

RECYCLING POST CONSUMER POLYURETHANE FOAM IN NEW ZEALAND

**Jo Knight, CEO, Zero Waste New Zealand Trust,
Phone 09 486 0736, email jo@zerowaste.co.nz, website www.zerowaste.co.nz**

Introduction

The Zero Waste Trust is constantly on the look-out to increase the number of materials that can be recycled, rather than going to landfill. We recently discovered a new possibility – flexible polyurethane foam. Polyurethane foam is hugely used in the building and construction, vehicles, furniture, footwear and bedding industries, to name a few. It makes up 5% of all plastics, and is made from petrochemicals.

At the ZW Conference at Kaikoura last year, Terry Macdonald of the St Vincent de Paul Society, Lane Oregon, spoke about the DR3 programme (Divert, reduce, reuse, recycle) in California, which he was setting up with a goal to recycle 500,000 pounds of polyurethane foam per year from old mattresses. Terry Macdonald recently indicated that the programme was going very well and they are currently taking apart 15,000 pieces per month in two locations.

The U.S.A. has a number of business-to-business polyurethane recycling businesses. These have grown considerably over the last year, fuelled by the huge amount of storm damage in the south of the country. The United States currently has more demand for products manufactured from flexible polyurethane foam (FPF) wastes than can be supplied through domestic scrap recovery. Importation of foreign scrap is now a common practice, and it's a competitive situation.

Other markets, such as Europe, are rapidly developing innovative uses for scrap to provide high-value products for their consumers. While the majority of polyurethane foam scrap is processed into bonded carpet underlay for the U.S. market, scrap can also be used in a number of different ways. Its relative high density and excellent resilience makes foam scrap suitable for some furniture cushioning, sound insulation, gymnastic mats and other value-added applications.

Apart from reuse in carpet underlay and these other uses, some of the processes that have been developed overseas may show the way for the future here in New Zealand.

- **Regrinding** industrial and post-consumer flexible polyurethane foam into powders to produce new foam.
- **Adhesive Pressing** coats polyurethane granules with a binder and then cures them under heat and pressure to make contoured parts like automotive floor mats and tire covers.

- **Compression Moulding** polyurethane granules under heat and pressure can produce rigid and 3-D parts, such as pump and motor housings.
- **Chemolysis** - a chemical process to glycolyse mixed polyurethanes and form new polyurethanes that largely retain the properties and functionality of the original materials.
- **Incineration** - high calorific value.

In the United Kingdom, The Furniture Reuse Network, which is an umbrella organisation for about 300 similar organisations, collects, repairs and redistributes furniture but does no dismantling. However, recently in Scotland a mattress recycling operation has started as a social enterprise. Called **SpringBack**, it has received significant support both for set-up and custom made machinery. It is based on a successful model run by the St Vincent de Paul Society in California. **SpringBack** started in June 2005, and it is currently getting some income from foam, springs, cotton, plastic, wood etc. Because of the vagaries of world market demand, their business model is based on supplying the uplift and deconstruction service. They charge a per unit price for the recycling service. Price depends on numbers, distance from their base, etc. The customer base is local authorities, universities, prison service, and retailers. To keep costs down, they only uplift significant volume at any one time and will only uplift from a central storage point.

The New Zealand situation

Late in 2005 Zero Waste NZ discovered that foam scraps were being imported into New Zealand by a foam manufacturing company to use for making foam underlay for carpet. The company concerned, Vita New Zealand Ltd, has a good recycling record and holds the Enviromark certification. Their environmental statement (published on their website) includes, amongst other things, the statements that Vita NZ will:-

- comply with all laws and regulations, especially regarding environmental issues;
- recycle where possible both internally and externally;
- replace raw materials where possible in an effort to use recyclable, reuseable or renewable resources.

Bonded polyurethane carpet underlay is made when scrap foam of various types is shredded into small pieces and placed into a processing unit with a chemical adhesive. The mixture is pressurised and injected with steam to form a large foam cylinder or block. This material is then "peeled" into the desired thicknesses for carpet cushion use. The use of various types of foam (sometimes of different colours) gives bonded foam carpet its unique "marbled" look. Vita was already collecting off-cuts or remnants of new foam from furniture makers, but had not considered using post-consumer foam. As the production of foam underlay involves high temperatures and can include anti-bacterial treatment, the factory hierarchy was prepared to trial samples of post -consumer foam. This trialling proved satisfactory, so setting up a system to purchase back post -consumer foam from within New Zealand was explored.

Development of the Collection System

The Vita factories in NZ are based at Avondale in Auckland, Upper Hutt and Christchurch. Both Auckland and Christchurch factories make foam, and all utilise scrap foam either produced on site or imported from throughout the world. Foam made at their factories is either sold as foam, or is further processed into products which contain foam, notably furniture.

In addition, Vita undertakes its own distribution of these products; there are weekly trucking routes in both the North and South Islands. As transport costs are frequently the fiscal killer of any recycling scheme, this was a bonus as here was an opportunity to backload any collected post-consumer foam using the trucking route in both Islands.

