

# Making The difference - Textile Recycling Today... Innovation For Tomorrow

Garth D Ward

*Garth is coming to the formal end of an exciting, fulfilled career. This has been enjoyed in three distinct professional phases. The first episode was working in the Pathology Departments of two National Health Service Hospitals. Garth worked during the day diagnosing diseases and their treatments whilst studying at night school to obtain a Fellowship in Medical Laboratory Science in Haematology and Medical Microbiology. He then moved into the "commercial" field with the then leading medical diagnostic company as a salesman, progressing to Marketing Manager. For the final part of this second interlude he was headhunted to be a Managing Director, leading a group of scientists to develop diagnostic tests for diseases in fish, plants and animals. His final and most fulfilling position has been with Salvation Army Trading Co Ltd. melding the earlier learned skills and using them to help develop a social, environmental textile collection company whose profits contribute to the second part of The Salvation Army's mission "...to help people in need without discrimination." Outside of work his main happiness is travelling with his wife Christine and spending time with their 8 children and 10 grandchildren!*



## Fast Fashion

Woking, England: Josephine Copeland and her 20-year-old daughter, Jo Jo, visited Primark at the Woking Peacock Centre Mall to buy presents for friends, but ended up loaded with clothes for themselves: boots, a cardigan, a festive blouse and a long silver coat with faux fur trim, which cost £12 but looks like a million bucks. "If it falls apart, you just toss it away," said Jo Jo Copeland, proudly wearing her purchase. Environmentally, that is more and more of a problem.

With rainbow piles of sweaters and T-shirts that often cost less than a sandwich, stores like Primark are leaders in the quick-growing "fast clothes" industry, selling low-cost garments that can be used and discarded without a second thought. Consumers, especially teenagers, love the concept, pioneered also by stores like Old Navy and Target in the United States, since it allows them to shift styles with speed on a low budget.

But clothes - and fast clothes in particular - are large and worsening sources of the carbon emissions that contribute to global warming, both because of how they are produced and how they are cared for.

"The \$1 trillion global textile industry must become eco-conscious. But how

to develop more 'sustainable clothing' is a seeming oxymoron in a world where fashions change every few months."<sup>1</sup>

This does not only apply to clothes. Last year the following was printed in the Guardian newspaper<sup>2</sup>:

"In Britain in recent years, as in other rich countries, many consumer goods have become deliciously, dizzyingly cheap. ...Economists have struggled to find historical precedents for such plunging prices at a time of high consumer demand. There has not been anything quite like this since the 1930s ... when prices fell despite growing consumer appetites."

What is the cause? It is the outcome of a materialistic society that is market driven, a society that strives for equity of supply for all. Personal demand for goods is high and the process chain implications of this demand are so complex that few can comprehend them. Prices, and therefore, unit profit margins are so low that a retail organisation must sell nearly twice as many items just to make the same financial profit as it did 5-10 years ago. Consequently the marketers continually exhort us to change to the latest fashion or colour. They have turned need into want. Many people are sufficiently affluent to accede to these demands, however most are not generally aware

of the impact of these desires. Equally designers cannot evade their responsibility; few, if any comprehend resource management and the need to 'build in' to the design of all products the possibility of re-using, re-styling, re-designing and re-manufacturing; in other words taking true responsibility for their products.

## Textile Recycling

In 1991 The Salvation Army, knowing absolutely nothing about waste, recycling, or sustainability, commissioned a business plan to set up a chain of Charity Shops and a clothing bank collection scheme to supply them with clothes. Its objectives were to raise funds for The Salvation Army and to create jobs at a time of recession. In November that year Salvation Army Trading Co Ltd (SATCoL) was incorporated, entered into a contract with Kettering Textiles Ltd a bespoke textile recycling company, commenced evaluating and introducing new ideas and new ways of carrying out the business basics. As a consequence today the organisation collects and processes in the region of 10% of the UK's second hand clothes.

