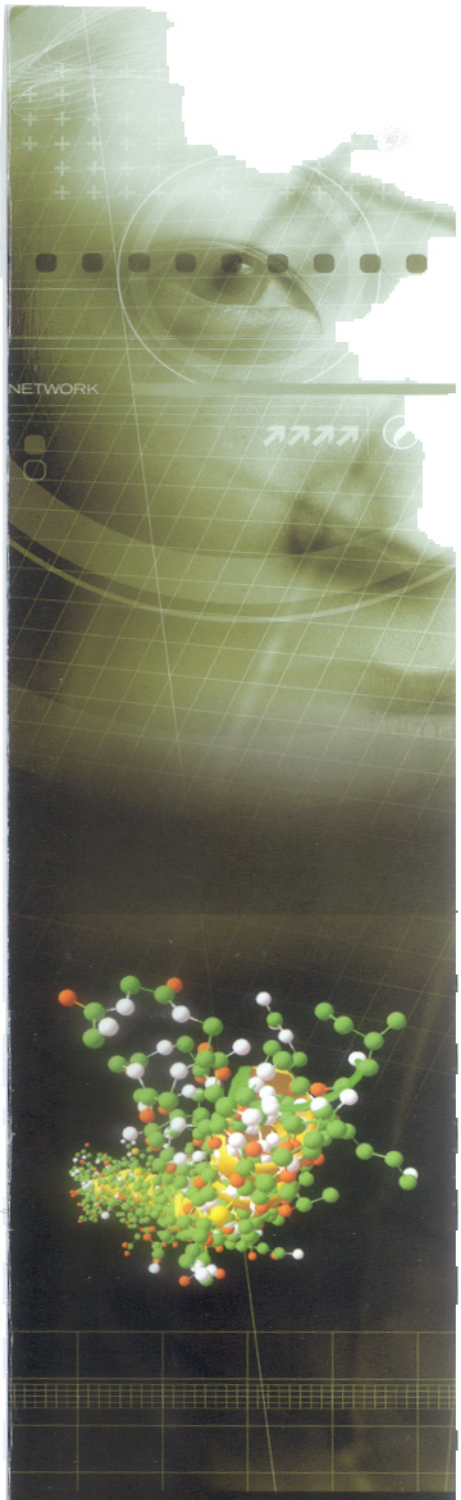

Technical Bulletin

Closed Loop Recycling for Wool Carpet

- **Shredding for use as a fertilizer and soil conditioner has been shown to be a viable recycling option for used wool carpets and carpet waste.**
- **Shredded wool carpet added to the soil increased the dry matter yield of grass by as much as 80%.**
- **The suitability of shredded wool carpet as fertilizer is also confirmed by higher levels of essential elements such as nitrogen, sulfur and magnesium in the fertilized grass than in the unfertilized grass. The levels of essential elements and organic carbon in the soil were also increased.**
- **This closed loop cycle (grass → wool → carpet → grass) is a very efficient form of fiber recycling because it is solar powered, unlike recycling of synthetic fibers.**

Wool carpets have the potential for closed loop recycling [1], involving returning the shredded, used carpet straight into the soil as a fertilizer. As well as increasing soil productivity, being able to recycle used wool carpet in this way will alleviate the problems associated with disposal, especially to already burgeoning landfills.

Disposal of used carpets produces large volumes of waste for landfills. Incineration of carpets is only possible in countries with the necessary infrastructure, and in the face of increasing environmental pressure, this option is rapidly becoming unsustainable. In addition to used carpet, carpet mills produce a significant amount of waste during manufacture, much of which is simply dumped.

Although synthetic fiber producers have made limited progress in the area of recycling, by way of down-cycling, re-extruding and depolymerization, all these require considerable energy and investment in plant [2, 3]. In contrast, wool carpets offer the potential for closed-loop recycling, involving returning the used carpet to the soil as a fertilizer/soil conditioner. In wool producing countries, this means that the nutrients released into the soil would increase grass growth to be eaten by sheep to help grow more wool. It would also have the spin-off of reducing the application of inorganic fertilizers. Adding to the environmental friendliness of this option is the fact that the primary energy source for this process is the sun.

