APPLICATIONS OF GLASS REINFORCED PLASTIC (GRP) WASTE POWDER IN RUBBER COMPOSITES

INTRODUCTION

Natural rubber (NR) is used to manufacture a wide range of industrial rubber articles. The price of raw rubber has been increasing over the years and there is a need for cheaper alternatives to reduce costs. In some rubber articles manufactured for the construction industry, such as carpet underlay, bearing pads, bridge and concrete expansion joints and insulation pads, there is a clear opportunity to use GRP waste in the form of finely ground powder to replace raw rubber. This could offer major environmental, economic and technological benefits to the polymer sector as a whole.

As a part of the government and industry funded "Built Environment Action on Waste Awareness and Resource Efficiency" (BEAWARE) project, glass reinforced plastic (GRP) waste was selected for new recycling applications in rubber composites.

The aim of this briefing document is to report the outcome of a feasibility study on the use of GRP waste powder in rubber products and establish whether this could provide a new route for recycling the GRP waste powder. The strategy for carrying out this work consisted of two stages as shown in Figure 1 (a) and Figure 1(b).

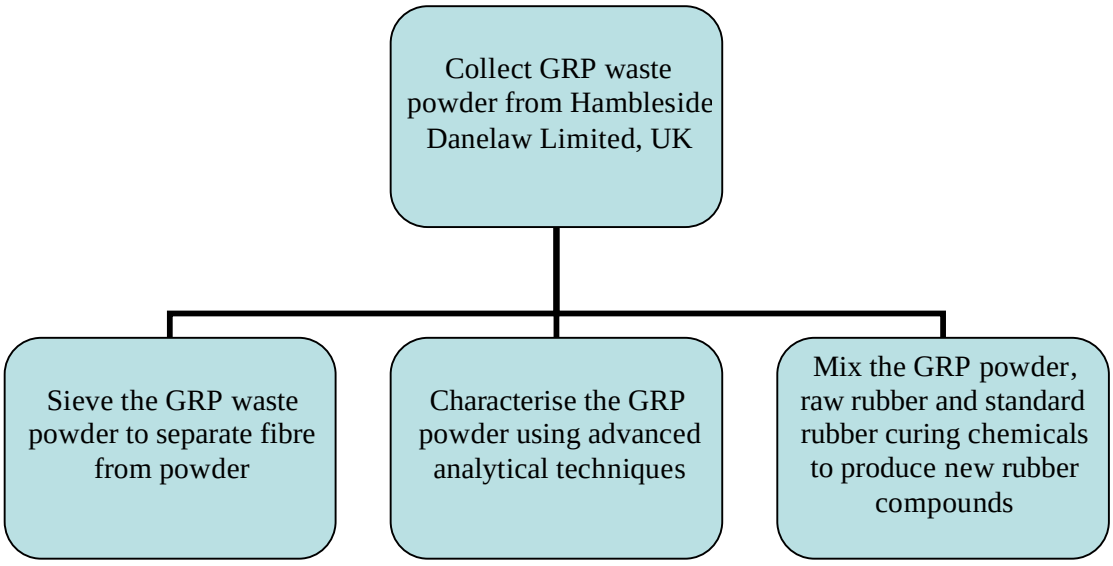

Figure 1(a): GRP waste in rubber testing process (Stage 1)