Textile recycling, itself, is not new; indeed, it is probably as old as the art of spinning and weaving. Benjamin Law is seen as the father of 'modern day' recycling<sup>3</sup>. In 1813 he was the first to

take old clothes and process them into a state (mungo and shoddy) that could be re-spun into useable yarn. Textile recycling grew in popularity over the years and in the twentieth century the 'rag and bone man' was a familiar sight driving his horse and cart down the street. People would rush out and give him any old clothes or objects that were no longer needed. It was an era when, traditionally, people kept their clothes a lot longer, mending and altering them, rather than the 'throw away' trend seen today. Interestingly the rag and bone trade probably had its origins in London in 1588 when Elizabeth 1 granted privileges to 'Mudlarks and Scavengers' to collect rags for making paper<sup>4</sup>.

Tracing textile recycling over the last 60 years or so the only major innovation has been to the collection infrastructure, which has been mechanised. However, clothes are still sorted, reused and recycled in much the same way as they have for the last half century or more.

Today, clothing re-use and recycling cannot be divorced from every day living and as intimated earlier the naissance of the 'value' stores in the mid 1990s, and the concomitant comprehensive change in the UK's purchasing habits, have initiated consequences that are already seriously effecting the second hand clothing trade. More and more tonnage is collected but of a much lower quality, thus affecting the economic viability of the industry. Coupled with this, operating costs have escalated as fuel prices and other expenditure and bureaucracy have increased.

**Short to Medium Term**

In 2005 SATCoL realised that doing nothing was not an option so decided to approach these issues from two separate directions.

As a first short to medium term step sorting the collected garments into 140 grades ceased. Today any overt waste is removed and then the clothes, after satisfying any humanitarian needs at home or abroad, are exported in their original' condition. Thus in the last few months this has reduced costs, protected UK jobs, helped to create employment in 'developing' countries and reduced environmental impacts by reducing energy usage.

Incidentally 83% of the clothes are being re-worn, 14% are being turned into wiper cloths leaving just 3% unusable; a significant improvement on the 60% reuse, 30% recycled and 10%

unusable that is averaged in the UK. Admittedly many of these tangible benefits accrue in other countries, but the environment is global.

**Long Term Action**

The second, but much more progressive, long-term approach has been to work, with the Nonwovens Innovation Research Institute of Leeds University & Oakdene Hollins Ltd., on Defra funded research<sup>5</sup>. This integrated an economic and market analysis of the UK textile recycling industry with a study of technical and market developments aimed at developing new markets for recycled grades of clothing. This will ensure that the UK and European textile recycling industry will have the means of re-processing the low quality garments. This project has proved very successful and the results form the basis of the rest of this paper.

**Table 1: UK clothing sales in 2003<sup>6</sup>**

Apparent Consumption	K Tonnes
Men's	505
Women's	676
Shoes	169
Household textiles	500
Total	1,850

The Guardian estimated that, over the last ten years women had doubled the average number of women's wear items they buy in a year<sup>7</sup>. However, UK clothing sales figures for 2003 (Table 1) indicate that men consume nearly as much.

Figure 1<sup>8</sup> shows the increasing rate of growth in the UK new clothing market over the last ten years and the huge reductions in unit prices. Clearly, 'value' products are encouraging consumers to buy more clothes, but at lower prices.

There is a colossal waste (Table 2) as most people discard their old clothes into the municipal solid waste stream (MSW). Naturally, this needs to be addressed urgently, but with caution as will be seen later. The vast majority is exported – the new clothing trends (Figure 1) provide the reason for this as low quality new 'value' clothes compete directly with the sales of second hand items. Charity shops<sup>10</sup> have responded to the challenge of this lower quality clothing by moving into the sale of alternative used products, such as books, toys and electronic media and into new merchandise such as greeting cards and 'fair trade' commodities. As a result, they need and sell fewer clothes. Most interestingly over 1 billion garments are unaccounted for (397,000 tonnes, Table 2). The expression 'the nation's wardrobe' has been coined as their repository. An, as yet, unanswered question: What happens when it bursts?

