End-of-life Tyres Management

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Editor' Note: This paper has been targeted for a broad audience. The level of scientific detail provided is therefore not as high as would be normally be required in technical paper subject to peer review by environment industry professionals.

Introduction

Most of tyres are derived from land based vehicles including bicycles, motorcycles, cars, light commercial vehicles, trucks, buses, and industrial and agricultural vehicles (TRL, 2013).

Tyres are basically constituted by natural and synthetic rubber, carbon black, steel cord, polyester, nylon, steel bead wire, silica and others chemicals, oils and pigments (WBCSD, 2008), and their composition is different according the tyres type (e.g. bicycle, truck, passenger car) and their producers (Sharma and Reddy, 2004).

As other materials, tyres have a limited life cycle, so they are an environmental problem worldwide (Dias and Santos, 2008).

Some of the environmental and public health problems related to end-of-life tyres are:

- no end-of-life treatment with legal or illegal disposal: (1) discarded stockpiles promotes mosquitos development, which are vectors of diseases (Ferrão et al., 2008; Leff et al., 2007); (2) fire hazard (Edeskär, 2006); (3) tyres fires are difficult to extinguish (Lisi et al., 2004) and can contaminated surface and sub-surface water, air and soils (Leff et al., 2007; Shalaby and Khan, 2005); (3) leaching problems occur with metals and some substances added to the rubber (WBCSD, 2008); (4) visual impact on landscape (Ferrão et al., 2008);
- landfill disposal: (1) whole tyres occupy a large space of the landfill, decreasing landfill life cycle (Shalaby and Khan, 2005); (2) whole tyres have tendency to migrate to the top of the landfills, breaking protection layers and increasing the instability of the sites (Ferrão et al., 2008; Levy et al., 2002); (3) tyres (shredded or whole) are non-biodegradable material (Shalaby and Khan, 2005); (4) leaching metals can occur from tyres disposal (Ferrão et al., 2008).

Nevertheless, end-of-life tyres are resources that can be valorized, with economical and environmental benefits.

In the following document we will analyze end-of-life tyres management. First we will discuss the global panorama in Europe. Secondly a description of a single country (Portugal) will be reported in more detail. Finally, we condude, with a referral of the new challenges on the topic.

End-of-life Tyres Management in Europe

Since 2000, end-of-life tyres cannot be landfilled on european countries result of the European Directive 1999/31/EC, dated 26 April 1999. As a consequence other solutions and destinations have been promoted recently (Figure 1).

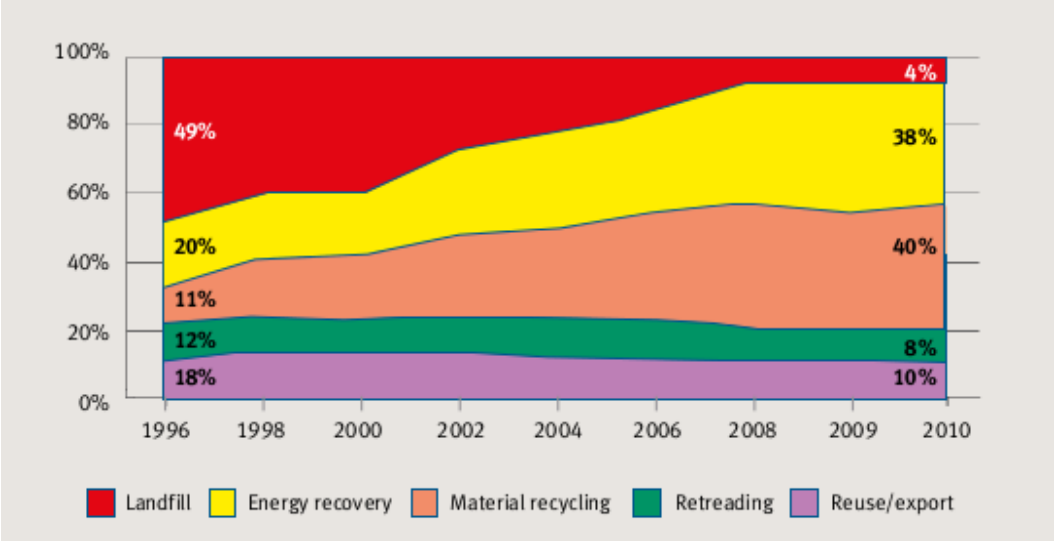

Figure 1: *Evolution of end-of-life tyres management in Europe (Source: ETRMA, 2012)*

According to ETRMA (2012), since 1996 more than 24 million megagram of end-of-life tyres have been recovered either through energy or material recovery, and on 2010 only 4% of end-of-life tyres produced are landfilled, against 96% of other destinations (38% energy recovery, 40% material recycling, 8% retreading, and 10% reuse/export).

Despite Europe developing three types of end-of-life tyres management schemes that promoted a rapid improvement of end-of-life tyres utilization (ETRMA, 2012), there are no specific European regulations for recovering used tyres. Each member is free to choose its management system: (1) the producer responsibility system; (2) the tax system; and, (3) the free market system (Valorpneu, 2013). Figure 2 shows the end-of-life tyres management systems in Europe.

Figure 2: End-of-life tyres management systems in Europe (Source: Valorpneu, 2013)

Producer responsibility system

This system is articulated in each country under the corresponding legal framework, which usually led to the establishment of a non profit organization financed by tyre producers and intended to manage collection and recovery of end-of-life tyres by the most economical solutions (Uruburu et al., 2012). This management system is related with producer responsibility principle as an economical instrument, promoting virgin material savings and waste production reduction (Ferrão et al., 2008; Braga and Morgado, 2007).

