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Opportunity knocks for tyre

What do producers of all-weather sports pitches, playgrounds and shoes have in common with road builders and automotive industry suppliers? They all use raw materials derived from recycled tyres. In recent years, end-of-life tyres have been undergoing a transformation from environmental problem to valuable link in the recovery and recycling chain.

Sorting centre where 10 000 tyres can be sorted every day. *(Source: Lintire)*

The enormous worldwide growth in mobility over recent decades has led to a huge increase in the volume of end-of-life tyres. In the absence of well-organised collection networks and outlets for recycled used tyres, many countries have regarded them, and continue to regard them, as an intractable environmental problem. Add to that the negative publicity often surrounding discarded tyres - for example, reports of illegal dumping or of fires in storage depots - and prejudices have become firmly rooted.

Fortunately, the situation is changing rapidly as more and more is being done to address the issue of end-of-life tyres. The principal advance has been growth in the number of environmentally-friendly and cost-effective options for recycling tyres; particularly in the EU, tyres are now increasingly regarded as a useful resource for various recycling options.

The EU is a pioneer in the organisation of the collection, processing and recycling of tyres, mainly as a result of legislation and uniform guidelines that apply to all member states. The EU also actively encourages research into new applications for materials recovered from tyres. Meanwhile, raw material prices and growing environmental awareness among governments, manufacturers and consumers are also helping to gain wider acceptance of new products created through recycling.

Major driving force

As already mentioned, legislation is a major driving force behind EU advances in the organisation of tyre recycling. The regulations that have had the greatest impact on restricting the landfilling

recycling

of tyres and promoting recycling are the Landfill Directive (1999/31/EC) and the Directive on End-of-Life Vehicles (2000/53/EC) which prohibited the landfilling of complete tyres in 2003 and the landfilling of shredded tyres three years later.

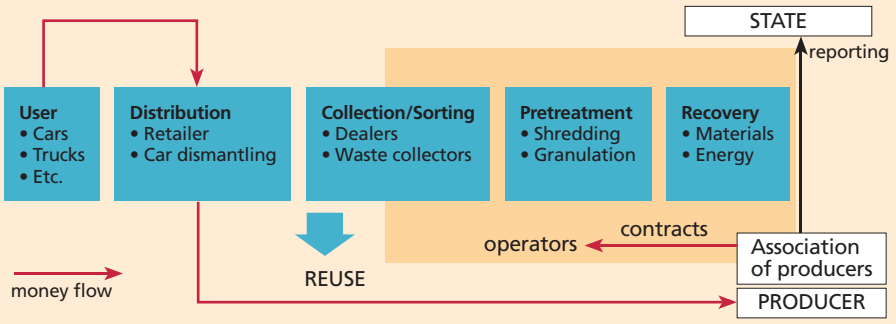
Owing to the large number of market players such as manufacturers, importers, retreaders and garages that collect, sort and recycle tyres, it is difficult to determine the volume of end-of-life tyres with any precision, but the most reliable figures come from the industry's umbrella organisation, the European Tyre & Rubber Manufacturers' Association (ETRMA). As shown in ***Figure 1,*** more than 3.4 million tonnes of tyres were reportedly processed in 2007; of this total, 1.3 million tonnes were used for material recycling, 1.1 million tonnes for energy recovery, 0.4 million tonnes for retreading and 0.3 million tonnes for reuse and export. The combined recycling rate for all EU member states was 91% while the figure for the EU-15 was 95%. Both these figures were higher than those recorded in, for instance, Japan (89%) and Canada (80%). It is also important to note that the new EU member states are making rapid strides in increasing their tyre recycling rates.

It has also been found that used tyres from end-of-life vehicles account for roughly 10% of all end-of-life tyres that are recycled. According to the ETRMA, the European tyre replacement market contracted dramatically in the first four months of 2009 when compared with the same period in 2008. Sales of truck tyres fell by 32%, passenger car tyres by 8% and agricultural tyres by 15%. The recession is also having a negative impact on the supply of end-of-life tyres to sorting and recycling companies.

