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New milling technology converts construction by-products currently regarded as waste into commercially marketable powder products

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New patented milling technology has the potential to meet the fine grinding requirements of minerals, construction industry waste and manufactured materials that were previously regarded as uneconomic.

The new grinding technology developed by the UK based International Innovative Technology (IIT) combines low energy consumption with a compact size and powerful grinding force.

Because of the low energy consumption associated with the new technology, the highly efficient and versatile milling system has considerable recycling potential by providing the means to convert by-products currently regarded as waste, into commercially marketable powder products. These include plastics, composites and glass - as well as aggregates and minerals processing by-products

The majority of traditional grinding processes are air swept systems in which the feed materials are introduced into the grinding chamber in a stream of air.

However air swept mills require significant power to maintain flow through the system. In addition, many conventional ball mill and similar grinding systems involve the fairly random application of the attrition force on the material in the mill.

The new vertical mill developed and patented by IIT comprises a technically advanced modular design capable of grinding soft, medium and hard materials to 9.5 on the Mohs scale and with 90% passing 45 microns and below.

Compact and powerful, the centrifugal grinding mechanism of the m-series is extremely efficient, with the vertical material flow path and special roller assembly ensuring that the force produced is translated into maximum particle grinding power.

In the new m-series mill, the product in-feed mechanism and chamber comprises a rotating spreader plate which throws the material outwards (by centrifugal force) against the wall of the grinding chamber and downwards (by gravity) through the grinding module.

As the material descends, it is forced between the rollers and the outer grinding ring on the inside of the mill housing (barrel) and is reduced to a powdered form.

All material introduced into the mill must come into contact with the grinding

module. The rotational speed of the rollers (typically 300 rpm) carrying the grinding heads controls the crushing force applied and the diameter of the mill housing determines the throughput volume.

Multi stage grinding is achieved through the incorporation of a number of grinding modules in series with particle size controlled both by the number of modules and rotational roller speed applied.

Typically, a standard 600mm mill barrel operating at 300 rpm produces a very fine powder output at up to 5 tonnes per hour and multi-mill configurations are available to meet capacities of up to 50 tonnes per hour.

As a result of this configuration grinding efficiency is maximised with very low electrical energy input being required relative to the fineness and volume of powder produced. For example, depending on the specific milling application, the energy consumption typically associated with the new m-series is between 5kWh/T and 10kWh/T. By comparison, traditional milling process typically utilise between 3 and 10 times higher energy levels.

Recycling of plastic waste

Glass Reinforced Plastic (GRP or fibreglass) is used in thousands of consumer and building products. However, because GRP is a notoriously difficult materials to break down, the effective disposal of waste GRP is a significant problem worldwide.

For many years it has been widely regarded that the only viable option for disposing of waste GRP was landfill and in the UK alone it is estimated that around 150,000 tonnes are sent to landfill every year.

To help overcome such problems, during the last 18 months IIT has successfully worked with a UK GRP manufacturer as part of its sustainable manufacturing programme to explore methods of recycling GRP.

As a result of the research and development work undertaken during this period a successful GRP recycling plant is now fully operational – and has overcome concerns that GRP is too hard and abrasive to be recycled cost effectively.

This process involves GRP waste first being converted into flakes before secondary reduction is carried out in an m-series mill which successfully converts the flakes into a fine powder of generally less than 100 microns.

Tests - and subsequent production runs - have shown that the inclusion of a percentage of this powdered material back into the primary batch for new GRP products has no detrimental effect on GRP in terms of strength, light transmission, light diffusion or durability.

The company has now incorporated a fully operational recycling plant as part of its primary production facility. As a result of the mill's ability to successfully convert waste into recycled powder, the quantity of GRP going to landfill has been reduced and the costs associated with the use of some traditional batch raw materials has also been cut.

However one of the key benefits for the company involved is that is can now claim genuine 'recyclable' credentials which significantly enhance its corporate reputation and product marketability.

Commercial applications for waste glass

In the glass industry work has been carried out to show how the economic fine grinding of glass waste can also be successfully utilised for commercial applications.

Historically the unfavourable economics associated with the fine milling of glass waste in conventional grinding systems such as ball mills has largely ruled out potential applications in the brick manufacturing industry and in filtration processes.

As part of its work on the economic, practical and technical challenges associated with the recycling of glass waste, the UK's Waste & Resources Action Programme (WRAP) has identified the considerable potential for powdered glass to act as a fluxing agent in the manufacture of bricks.

This work has shown how the addition of powdered glass can successfully reduce the firing temperatures required during brick manufacture – particularly when used with those types of firing clays that demand the highest energy levels.

However IIT has successfully undertaken the milling of glass waste to 50-75 microns to demonstrate the feasibility and cost effective production of powdered glass product.
WRAP has estimated that the UK domestic window replacement sector generates around 90,000 tonnes of glass every year. Until now, all of that glass has gone straight into landfill and these figures are expected to rise to between 160,000 and 250,000 tonnes per year over the next 10 years.

The ability to economically mill and recycle glass powder could therefore significantly reduce waste management costs associated with landfill disposal of waste glass and at the same time provide a completely new income stream from this commercial application.
In addition, similar opportunities for powdered glass are also provided by in water filtration and sports turf applications – both of which have also been researched and developed by WRAP.

With the new mill size and energy costs of converting granular materials into a fine powder no longer an inhibiting factor, volume powder milling applications can now be easily integrated into previously inaccessible locations.

It follows that the energy efficiency associated with the new technology brings new opportunities for the fine grinding of those materials that were previously regarded as waste.
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