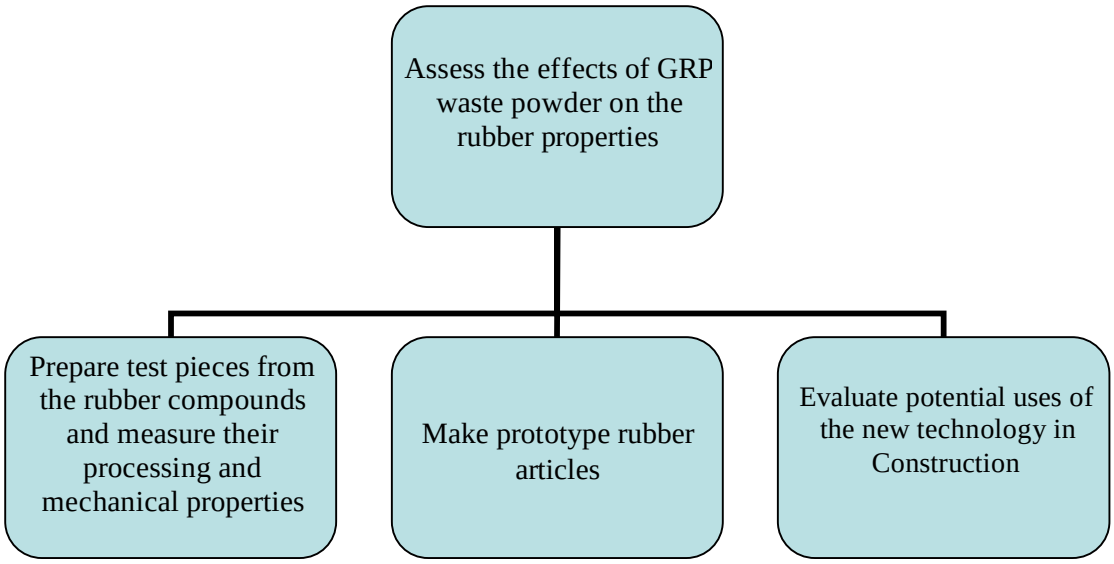

Figure 1(b): GRP waste in rubber testing process (Stage 2)

METHODOLOGY

Materials: the rubber used was natural rubber. The polymer composite waste powder was prepared and supplied by Hambleside Danelaw Rooflights and CladdingLimited, UK. The GRP waste sample contained large chunks of fibre which were separated from the powder by a 200 micron size sieve. This produced a powder containing particles up to 600 micron and glass fibre fragments approximately 560 micron in size, which was considered to be suitable for mixing with rubber.

Mixing: the rubber was mixed with up to 50wt% waste powder and standard rubber curing chemicals to produce rubber compounds. This effectively replaced the virgin rubber with 50wt% GRP waste powder.

Test methods: suitable tests pieces were made for measuring the processing and mechanical properties of the rubbers. All the tests were performed according to British Standards 903, which are often used by the rubber industry to evaluate properties of rubber compounds.

FINDINGS

Technological benefits for rubber and the rubber industry

The inclusion of GRP powder has significant benefits for the rubber properties. These includean increase in the hardness and modulus elasticity of the rubber, which makes it ideal for use in rubber articles made for the construction industry; and improvement in the acoustic properties of the rubber, which makes it suitable for building applications. The fact that GRP powder can be recycled in rubber as a filler to replace a portion of raw rubber using the current processing techniques and practices should be of major interest to the manufacturers of rubber articles.

Environmental benefits

Natural rubber is imported into the UK from countries such as Malaysia, Thailand and Vietnam by sea. This involves significant transportation and storage costs as well as emission of polluting CO_2 gases. Reduction in the consumption of natural rubber in industrial rubber articles will help to reduce demand and minimise import from overseas. Moreover, recycling GRP waste powder as a filler in rubber will help to divert the GRP waste from disposal in landfill and incineration to more useful industrial processes with major benefits for manufacturers, users and the environment.

Economic benefits

Currently, natural rubber is traded at £1500/tonne on the global market. Assuming 50% by weight of the rubber is replaced with GRP waste powder in applications such as insulation pads, this will make a huge saving of £750/tonnes in addition to savings with regard to transport/shipment, material handling and storage. Moreover, replacing solid rubber with waste powder will reduce energy needs for mixing rubber compounds considerably.

Potential benefits to the construction industry

Many rubber articles which are currently used in the construction industry can be manufactured cheaper when a considerable portion of rubber is replaced with GRP waste powder. These articles include:

- acoustic insulation;
- bridge and concrete expansion joints;
- pads for under sport flooring;
- carpet underlay;
- rubber mats; and
- rubber water stops.

A prototype GRP waste powder-filled rubber pad was manufactured after the completion of this project (Figure 2). This could be ideal for building insulation, rubber mat and bridge and concrete expansion joints.

Figure 2: GRP waste powder-filled rubber prototype

SUMMARY

From this study, it was concluded that GRP waste powder can be used in rubber articles for various applications in construction as a substitution for raw rubber leading to significant economic and environmental benefits. The use of GRP waste in rubber composites increases the damping ability of the rubber considerably and can be used in insulation and anti-vibration applications in both the construction and rubber industries. This will potentially open new recycling routes for GRP waste powder in rubber composites with major economic, technological and environmental benefits for the UK.

Further information and contact

The full GRP waste in concrete report is available at the BEAWARE website: www.beaware.org.uk

For further information please contact
Mohamed Osmani (Loughborough University)
Tel: 01509 228155
Email: m.osmani@lboro.ac.uk