Figure 1 - Volume of end-of-life tyres and recycling rates per member state in 2007.

(Source: ETRMA)

Figure 2 - Example of a deposit and return system



Three systems in the EU

There are three systems used in the EU for collecting end-of-life tyres, one of which is illustrated in ***Figure 2.*** System 1 involves manufacturers being taxed by the government to generate funds which are used to pay collection and recycling companies; System 2 is the deposit-and-return approach whereby manufacturers are themselves responsible for recycling and contribute to a joint fund from which the costs of collection and recycling are met; and under System 3, all involved parties must comply with waste legislation but can choose the way in which they do this.

The practical results of the deposit-and-return system can be easily measured National organisations for collecting and recycling end-of-life tyres have been created since the introduction of a European system of producer responsibility.

Grinding and cooling

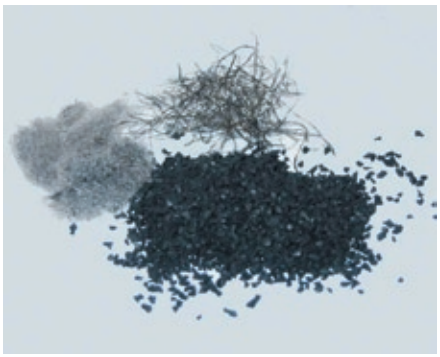
Every recovery and recycling system must start with the collection of used tyres. Once collected, tyres first have to be sorted so that those suitable for reuse are separated from those that have to be scrapped. Tyres for reuse are further divided into those that can be directly reused and those that can be reused following retreading.

Scrap tyres are often cut into shreds or chips which can then be sold as a fuel to power stations or cement kilns. Specialist companies can also process entire tyres or shreds into granules of various sizes, with the size of the granule depending on market demand or the application for which they are intended.

Conversion of tyres into rubber granulate can be achieved through grinding at ambient temperature or via the cryogenic route. Both processes yield three products - steel, textiles (in the case of passenger car tyres) and rubber granulate - and all possess specific characteristics.

The amount of energy required to grind rubber

State-of-the-art ambient granulating line.
(Source: Eldan)



Products from the granulating process: steel, textiles and rubber granulate.
(Source: MeWa)

Application of rubber granulate in synthetic turf fields.
(Source: Granuband)

Cold cure retreading: Bandag method.
(Source: KARGRO)

Hot cure retreading: UBO method.
(Source: KARGRO)

at ambient temperature increases as the size of the granule declines. The powder that is produced at ambient temperature also becomes increasingly static as the granules become smaller, so that the material 'sticks' and becomes difficult to pack. This is due to the frayed structure of the small granules.

Both of these problems are avoided by grinding rubber at a temperature so low that it becomes as brittle as glass. With this cryogenic method, liquid nitrogen at –230°C is used to cool the rubber to approximately –80°C. The resultant brittle rubber can be broken rather than torn, thereby requiring little energy and producing remarkably smooth granules. The rubber can then be reduced relatively easily to granules smaller than 250 mm. Rubber powders with granules of this size can then be mixed in virgin compounds and used for a wider range of applications than coarser powders.

Nowadays, customers exist for all of the materials that are produced during the successive stages of the reduction process - from complete tyre to rubber product. Companies that lay synthetic turf sports pitches offer a good example.

Retreading options

Retreading involves applying a new tread to the tyre carcass which can last for hundreds of thousands of kilometres. A distinction is made between cold cure retreading and hot cure retreading: the advantage of the cold cure route is its flexibility since it can be used for the production of small batches of various sizes; with the hot cure method used mainly for mass production, the tread is vulcanised in regular tyre moulds.

Truck tyres can be retreaded three to five times, while aircraft tyres are given a new tread up to ten times. Owing to the heavy demands placed on these treads, they are replaced long before the carcass shows any signs of wear. Roughly 40% of the truck tyres on the European market are retreads - equivalent to more than 6 million tyres within the EU-15.

