Creating markets for recycled resources

Plasterboard Case Study

International practice in plasterboard recycling: Denmark

• Gypsum Recycling International A/S

Date established	2002
Activity	Recycling waste plasterboard and gypsum for use in new plasterboard production
Feedstock materials	Waste gypsum and plasterboard from civic amenity centres, construction and demolition activity and plasterboard manufacture
Key product	Recycled gypsum for incorporation into new plasterboard
Total annual tonnage input	33,000 tonnes
Key clients	Knauf and BPB in Denmark, Sweden, Norway Lafarge in The Netherlands BPB in Ireland USG and National in the USA Knauf (and Lafarge) in the UK Yoshino Gypsum in Japan

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Overview

A key priority for Danish waste management policy is the reduction of waste generation. Recycling is an important element of this and there are a range of drivers that promote increased recycling including legislation and economic incentives such as taxation.

In Denmark, it is estimated that 55,000 tonnes of gypsum waste is generated per annum, primarily from construction, demolition and manufacturing activity. Up until the late 1990s, the traditional approach to management of gypsum waste was to dispose of it to landfill. It was then considered uneconomic to dispose of a potential source of gypsum when the country was a net importer of gypsum. Gypsum Recycling International (GRI) saw the gap in the market and established a plasterboard recycling business in the early 2000s and has since developed a mature market position in Denmark.

GRI's approach is to manage the waste from collection at the generating source, to the delivery of recycled gypsum back to the plasterboard manufacturers. The key components of this system are as follows:

- Segregation and collection
- Haulage
- Recycling
- Reprocessing back into plasterboard

Civic amenity centres play an important role in GRI's Danish business, with up to 50% of all plasterboard waste collected by GRI originating from these centres. The remaining 50% originates directly from construction companies and other associated trade companies or through the bulking up of plasterboard waste at waste transfer centres.

GRI reprocess the waste material and provide plasterboard manufacturers with recycled gypsum powder at a price per tonne lower than the cost of virgin raw gypsum. On average 20% - 25% recycled gypsum can be integrated into the manufacture of new plasterboard and up to 40% recycled gypsum has been successfully tested.

Danish Gypsum Waste Management Background

Gypsum is one of the most widely used materials in the building sector and originates both naturally and as a synthetic by-product from a range of industrial processes. Approximately 3 million tonnes of gypsum waste arises in Europe annually, of which it is estimated that 55,000 tonnes arise in Denmark. This is predominantly plasterboard in the form of offcuts from construction sites and stripped-out plasterboard from demolition and renovation sites.

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In Denmark, overall responsibility for waste management is with the Environmental Protection Agency (EPA). A key priority of Danish waste management policy is the reduction in waste. Recycling is an important element of this and approximately 60% of all waste is recycled. This is driven by legislation, economic incentives and other mechanisms, including:

- Denmark's waste tax, which makes it expensive to landfill material but recycling material is exempt;
- Subsidies for cleaner technologies; and
- Agreements, for example between the EPA and the Danish Contractors' Association on selective demolition of building materials.

In the late 1990s, the traditional approach to the management of gypsum waste was to dispose of it to landfill. The drivers described above were pushing towards the development of alternative approaches, but these would still have to fit into the existing waste management system. The practical organisation of waste management is the responsibility of the Danish municipalities. Generally, if they are large they manage waste themselves whereas if they are small then they are likely to join up with others to create joint waste management companies. In addition, there are private waste management companies established for certain waste sources, streams and recycling. This structure provided an opportunity for private companies to develop specific gypsum/plasterboard recycling facilities.

Development of Gypsum Recycling International in Denmark

Business start up and expansion

The idea of recycling plasterboard was part of the founder's concerns for a number of years, culminating in the development of recycling technology in 2000. This was based on an observation of a gap in the market for plasterboard recycling. After further research Gypsum Recycling International (GRI) was established in 2002 as a commercial business to compete directly with other plasterboard disposal options, through the provision of an efficient collection and processing system, and was a fully operational business by July 2003.

