment (for example, evaporation, drying, calcination, catalytic processing, neutralisation, precipitation and encapsulation)
- thermal treatment
- biotreatment
- blending or mixing waste
- storing or repackaging waste.

Disposal should then be carried out through a well managed and appropriately licensed waste disposal facility.

This series of fact sheets provides examples and suggestions to the modern manufacturer on how to achieve both economic and environmental benefits from eco-efficiency. Visit the project website **www.ecoefficiency.com.au** for more ideas and case studies.

7 Corder, G, van Beers, D, Lay, J, van Berkel, R, 2006, Benefits and success factors of regional resource synergies in Gladstone and Kwinana. Green Processing 2006: International Conference on the Sustainable Processing of Minerals, 5-6 June, Newcastle, pp83-92.

8 QLD Government, Environmental Protection (Waste) Management Policy 2000.

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