

Review

Recycled Tyre Rubber Modified Bitumens for road asphalt mixtures: A literature review [☆]Davide Lo Presti ^{*}

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HIGHLIGHTS

- Introducing the Recycled Tyre Rubber (RTR) material as environmental problem as well as engineering resource.
- Introducing the wet process technology.
- Describing in details the existing products associated to the wet process high viscosity technology.
- Describing in details the wet process No Agitation technology.
- Comparing the described technologies and providing justifications and suggestions toward a widespread use of RTR-MBs.

ARTICLE INFO

Article history:

Received 24 June 2013

Received in revised form 3 September 2013

Accepted 6 September 2013

Available online 29 September 2013

Keywords:

Recycled Tyre Rubber
Asphalt Rubber
Bitumen Rubber
Crumb Rubber
Terminal blend

ABSTRACT

Nowadays, only a small percentage of waste tyres are being land-filled. The Recycled Tyre Rubber is being used in new tyres, in tyre-derived fuel, in civil engineering applications and products, in moulded rubber products, in agricultural uses, recreational and sports applications and in rubber modified asphalt applications. The benefits of using rubber modified asphalts are being more widely experienced and recognized, and the incorporation of tyres into asphalt is likely to increase. The technology with much different evidence of success demonstrated by roads built in the last 40 years is the rubberised asphalt mixture obtained through the so-called “wet process” which involves the utilisation of the Recycled Tyre Rubber Modified Bitumens (RTR-MBs). Since 1960s, asphalt mixtures produced with RTR-MBs have been used in different parts of the world as solutions for different quality problems and, despite some downsides, in the majority of the cases they have demonstrated to enhance performance of road's pavement. This study reports the results of a literature review upon the existing technologies and specifications related to the production, handling and storage of RTR-MBs and on their current applications within road asphalt mixtures. Furthermore, considering that RTR-MBs technologies are still struggling to be fully adopted worldwide, mainly because of poor information, lack of training of personnel and stakeholders and rare support of local policies, the present work aims to be an up-to-date reference to clarify benefits and issues associated to this family of technologies and to finally provide suggestions for their widespread use.

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Abbreviations: CRM, Crumb Rubber Modifier; ELTs, end of life tyres; RTR-MB, Recycled Tyre Rubber Modified Bitumen; RTR, Recycled Tyre Rubber.

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1. Tyre rubber: environmental problem or engineering resource?

The increasing number of vehicles on the roads of industrialised and developing nations generates millions of used tyres every year. About 1.4 billion tyres are sold worldwide each year and subsequently as many eventually fall into the category of end of life tyres (ELTs) (Fig. 1). Moreover, the amount of ELTs in Europe, US and Japan are about to increase because of the projected growing number of vehicles and increasing traffic worldwide. These tyres are among the largest and most problematic sources of waste, due to the large volume produced and their durability. The US Environmental Protection Agency reports that 290 million scrap tyres were generated in 2003 (EPA, 2007). Of the 290 million, 45 million of these scrap tyres were used to make automotive and truck tyre re-treads. In Europe every year, 355 million tyres are produced in 90 plants, representing the 24% of world production [1]. In addition the EU has millions of used tyres that have been illegally dumped or stockpiled. The inadequate disposal of tyres may, in some cases, pose a potential threat to human health (fire risk, haven for rodents or other pests such as mosquitoes) and potentially increase environmental risks. Most countries, in Europe and worldwide, have relied on land filling to dispose of used tyres but the limited space and their potential for reuse has led to many countries imposing a ban on this practice. The current estimate for these historic stockpiles throughout the EU stands at 5.5 million tonnes (1.73 times the 2009 annual used tyres arising) and the estimated annual cost

for the management of ELTs is estimated at € 600 million [2]. With landfills minimising their acceptance of whole tyres and the health and environmental risks of stockpiling tyres, many new markets have been created for scrap tyres.

In order to face this problem, in Europe in 1989, a used tyres group composed of experts from the main tyre manufacturers

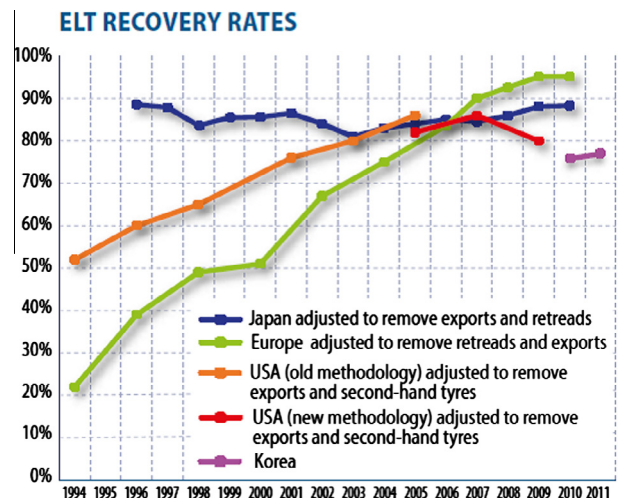


Fig. 1. Evolution of ELTs recovery rates in major tyre markets, adapted from [2].

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