Despite the lack of direct legislative support for minimising plasterboard waste to landfill, the national drivers discussed above are seen as assisting in the establishment and continued success of the company.

Civic amenity centres play an important role in GRI's business in Denmark. These provide disposal facilities for private individuals as well as independent builders and small building operators, who are allowed to use the sites for free or are taxed on the waste, dependant

on the municipality. GRI collects from all civic amenity centres under contract, and nearly all civic amenity sites in Denmark now have a GRI plasterboard container on site. Due to the nature of civic amenity centres in Denmark, up to 50% of all plasterboard waste collected by GRI originates from these centres. The remaining 50% of plasterboard waste recycled originates directly from construction companies, other associated trade companies or through the bulking up of plasterboard waste at waste transfer centres.

GRI plasterboard collection container at a civic amenity centre

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GRI recognised that a complete service was required to complement the Danish municipalities' waste management systems, from provision of the collection bins for the waste plasterboard, to the delivery of recycled gypsum to the plasterboard manufacturers. A logistics system was developed which was capable of assuring effective collection, handling and invoicing of the waste producers. This included the development and introduction of specially designed containers for easy filling and removal.

GRI's recycling technology can handle gypsum blocks and plasterboard waste from new construction and production waste from the manufacture of the products, as well as old gypsum waste from other sources, such as renovation and demolition. The success of GRI's operations in Denmark have resulted in total market capture in plasterboard recycling in Demark and has since seen the expansion of their business to fully operational facilities in other countries in Europe and the USA.

With the introduction of the EU Landfill Directive (July 2005), high sulphate wastes (including plasterboard) have been reclassified as non-hazardous non-inert wastes. This directive requires plasterboard to be landfilled in separately engineered cells, segregated from other waste types, in non-hazardous landfill sites. This directive has, to date (June 2006), yet to be transposed into Danish legislation, but will provide an additional driver to increased recycling of plasterboard even though at present Denmark already recycles over 60% of plasterboard waste.

GRI Recycling Facility and Methodology

GRI's approach is to manage the waste from the collection, to delivery of recycled materials to the plasterboard manufacturer. The key components of this system are as follows:

- Segregation and collection
- Haulage
- Recycling
- Reprocessing back into plasterboard

Segregation and collection

Segregation takes place through the design and implementation of an on-site containerised collection system. This approach ensures a low cost separation and collection system for the gypsum waste. The containers are available on a sale or lease basis and can be located at construction sites, refurbishment and demolition sites, waste transfer stations, civic amenity centres, and other locations where plasterboard waste is generated, stored temporarily or sorted.

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The containers used as part of the segregation process were specially designed by GRI to allow for easy loading and removal of the waste plasterboard. They were designed for flexible use and can be loaded from the front through a letter-box style opening or from above when the hydraulically assisted lid is opened. Each container has a capacity of 30 cubic metres, capable of holding 6-7 tonnes of waste.

Plasterboard waste with up to 3% contamination is accepted for collection, whereas waste containing more than 3% contamination is rejected as per their standard contract.

GRI plasterboard collection container in use at a civic amenity centre

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Haulage

Once the accumulated volume of waste is sufficient GRI collect the material, generally transferring the waste onto a specially designed waste haulage truck with a grabber. This means that the on-site container does not have to be moved. For health and safety reasons on site it is usual for an area to be closed off whilst this operation occurs.

Gypsum Recycling International on site collection system

The collected waste plasterboard is weighed on the truck, this information being used to invoice the waste producers. The cost per tonne charged by GRI is lower than the cost of disposing of the waste to landfill.

The material is then transferred to one of a network of centralised warehouses for storage prior to recycling. The warehouses used to store the plasterboard waste are mostly located close to a plasterboard manufacturing plant, as this ensures that the cost of the recycled gypsum as a raw material remains cheap and competitive.

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Plasterboard waste storage warehouse

Recycling

The recycling unit was specially designed and developed by GRI. It is mobile and can be easily moved from one plasterboard storage warehouse to another, permitting an optimal location of the warehouses and minimising transportation costs. With this approach, one recycling unit can service several warehouses / plants. Dismantling and setting up of the unit can be done in a few hours.