**Carbon Dioxide Impacts**

An element of the report was to evaluate the carbon dioxide (CO<sub>2</sub>) impact of both reusing and recycling clothing.

Figure 3 is based on data obtained from Defra<sup>12</sup> and Marks and Spencer<sup>13</sup> and shows quite clearly that in CO<sub>2</sub> terms *recycling* textiles is second only to aluminium and that *reusing* clothes conveys an even greater benefit to the environment. The data from which Figure 3 was constructed indicate that the textile recycling industry and charity shops, together, effectively reduce CO<sub>2</sub> emissions by up to eight million tonnes per year, although this benefit does not accrue to the UK. However, as long as weight targets are used to assess recycling performance these benefits are likely to go relatively unnoticed.

**Figure 1: New clothing trends over a 10 year period**

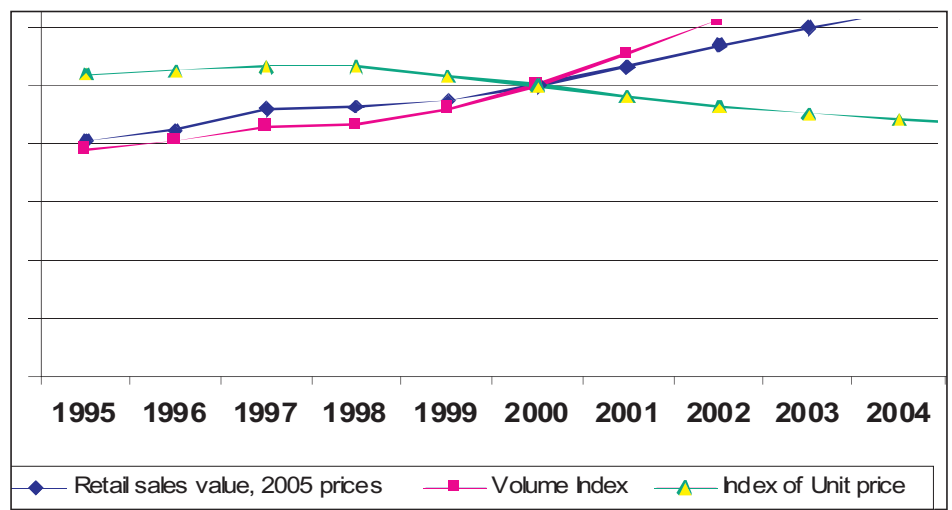
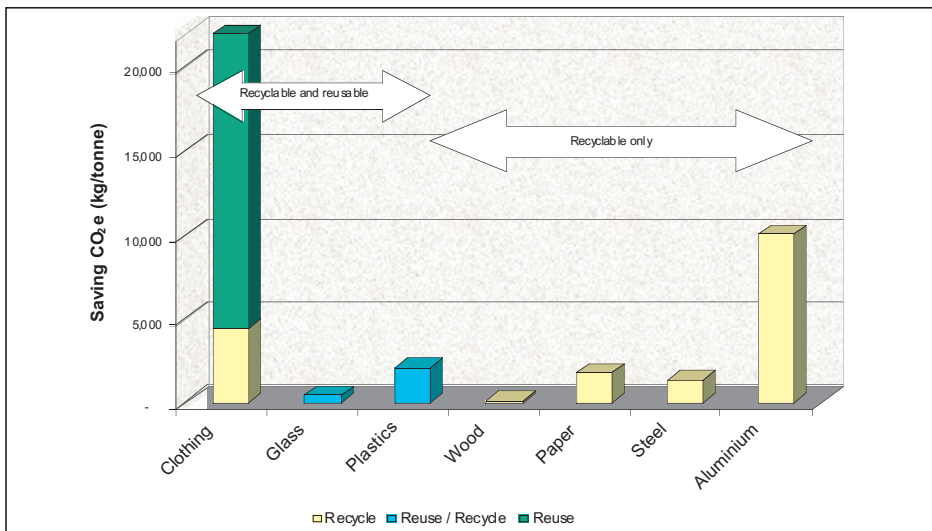