Tax System

Under the tax system model, the government of each country is responsible for the collection, recovery and recycling of end-of-life tyres (Uruburu et al., 2012; ETRMA, 2012; WBCSD, 2008). It is financed by a tax that is levied on end-of-life tyres producers and subsequently passed onto the customer. This is an intermediate system whereby the producers pay a tax to the State, which is responsible for the overall organisation and remunerates the operators in the recovery chain (Uruburu et al., 2012; ETRMA, 2012).

Free market system

Under the free market system, national legislation sets the objectives to be met, but does not designate who is responsible. In this way, all operators in the recovery chain contract under free market conditions and act in compliance with legislation. This may be backed up by voluntary cooperation between companies to promote best practices (Uruburu et al., 2012; ETRMA, 2012).

End-of-life Tyres Management in Portugal

In Portugal, according to Decree-Law 111/2001 of April 6, end-of-life tyres have two main possible destinations:

- reuse (tyres retread); and,
- valorisation: (1) reuse for other purposes (e.g. geotechnical infrastructures/civil engineering applications); (2) recycling: recycle rubber (e.g. football pitches, playground pavements, rubber modified asphalt) and/or steel (recycling through mechanical and/or cryogenic processes); (3) recovered fuel: combustion (e.g. cement kilns), gasification, pyrolysis (carbon black, fuel oil, char, steel).

This portuguese law also extends the responsibility of tyres producers to end-of-life tyres and suggests the constitution of a non-profit society responsible for the management of those tyres (Ferrão et al., 2008).

Valorpneu was created on February 2002, with the objective to organize and manage the system for collection and ultimate disposal for used tyres, promoting collection, separation, retake and recovery (Valorpneu, 2013; Ferrão et al., 2008).

Since 2003, more than 700,000 megagram of end-of-life tyres have been collected and managed by Valorpneu Integrated System (Valorpneu, 2012), as shown on Figure 3.

Figure 3 also shows that in the last decade the major destinations of end-of-life tyres have been the recycling industry followed by retreading industry and energy recovery agents.

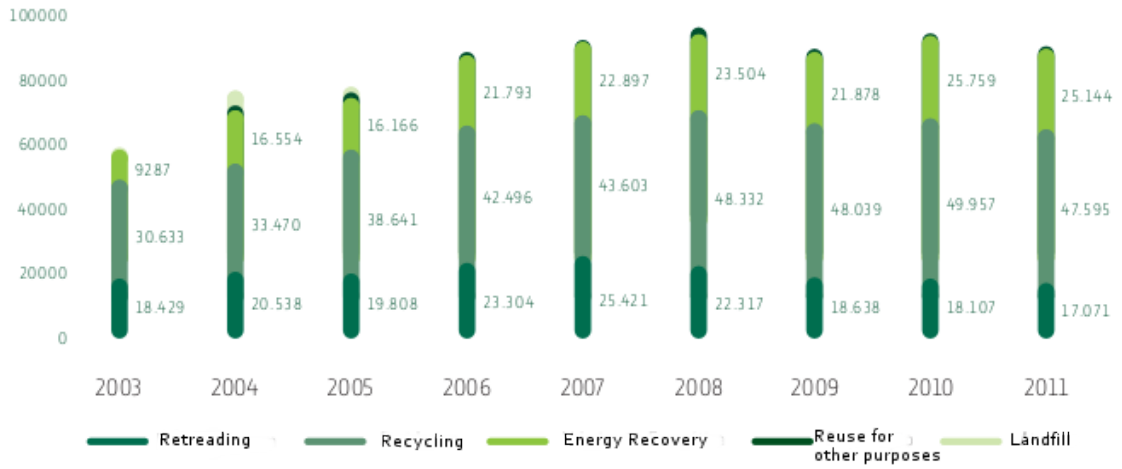

Figure 3: Valorpneu management of end-of-life tyres (values in megagram) since 2003 to 2011 (Source: Valorpneu, 2012)

On 2011, Valorpneu Management Integrated System operators were: 31 retreaders, 3 recyclers, 4 energy recovery agents, 23 transport operators and 49 collecting points on collection network, and they were responsible for 78,881 megagram of end-of-life tyres: (1) 17,071 megagram for retreading; (2) 563 megagram for reuse for other purposes; (3) 47,595 megagram for recycling; and, (4) 25,144 megagram for energy recovery.

New challenges

According to European Directive 2008/98/EC of November 19 on waste (Waste Framework Directive), tyres can reach end-of-waste status, as long as the fulfill the end-of-waste criteria. This provides a high level of environmental protection and an environmental and economic benefit. This leads to an increase of product manufacturing using less virgin raw materials and simultaneously enables less waste to be eliminated.

Because end-of-life tyres can have further uses, e.g. used as whole as filler materials in civil works, as fuel in cement kilns or as scrap or tyre rubber particles resulting of the recycling processes, the Joint Research Center (JRC, 2008) considers that end-of-waste status cannot have an unique set of requirements.

Nevertheless, worldwide end-of-life tyres uses have numerous possibilities, existing and under development (WBSCD, 2008) and can be an alternative to raw materials. According to WBSCD (2008), various efforts are currently in underway in many countries where different legal systems exist to reduce the number of tyres in landfills and to find innovative, environmentally friendly uses for end-of-life tyres.

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