All plasterboard waste can be recycled using the system, including waste plasterboard containing foreign materials such as plastic, wallpaper and metal, e.g. nails and screws. The recycling unit separates foreign material and the facing paper from the plasterboard prior to the gypsum core being granulated and powdered. The treatment facility is capable of handling new construction waste and demolition waste, as well as wet and dry plasterboard waste.

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GRI mobile plasterboard recycling unit

The following waste is considered acceptable & non-acceptable:

Acceptable:

- Waste gypsum and plasterboard from manufacturing
- Natural gypsum raw materials
- Virgin plasterboard off-cuts
- Plasterboard underlayers
- Dunnage (strips of plasterboard used to form pallets on which plasterboard sheets are delivered to sites)
- Complete boards or broken parts
- Gypsum ceiling and floor materials

Non-acceptable:

- Plastics and foils
- Insulation materials (glass fibre and mineral fibre)
- Steel rails and bars
- Wood
- Other impurities

Current treatment capacity per reprocessing unit is in the region of 100,000 tonnes per year.

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Reprocessing back into plasterboard

GRI delivers the recycled gypsum powder back to plasterboard manufacturers. It is supplied at a price per tonne lower than the cost of virgin raw materials and the quality of the supplied powder is guaranteed. Both Danish plasterboard manufacturers, Danogips (Knauf) and Gyproc (BPB), take delivery of the recycled gypsum powder for use in the production of new plasterboard.

The GRI recycling process leaves virtually no gypsum on the paper. Paper content within the recycled gypsum powder product is kept below 0.5%, which is considered non-detrimental for further use in the plasterboard industry. The recovered paper is used for a variety of purposes, or is incinerated if no market can be found.

On average, 20% to 25% recycled gypsum can be integrated into the manufacture of new plasterboard, and up to 40% recycled gypsum content has been successfully tested without detriment to the final plasterboard product.

Recycled gypsum powder derived from waste plasterboard

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Conclusions

This case study demonstrates that a successful plasterboard recycling business can be established under competitive and commercial market conditions. The commercial viability of the business is supported by various indirect market drivers, such as taxation and the support of the various municipalities, which ensure that recycling as a waste management option is more cost effective than disposal to landfill. This has allowed Gypsum Recycling International to establish a stable source of material for their business.

GRI's ability to adapt to the needs of the producer has allowed them to capture the plasterboard recycling market in Denmark, with approximately 85% of all public civic amenity centres now serviced by the plasterboard collection system, and approximately 60% of all gypsum waste in Denmark being recycled.

Locating collection containers at civic amenity centres minimises transport costs for small-scale producers and ensures convenient accessibility of facilities. This has proved to be an effective approach within the existing waste infrastructure network.

Offering a complete collection system (provision of containers, regular collection, and accurate billing) for large scale producers such as construction and demolition sites has also proved to be effective. When combined with GRI offering the service at a price per tonne lower than the cost of landfill disposal, the result is demonstrated by the widespread use of the system across Denmark.

GRI operate a network of centralised warehouses where the plasterboard waste is temporarily stored prior to being recycled. These have been located close to plasterboard manufacturing plants – the main client for the recycled gypsum. This operational structure minimises haulage costs from source to warehouse and then on to the point of use, and so enables GRI to supply the recycled gypsum at a price per tonne lower than the cost of virgin raw materials.

The recycling unit was specially designed and developed by GRI, and is mobile to enable it to travel between the warehouses. The recycled gypsum produced is of suitable, consistent and guaranteed quality to enable it to be used in the manufacture of new plasterboard.

On average, 20% to 25% recycled gypsum can be integrated into the manufacture of new plasterboard, and up to 40% recycled gypsum content has been successfully tested without detriment to the final plasterboard product.

Recycling plasterboard can provide a successful alternative solution to landfill, that makes most efficient use of material resources, is cost effective, and improves the environmental image of the plasterboard industry. Further drivers will occur in Denmark when the EU Landfill Directive is transposed into national legislation.

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