Table 2: Summary of textile arisings and disposals in the UK in 2003<sup>9</sup>

	K Tonnes	K Tonnes	% of new consumption
Apparent consumption of new textiles	1,812		
Imports of used textiles	12		
Consumption of used textiles (mainly Charity Shops)	41		
<b>Total Consumption</b>		<b>1,865</b>	<b>100%</b>
<b>Textiles entering the MSW waste stream</b>		<b>1,165</b>	<b>63%</b>
Textiles collected for resale and recycling	324		
Of which:			
Resale for re-use in the UK (mainly Charity Shops)	41		
Exported for resale for re-use	174		
Recycled in the UK	62		
Exported for recycling	26		
Rubbish, returned to waste stream	21		
<b>Net textiles diverted from waste stream</b>		<b>303</b>	<b>16%</b>
Textiles unaccounted for		397	21%

Figure 2: CO<sub>2</sub> benefits of closed loop recycling/reuse compared to landfill disposal<sup>11</sup>



**Collection Viability**

Earlier a brief mention was made of the adverse economic effects that are of concern to the industry and the effect that the lowering of the quality of clothes, but increasing the quantity, is having on the commercial viability of textile collections. Put very simply (Figure 3):-

- Marginal costs of collection and sorting and then onward sale (MC) increase as the proportion of clothing collected increases and a greater effort is required to abstract smaller and smaller proportions of quality textiles from the waste stream.
- A variable mixture of clothes is collected and sold, therefore, the average unit selling price and thus margin will vary with the mix (MR).
- Where income and cost intersect is obviously the break even point.

- The principal reason for any decline in the level of recycling and re-use is that new clothing and fibre can be purchased at lower prices as restrictions on international trade are removed, which will lower the prices achievable for clothing or fibre by the recycling industry, (shown by a left shift of the curve – MR<sub>1</sub>) so the break even point reduces too (from a to b).
- Thus, lower quality clothing collections eventually have the potential outcome of forcing textile recyclers into bankruptcy and then there will be no collections at all unless they are subsidised.

Urgent action is needed to negate this effect. Accurate figures are not yet available but the effects are already in evidence. There has been one textile merchant bankruptcy in the last 24

months and in January 2006 Scope<sup>15</sup> commenced a programme of shop closures due to the reducing value of clothes.

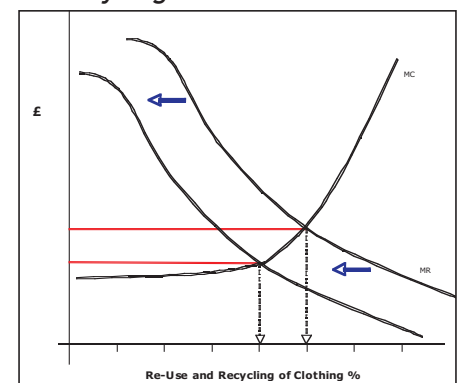
RREUS<sup>16</sup>, a specialised European network of national and regional social economy federations and enterprises with activities in re-use and recycling, affirms "The secondary textiles sector is facing an important crisis, due to several types of factors; ... Deterioration of the quality of the original material collected, - in consequence, the percentage of good quality, that can be sold as second-hand clothes, is decreasing (it is now 40% where it used to be 60%); 60% of the quantities collected have to be recycled (which is not profitable), or disposed of."

**Producer Responsibility**

The long-term approach must be to incorporate true voluntary producer responsibility into the fashion business. Chief Executive Officers (CEOs) have to understand that where a business uses natural resources it must do so in an efficient manner, so that the company's operations do not compromise the ability of future generations to meet their own needs<sup>17</sup> and that it can be carried out in ways that enhance the profitability of their organisation.

