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HOW TO TURN TEXTILE WASTE INTO VALUABLE FIBERS

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ABSTRACT
The worldwide production of fibres has been increased gradually in the last 50 years (CIRFS, 2008). Apparel industry is one of the most important users for fibres. Recycling and reuse of apparel waste that the owner no longer needs has been carried out in many European Union (EU) countries since 1980s by putting up containers to the specific areas. The collection is mostly organized by charitable organizations, communities or some commercial textile recycling companies. Revenue from second-hand sales is enough to cover the processing cost of un-salable clothing. On the other hand, collectors are facing problems due to rise in waste fraction in the last 15 years (Feldmann, 2008). While landfilling is the last option for waste disposal in EU, incineration causes high disposal costs to the apparel collectors. This study aims to decrease the waste fraction by processing it into a fibrous product and to increase the profit of environmentally friendly apparel collection.

Textile chain has a lot of impacts on the environment by the enormous consumption of energy, water and chemicals. (Seuring, 2004; Leung et al., 2008; Coster, 2007). Therefore, recycling of used clothing should be improved by development of new technologies. In this study, un-salable apparel which is supplied from the apparel collector Humana-People to People Austria has been processed into short fibres. Firstly, apparel has been crushed with a shredder. After removal of the foreign parts, the shredded pieces have been ground with a laboratory scale cutting mill having 0.5mm mesh sizes. Finally, a homogeneous fibrous product has been obtained from end-of-life apparel.

Composition of the reclaimed fibres has been determined by solubility experiments (Shao and Filteau, 2004). Solubility test results showed that cotton and polyester are the main fibres used in the apparel industry, which is in accordance with their world productions (Table 1). Reclaimed textile fibres contain a large variety of fibres and the composition of the three samples varies, as well. This is not unexpected since the composition of the reclaimed fibres can change depending on many factors, such as the place and the season of collection.

An optical image analyzer (MorFi Analyzer) (Passas et al., 2001) which determines fibre length and width has been used for the determination of length and width of reclaimed fibres. The distribution functions of reclaimed fibres have been compared with a commercial product Arbocel®. It is ground cellulose which is used in a variety of applications, such as in the construction industry to increase load capacity and temperature resistance of asphalt pavement (Rettenmaier, 1991). The average arithmetical widths of reclaimed fibres are about 20 µm, which corresponds to typical diameters of textile fibers demonstrating that fiber width is not affected by the grinding process. The average arithmetical width of Arbocel® (25 µm) is slightly higher than reclaimed fibres. The distribution functions of length for the reclaimed fibres are almost the same as Arbocel®. The average arithmetical length of reclaimed fibres is very close to 0.5mm that is the mesh size used during the cutting process. The average arithmetical length of Arbocel® is 0.55mm. As a result, a fibrous product having similar morphological properties with the commercial, expensive additives could be obtained by processing of end-of-life apparel.

Table 1 Composition of fibres derived from end-of-life apparel and their world productions in 2007.

			Sample 1		Sample 2		Sample 3		World Production[+]
Man-made fibres	Cellulosics	Viscose	12.2	18.4	7.9	13.5	5.9	10.3	4.9
		Acetate	3.4		5.2		4.4		
		Triacetate	2.8		0.4		0.0		
	Synthetics	Polyamide	7.1		1.2		6.0		5.3
		Polyester	17.3		23.2		11.3		42.5
		Acrylic	3.5		4.8		2.6		3.3
		Polyolefin	3.2		7.2		5.9		5.6
		Elastane	5.7		9.7		4.4		-
		Others [#]	-		-		-		0.9
Natural fibres		Cotton	28.9		26.84		32.8		35.7
		Wool	6.0		4.3		12.7		1.7
		Silk	1.2		4.9		6.6		-
		Insoluble	8.7		4.4		7.4		-

[+] World production in 2007 (CIRFS, 2008, Fibre Organon).
- No data available.
[#] Others include aramid, elastane, PVA/PVC.

In conclusion, there is a possibility to use the reclaimed fibres in the construction industry for viscosity adjustment or reinforcement. Further investigation is necessary for the suitable application area of the new fibrous product obtained from apparel waste. If a suitable market could be found for the reclaimed fibres, the zero -even negative- value clothes turn into valuable fibres.

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