Field Trial

In what, to our knowledge, was the first trial of its kind, old worn wool carpet was mechanically shredded, returned to the soil, and the effect on grass yield and soil and grass nutrients measured.

A 25 m^2 section of paddock, which had been in grass pasture for a number of years, was rotary hoed and divided into four quadrants, each 2.5 × 2.5 m. The area had very little clover, and the trial plot was not sprayed with weed killer. The paddock, which had supported sheep at a low stocking rate for the last few years, had not been regularly fertilized. However, the soil, a Temuka silt loam, was considered to have a high level of fertility, well above average for that soil type. The trial plot was free draining with few stones.

A used woven 100% wool carpet was put through a Garnett card, which shredded it into a mass of single fibers and small fragments of backing, which were collected and rotary hoed into the northwest and southeast quadrants of the trial plot at about 1 kg/m^2. The shredded carpet was left for 2 weeks to start decomposition, and then in spring, Italian ryegrass seed was planted at the rate of 5 g/m^2 over all quadrants.

Trial plot prior to grass sowing, with the gray colored carpet fertilized quadrants on the left and right.

The trial plot was watered every 2-3 weeks as conditions were very dry. By 10 weeks, the grass grown on the two quadrants fertilized with shredded carpet was a darker shade of green than the unfertilized grass, which was an indication of a higher chlorophyll content and therefore a healthier state. This color difference became more pronounced as the trial proceeded, and was still evident 9 months later, despite two lots of harvesting for analysis.

Three weeks after the first harvest, the grass in the fertilized quadrants (bottom left, top right) is lusher than that in the unfertilized quadrant in the foreground.

Five weeks after the first harvest, the darker color of the fertilized quadrants can be clearly seen.

Grass Yield and Nutrient Content

Ten weeks after planting, analysis of the grass showed higher levels of essential elements in that from the fertilized quadrants than that from the unfertilized quadrants (eg, 25% more sulfur, 17% more magnesium, 15% more potassium, 10% more nitrogen and 7% more phosphorous). Levels of essential elements and organic carbon were also found to be higher in soil from the fertilized quadrant.

After 15 weeks the grass was cut and collected separately from each quadrant, weighed and then dried in an oven at 40°C for one week, conditioned at 20°C and 70% humidity for one week, and

Average grass yield (kg) from carpet fertilized and unfertilized quadrants.

Weeks after planting	State of grass	Unfertilized	Shredded carpet	Increase* (%)
15	Fresh	37.8	50.3	33
	Dry	10.9	13.5	24
25	Fresh	8.8	17.2	95
	Dry	2.3	4.2	82

*Increase due to application of shredded carpet.

weighed again. The resulting dry weight yield was 24% more from the carpet fertilized quadrants, even though the same amount of grass seed had been sown over the whole area. A second harvest after a further ten weeks (a drier summer period) showed an 82% increase in dry weight yield over that from the unfertilized quadrants.

Conclusions

It can be concluded from the sustained higher yields found in this trial that the shredded carpet acts as a slow release fertilizer, with the elements being released over time as the carpet breaks down. Wool has the ability to act as an ion exchanger, which allows it to absorb and retain excess ions, which are then made available to the soil as required. This ability would be particularly advantageous in reducing the run-off of nitrates, which are the subject of restrictive legislation in Europe.

In the marketing of a commercial product based on shredded wool carpet, one further possibility is the incorporation of a conventional fertilizer to provide an immediate injection of soil nutrients, to augment the slower, sustained release from the wool.

This simple closed loop recycling experiment has demonstrated the true environmental soundness of wool.

References

1 Carpet America Recovery Effort (CARE). Annual Report 2003.

2. DuPont on carpet waste and recycling. *International Carpet Yearbook,* 1996.

3. Americans to build nylon recycling plant. *International Carpet Bulletin,* January 1998.

Grass → wool → carpet → grass