The retreading market is currently under pressure owing to the recession and to the influx of cheap tyres for passenger cars, vans and trucks from Asia. Chinese tyres are often particularly inexpensive and are sometimes cheaper per kilogram than unprocessed rubber. Leading manufacturer Goodyear recently reported a fall-off in the retreading market of 30 to 40%. Whereas falling prices are the main problem facing companies that retread truck tyres, retreaders of passenger car tyres face the additional complication that today's consumer prefers wider tyres. Since used tyres are always several years old, the average used tyre is narrower than what the customer wants. Retreading can make a tyre safe and effective, but it cannot make it wider. Most car tyres suitable for retreading are therefore exported to countries where the car fleet is on average ten years older than that in the Netherlands or in other EU-15 countries.

World's largest retreader

There is a growing trend towards tyre manufacturers acting as retreaders. Michelin is in fact the largest retreader in the world today: the brand generates sales of retreaded truck tyres by concluding contracts with its customers for a certain number of kilometres. Truck tyres are guaranteed for that number of kilometres and retreaded in the meantime. This is an approach that could prove worthwhile for other retreaders.

In the EU, the share of tyres deposited in landfills declined from 62% to 9% between 1994 and 2007. The retreading share of the market remained stable at 12% during this period, while the figure for exports and reuse was stable at 9%. Material recycling increased sharply from 6% to 39% while energy recovery jumped from 11% to 32% ***(See Figure 3)***. The stability of the retreading market and the stagnation of the reuse and export share indicate that energy

Figure 3 - Trend in recycling of end-of-life tyres in EU in the period 1994-2007

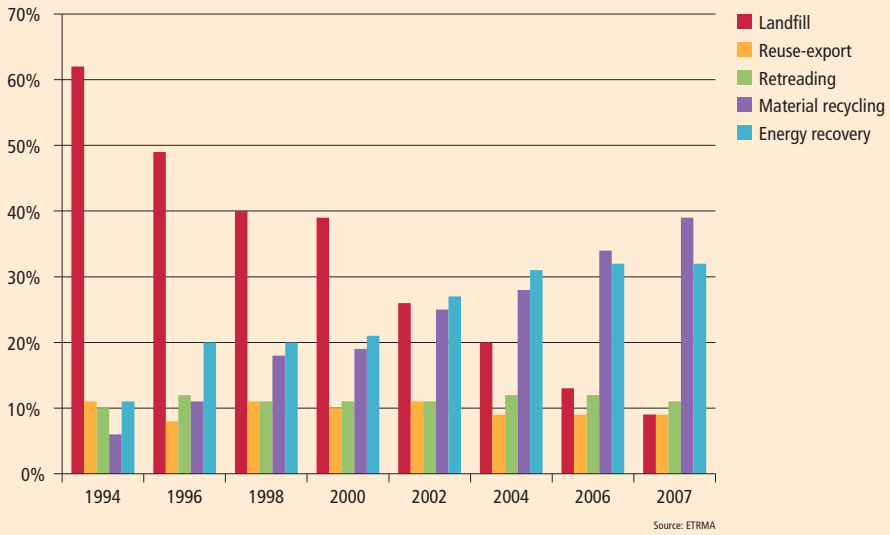
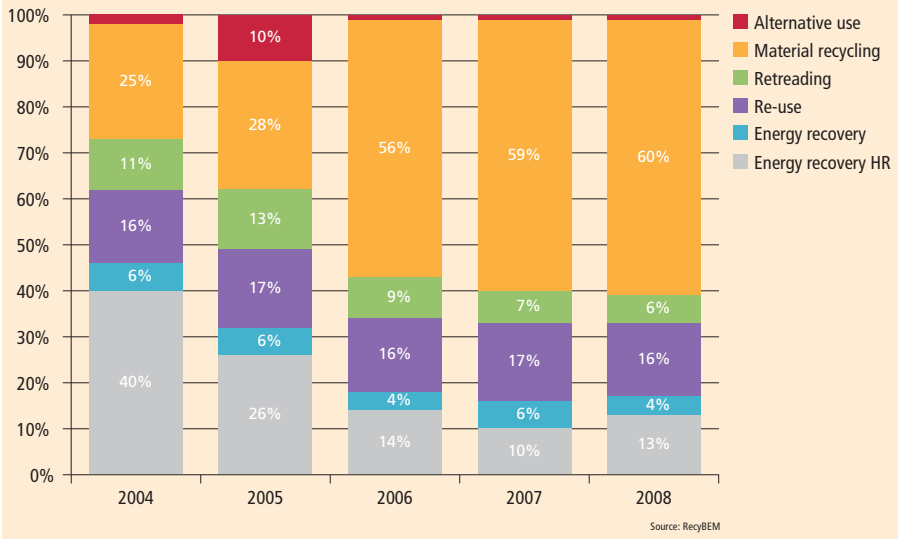