The Chartered Institute of Marketing recently produced a discussion paper where they stated: "The Triple Bottom Line<sup>18</sup> – economic, social and environmental – is a practical method for companies that want to become sustainable businesses. Whilst sustainability can be a confusing and open-ended term, the Triple Bottom Line is an effective concept because it creates a framework for companies to become sustainable, without ignoring the importance of the financial bottom line or other concerns that are vital to a company's survival, growth and economic success."

Figure 3: Changes in marginal revenues and costs for clothing re-use and recycling<sup>14</sup>



Although the required action and direction must be instigated by the CEOs, it will be carried out by designers and marketers working together and this will call for professional training and awareness raising, but of course it will not be a rapid process. After all, even within the waste and recycling industry, as well as Government, apparently there is still not a full understanding of real resource efficiency and management.

**New Technology and Markets**

The technical elements of this project have successfully developed new, innovative ways of reprocessing the lower quality and other non-wearable items into profitable products that should help to develop this theme.

Earlier it was noted that there was one million tonnes of textiles discarded into the UK's waste stream and it is assumed that they will generally be of a low quality. This is a massive latent resource but unfortunately the traditional textile recycling markets consume nothing like this quantity (Table 3)<sup>19</sup>. Thus to utilise this resource new markets must be created and this will require the development and utilisation of new technologies.

Much of the innovative work is still commercially sensitive but is based on fibre technology developed by the Nonwovens Innovation Research Institute in Leeds that utilises energy-efficient methods of forming fabrics directly from waste fibres extracted from clothing that are suitable for industrial use. The technical work to date has verified the feasibility of various processing methods for recycling low-grade clothing waste ranging from acrylic articles to denim. Potential commercial customers are closely involved in the evolution of the technology. The firm customer interest that has been established is helping to identify how the concept samples can be further developed to a commercial stage.

It is evident from the current research that by carefully considering the chemical and physical specifications of the waste fibres and assembling them into appropriately engineered fabric structures premium product markets can be targeted. It is the

properties and technical attributes that are important in determining the industrial utility of any fibre raw material, including recycled fibres. The added cost advantage of recycled fibre, usually less than 40% of the cost of the virgin fibre equivalent, adds to the attraction.

The first area of this research<sup>20</sup> demonstrates that the substitution of glass with recycled polymeric fibres in certain non-structural composites & bio-composites is technically feasible and has a very high chance of industrial acceptance. There are commercial partners who are very keen to incorporate this new fibre reinforcement technology as it provides a means of reducing the density and therefore the weight of non-structural parts as well as providing significant economic benefits.

A new variety of capillary matting for the horticulture and hydroponics markets has also been developed. Capillary matting is generally a low-tech area and the extra benefits and 'value added' embellishments relate to the engineering of unusually high wicking rates in the fabric making this aspect of the research<sup>21</sup> extremely appealing. Commercialisation studies are already well under way. Further development of pre-seeded matting was also studied but the results did not indicate that this was a product that would be economical viable as a 'stand alone'.

The automotive industry currently uses recycled textiles as for example, sound insulation and as sub-components of the interior floor covering. However, the waste fibre processing technology that has been developed has the ability to incorporate functional particulates such as phase change materials (PCMs) for temperature regulation<sup>22</sup>, as well as absorptive compounds that act as 'odour eaters' in the enclosed environment. These additives provide opportunities for 'adding value' and technological improvement of minimising cost, since most of the product is composed of recycled rather than virgin fibre. A consortium is being formed to move these materials to their next stage of development.

A final field of progress mentioned in the report<sup>23</sup> is air filtration, as used in applications such as air conditioning systems and face masks. The filtration efficiency of these media relies on both the physical properties of the fibre and the construction of the fabric itself.