The first discussions centered around:

- the minimum amounts to be gathered to achieve a free pick -up,
- that collected foam was to be bagged or bailed for ease of handling,
- the condition of the foam to make it acceptable for re-manufacture, which included cleanliness, dryness and lack of fibre or metal within the foam,
- the potential sources of suitable foam, as at this stage it was decided to not collect mattresses until health and safety issues could be addressed,
- the amount of payment for the collected foam.

It was logical then to seek to set up depots at which foam could be accumulated on the trucking routes so used foam in reasonable quantities could be back-loaded at no cost to the collector. A rudimentary network of seven depots supplying quantities of foam has now been set up in the South Island. The first few depots have also been established in the North Island.

Plastic foam is a product that comes attached and incorporated within other products. To separate the foam requires disassembly and that becomes an issue. Is it economic to disassemble in an ad hoc fashion as the material comes in, or should local areas gear the system up so there is a steady flow of couches etc for disassembly and therefore a steady flow of foam? For instance, in some areas it is understood there are substantial quantities of both used foam underlay and off-cuts going to the tip with the carpet layers. Local depots could proactively seek to get these dropped off for a lesser cost than land-filling, then sell the products in accumulated bundles to the trucks as they come around.

In order to gain some detail concerning the potential we were looking at, a few couches were disassembled to get an estimate of time taken and potential income from each couch.

So how much foam is in a couch?

PRODUCTS	WEIGHT (kg)	END USE
Foam	5	Recycled
Wood	15	Firewood
Fabric	3.5	possible sale
Waste	11.4	None at the moment
Treasures (coins etc)	0.1	Free latte

Total Weight 35kg

Having got some of the basic precepts of this system together, Zero Waste ran two seminars , one in each Island, to show potential depot operators how the foam was made- an amazing exothermal reaction, and how the foam underlay was processed from scrap. This allowed people to understand why strict quality parameters had been set around the collection of post consumer foam. It was education on both sides, both for people in potential depots and the staff of Vita.

It is hard work getting community groups and Resource Recovery centres to adopt a new line, especially when the recovery involves a processing time commitment to extract the foam from the couches and car seats. In addition to the time taken for disassembly, another problem which emerged was the availability of suitable storage to keep the foam dry while they accumulate the 3-4 cubic metres required for collection. The storage space has to be planned. In Canterbury, for instance, foam has been added to the Canterbury Waste minimization strategy and some funding is available to set up new facilities.

It has been even harder getting a system set up for the larger cities. They are locked into contracts to landfill and in this instance they are not the early adopters the smaller communities and towns are. Expanding services is often far from people's plans. It has become evident that the bigger cities will have to develop a different model. And this has started.

Vita has been a trend setter is considering this and helping with the set up and seminars. The back loading transport system is a vital aspect

The Future

Zero Waste NZ is currently investigating several possibilities for local foam collection, including the feasibility of setting up a depot in North Shore City for citizens to drop off furniture as a trial. Currently this means gaining money from three agencies all at the same time. If this proves feasible then perhaps this will provide a model for elsewhere

Zero Waste also has access to a group of workers who are keen and willing to strip furniture for foam - so we may have the genesis of a viable idea. It would be ideal to collect foam furniture straight from the inorganic collection. A request to have this considered as part of the new Auckland City Isthmus contract for the inorganic collection has been made. In the meantime, we have teamed up the labour group with a car-crusher firm and they are stripping foam from cars prior to crushing.

How Much Foam is in NZ ?

As the possibilities of foam collection expand, it is important to get an estimate on the size of this industry. A bit of extrapolation and deduction has been called for. For a quick estimate it has been assumed that incoming and new material is replacing existing material that is being thrown away.

About half New Zealand’s furniture these days arrives ready-made from overseas. From figures supplied by Internal Affairs, at least 773,000 ready made upholstered couches and assorted seats arrive in the country each year. To gain a reasonable sample size for foam yield we used the data from a biosecurity survey. In July 2006, a Biosecurity Monitoring Group from Biosecurity New Zealand disassembled 47 imported couches looking for infestations that might arrive in the country inside ready-made furniture. The 47 couches yielded 320 kgs of foam; an average of 6.81kg. each. Extrapolating the MAF figures gives us 5,300,000 kgs of polyurethane foam arriving in NZ each year in ready made furniture. Another estimated 5.5 million kgs is made in NZ, giving a grand total estimate of nearly 11 million kgs of polyurethane foam contained within furniture. No figures have been included for imported beds and imported scrap foam so this is a conservative estimate.

Some trials recovering foam from car seats have been completed. Each car could be stripped of foam in 3 minutes and yield around 7.5 kgs of foam. This showed that provided there were sufficient cars available in one place and at one time, an economic case could be made for stripping foam from the cars. The market size is the other question. Market sources indicate that the number imported is judged to equate to the numbers crushed. The 226,270 cars imported into NZ last year would yield 1,700,000 kgs of foam. That’s 1,700 tonnes: a volume of approximately 77,300 cu metres, and that’s just from cars.