Figure 4 - Trends in recycling of end-of-life tyres in the Netherlands in the period 2004-2008



recovery and recycling will grow in importance over the coming years.

Netherlands boosts material recycling

Figures for the Netherlands show that implementing organisation RecyBEM collected more than 8 million passenger car tyres in 2008. ARN has collected an additional million or so tyres from car dismantling companies. Thus, the Netherlands annually generates a total of 9 million used passenger car tyres weighing around 55 000 tonnes. Tyre sorting and processing companies in the Netherlands annually process approximately 115 000 tonnes of tyres of all types.

Figure 4 shows the quantitative increase in material recycling from 25% in 2004 to 60% in 2008. In this process, old tyres are converted into granulate which can be used as raw material for new rubber products. The decline in the percentage of thermal recycling (incineration with energy recovery) from 46% to 17% demonstrates that the tyre industry also takes the environmental advantages of material recovery very seriously. No tyres were landfilled between 2004 and 2008. Retreading was confined almost entirely to truck tyres and declined in the Netherlands from 11% to 6% over the same period.

Bright future

The use of tyre-derived rubber granulate as an infill in synthetic turf is expected to maintain its growth. This granulate is used in sports pitches all around the world and must be viewed as a mass application. Since synthetic pitches last roughly ten years, this bulk application is infinite and, in time, will become a stable market. The first synthetic turf pitches will require replacement in 2012.

Granulate producers will face competition from new companies in Eastern Europe and prices will become further depressed. However, the market will ultimately settle; an important factor in this respect is that the distance over which entire tyres can be transported profitably is just 300 kilometres. The market for consumer products manufactured by granulate producers - such as tiles for playgrounds - is small at present but holds enormous potential. The inventiveness of companies will play an important role in this.

Gate fee decisive

Tyre sorters can choose between sending scrap tyres for conversion into granulate or for thermal processing in a cement kiln or power station. Apart from the question of logistics, a decisive factor in that choice will be the gate fee applicable to these options. Companies that produce rubber granulate will therefore be forced to compete on price with cement kiln operators. This will continue to be the case since legislation does not prescribe a minimum quota for material recycling.

Devulcanisation of tyres will remain the Holy Grail of tyre recycling and a focus for research and development. It is entirely possible to produce reclaim materials from unmixed compounds, but in practice it has proved very difficult to make a high-quality product from tyre rubber because a tyre consists of a mixture of different compounds, each with its own devulcanisation characteristics. Devulcanisation has proved successful in the production of reclaim from inner tubes (butyl rubber) and treads (natural rubber), which can in turn be reused within the tyre industry to make, for example, inner liners for tubeless tyres.

During the last 15 years in Europe, the recycling of discarded tyres has grown into a flourishing and diverse industry in which there has been a steady improvement in the quality of materials and products, as well as in efficiency levels. The focus of the recycling industry is gradually shifting towards discovering new products and applications for residual materials from tyres. The development of new recycling technologies is quickly leading to new, better and cheaper recycling options. Tyre recycling can therefore look forward to a bright future. □

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