**Photograph 1: Roof & cover parts**



**Photograph 2: Wire & computer ducting**



**Photograph 3: Headliners – active sound absorption + local temperature control or cabin air management**



**Photograph 4: Active flooring – odour control + local temperature control**



**Table 3: Breakdown of the UK recycled textile market 2006**

Application	Volume (Tonnes/yr)	Market Proportion (%)
Mattress/Upholstery	41,000	66
Carpet Underlay	6,800	11
Automotive	5,400	8.7
Other	8,800	14.3
<b>Total</b>	<b>62,000</b>	<b>100</b>

Progress has been made on the replacement of virgin fibres with recycled fibre materials recovered from waste clothing in high performance air filtration media. Although further work is in progress to refine the methods of processing and fabric assembly to achieve industry specifications, this approach is sufficiently economic and technically promising to warrant further development.

#### Future Textiles<sup>24</sup>

The following is just a very small example of the innovation occurring in the textile world in 2007 to complete this brief examination of textile recycling:

- Wearable TV screens in garments – this is the latest generation of flexible display screens, which can be incorporated into clothing
- Self-ironing shirt – a shape memory shirt that recovers its pre-programmed shape as a result of a 20-micron diameter thread made of nickel and titanium woven into the cloth
- Holofiber – hologenix is billed as the world's first body-responsive textile fibre scientifically proven to significantly increase oxygenated blood flow, which can increase circulation and build strength
- Wonder slim – a new processing technology from Japan that coats fibres with a compound of caffeine and seaweed that activates fat-dissolving enzymes
- Solar powered jackets – designed to carry, connect and charge portable devices, these are commercially available now.

These are just five widely varying instances from the multitudes available. 'Smart' technology clothing is here now. Is the waste and recycling industry ready? Have recycling or reprocessing procedures been evaluated? Will these 'Smart' clothes be classified as textiles or WEEE?

Oliver Wendell Holmes Sr., (August 29, 1809 – October 7, 1894) an American Physician, writer and poet wrote: "Once stretched by a new idea, a man's mind never regains its original dimensions." This presumably means that man can never go back to what or where he was, he must always move forward. Earlier it was stated that the only serious innovation in textile recycling was in the collection infrastructure. The work just described means that innovation for tomorrow is happening now.

#### References

- <sup>1</sup> International Herald Tribune 24 January 2007
- <sup>2</sup> The Guardian, February 28 2006
- <sup>3</sup> [http://www.e4s.org.uk/textilesonline/content/6library/fr\\_library.htm](http://www.e4s.org.uk/textilesonline/content/6library/fr_library.htm)
- <sup>4</sup> <http://money.guardian.co.uk/workweekly/story/0,,1837511,00.html>
- <sup>5</sup> Recycling of Low Grade Clothing Waste Defra Contract Reference: WRT152
- <sup>6</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>7</sup> The Guardian, ibid
- <sup>8</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>9</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>10</sup> Charity Shops Survey 2005, Charity Finance
- <sup>11</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>12</sup> Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions, Defra, November 2005
- <sup>13</sup> Streamlined Life Cycle Assessment of Textile Recycling, ERM Ltd for Salvation Army Trading Company Ltd, 2002; & Life Cycle Assessment for Re-use/Recycling of Donated Waste Textiles Compared to Use of Virgin Material: A UK Energy Saving Perspective Woolridge, A.C. et al, Resources, Conservation and Recycling 46 (2006) 94-103
- <sup>14</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>15</sup> Scope to close 50 charity shops as £10m loss looms; [www.telegraph.co.uk](http://www.telegraph.co.uk) 13 January 2006
- <sup>16</sup> Report by Textile Re-use and Recycling Players on the Status of the Industry in Europe, RREUSE, June 2005
- <sup>17</sup> Personal communication from Chartered Institute of Marketing
- <sup>18</sup> Personal communication ibid
- <sup>19</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>20</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>21</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>22</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>23</sup> Recycling of Low Grade Clothing Waste ibid
- <sup>24</sup> Future Materials published by World Textiles Publications Ltd