	CARS	FURNITURE	
Numbers	226,270	773,000	
Average foam yield	7.5	6.8	
Kgs	1,697,025	5,256,400	
Cubic metres	77,300	239,430	Imported
		248,465	Made in NZ
	77,300	487,895	Total cu m.
Total Kgs	1,697,025	10,710,950	

Total from the two sources 565,195cu. m = 12,408 tonnes.

Westpac Stadium contains approximately 1,248,000 cu. m of air space, so we could fill it once every two years from these two sources alone.

Vita NZ Ltd have indicated that the lifetime of the imported product is only 5-7 years, so an expansion in the number of lounge suites being scrapped is probably going to start within the next 3-5 years.

This study shows these benefits from Recycling Foam

To the recycler

- There is a saving of landfill tipping fees.
- There is a payment per kilogram recovered.
- There is free transport available to depots on the trucking route.
- Having taken the foam from the frame, it takes only a small further investment of time to break the frame up. All furniture framing is untreated wood and so suitable for firewood or hogging for fuel.
- There is a possible destination for some of the fabrics in the rag trade.
- Foam recovered from cars reduces the volume of floc (a waste product of metal recycling), bringing savings in floc disposal costs.
- This showed that provided there were sufficient cars available in one place and one time, an economic case could be made for stripping foam from the cars.

To the landfill operator

- Furniture in landfill or in resource recovery parks is extremely bulky, so if it is broken up, compaction will be quicker and easier.
- Keeping the foam out of landfill has benefits as it is elastic, resilient and regains its shape easily

To the environment

- This material is recycled and used within NZ.
- Look at the landfill space that can be saved each year.
- Carbon Dioxide- reformulating and recycling product has lower energy components than making the product from virgin materials
- Resources- reusing this material saves significant raw product

To Dr Cullen

- Reduced imports of foam; saving of overseas exchange dollars.

Disadvantages

- An additional product line to deal with at Resource Recovery centres.
- Disassembly time costs compared with payment levels.
- Foam must be dry, clean and have no pieces of metal in it.
- Supply of foam-containing material to recycling centres is irregular.
- Dedicated, dry storage space is required.
- Very few people take into account the landfill savings as well.

Where to next ?

What is needed next is research, and extension and consolidation of the programme. What is obvious is that successful programmes need some initial help, and in the cities where big volumes of this material are going to landfill we need recovery industries set up and running on a decent volume business. Ongoing research should include:

- Investigation into setting up a system with the other furniture makers and sellers.
- Development of models for big city inorganic collections.
- Develop models for extracting foam economically from furniture.
- Develop models for extracting foam economically from cars.
- Collection of data on the impact on landfill volume, and the impact the removal of difficult voluminous material with bounce-back memory makes on compaction.
- Investigate the potential of mattress recycling as a progression to the furniture system.
- Collect and collate accurate data on foam use in New Zealand.
- Comprehensive document research of overseas trends.
- How to fund the development of this initiative

Conclusion

This is a good example of Extended Producer Responsibility, but it is one that is currently taking a lot of voluntary time. The possibilities of voluntary recycling with adequate internal funding available have largely been harvested in New Zealand.

This rudimentary system has only been achieved because a not-for-profit has put time and effort into it for a very small return.

Market forces and the establishment of the system as a reliable supply for the factories are keeping the price depressed at the moment. A higher payment would encourage suppliers, but the factories need evidence of commitment and a good flow of materials. Depots and factories work only to their individual focus and it a hard job getting those views to intersect and develop a 3D picture over time.

Both St Vincent de Paul, and FEAT enterprises in Scotland received considerable assistance to get set up and operating, and then became self sufficient. Such support is simply not available at the moment in New Zealand. It is badly needed right across the waste management spectrum.

Internet references

Alliance for the Polyurethane Industry, August 2005, 'Polyurethane Recycling', Available: <http://www.polyurethane.org>http://www.ecy.wa.gov/programs/eap/pbt/pbde/g/s_api/bin.asp?CID=867&DID=3746&DOC=FILE.P <http://www.europur.com/DF>

Dalmijn, Prof Ir Wijnand; de Jong, Ir Tako; and Kuilman, Ing Wim. DEXRT – effective processing of shredder residue. Recycling International Journal – September 2006, No. 7; p28-31.

Furniture Re-Use Network: <http://www.crn.org.uk/about/cases/frn.shtml>

Polyurethane Foam Association, 'The recyclability of flexible polyurethane foam', Available: <http://www.pfa.org/ce/lesson3.html>

Scottish Executive – Sustainable Development: <http://www.scotland.gov.uk/Topics/SustainableDevelopment/20501>

Troy polymers, Inc: <http://www.troypolymers.com>