

Aggregate Fines: The Current and Future Role of Research

The Mineral Industry Research Organisation (MIRO) has been engaged with research providers in a number of developments concerning the use of incorporation of aggregate fines in commercially marketable products. Derren Cresswell, Gordon Riddler and Abbie Richards of MIRO highlight some examples and outline other research and technology transfer developments.

The crushing and washing of aggregates from both hard rock and sand and gravel deposits can produce up to 40% fines, which can be anything up to 4mm in diameter depending on the character of the resource and local market specifications for the material. Fines less than 75mm are not used at all in blended materials. Traditional uses for aggregate fines, such as blending into fill and other lower-grade materials, are becoming more difficult to place into markets as they are eligible for the aggregates levy if they are not to be used as an aggregate without further processing. However, new uses and markets for these materials can be established through further research, and recent work funded through the ALSF Mineral Industry Sustainable Technology (MIST) programme, managed by MIRO, has highlighted some potential uses as well as characterising the material to bring utilisation a step closer.



For example, the production of a growing media using basaltic quarry fines and organic wastes has been studied by Mineral Solutions Ltd for use in horticultural markets, land restoration and development, and forestry. Blending the aggregate fines with organics produced a high quality compost with reduced nitrogen rich organic material. A linked project looked at a generic model uses of mineral fines with organics for growing media. Commercial viability was seen as borderline with increased bulk density increasing transport costs, but commercial advantage could be available by targeting specific local and 'green' markets.

Another project created a database of aggregate fines production. This has been presented on a CD-ROM and is also available online from Mineral Solutions at www.mineralsolutions.co.uk from the Quarry Products Association at www.qpa.org. This relation database, which is intended to be developed further by users, gives ready access to information and can be searched by rock type and other parameters.

Novel methods of separating the very fine silt and clay fractions from fine sand and water during aggregate washing have been investigated. This process is essential if best use is to be made of sand resources and a steady stream of fines for use in alternative applications is to be achieved. Good results were obtained by NRS Technologies Ltd, who used 'Hydroscrub' technology to both move and clean aggregate material. A 'pulse separator' was then employed to split the different size fractions and water using entrainment, settling and density effects.

A variety of growing media using different aggregate fines and organics

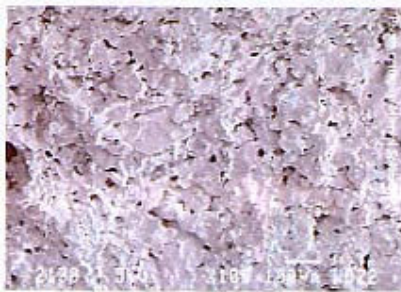


Tomato plant trials using basalt fines and organic material



A Further MIST project undertaken by The University of Leicester and Tarmac Southern developed a process and resource calculation model and visualisation tool to allow enhanced enhanced understanding of sane gravel exploration samples. These tools allow increased ability to plan extraction in order to either limit by products or plan for their occurrence and utilisation.

A Technology Foresight review, written as part of MIRO's EUROIM II project, covers the current market for quarry mineral by products, including fines, as well as looking at developing future technologies to address market trends. Early results of this study suggest current on site uses and markets limit other uses to blending to produce fillers.



SEM photograph showing the internal microstructure of granite fines sintered into a lightweight aggregate with 10% by weight paper-making sludge

Technologies needed to upgrade the materials still do not exist commercially and will depend on site specific characteristics with limited or uncertain volumes.

Future markets for quarry fines, which further research can address may include:

Low grade fillers:

For paints, plastics, construction blocks and decorative/architectural finishes and mouldings. A MIRO managed European research project (REFILL) concluded that the market for low grade fillers would be strong. To accomplish such penetration it will be necessary to understand the physical, chemical and mineralogical properties, and to have some idea of the variability of fines. Technologies to process the fines to a useable condition will also be needed. Developments by

Dorr-Oliver Eimco at Anglo American's Buxton Lime works have produced a novel fines and paste handling system for the Kiln feedstock.

Use in ceramic bodies as an alternative to clays:

Consolidation in the heavy ceramics industry has resulted in production plants that are now very large in order to achieve economics of scale. A trend toward niche markets for 'locally' sourced and produced bricks, tiles and especially decorative features that reflect local materials and construction systems would help. This would require a change in the manufacturing industry with small scale plants that are cheaper to run and maintain.

The production of synthetic aggregates:

As with brick manufacture, the capital outlay and need for economies of scale mean that very few quarries would be able to supply the quantities needed. A current MIRO research proposal in conjunction with the University of Leeds is looking at methods to determine minimum economies of scale and introduce plant control and modelling that will help small or mobile plants to be assessed for this purpose. This project also plans to look at similar techniques for the brick and ceramic industries.

Novel block/concrete production:

Developments by Imerys have produced density controlled blocks from a blend of fines and a polymer that is extruded as an aerated paste. The key to this development was research to understand the chemistry, mineralogy and processing requirements. Research undertaken by the Icelandic Building Research Institute has led to the use of 'silica' fines in the production of self compacting concrete.

These various approaches to research have a number of common themes:

- The need to develop local markets and technologies that suit particular deposits/arising.
- The need to understand the properties of the aggregate fines and how these can be manipulated to produce high grade products.
- The multidisciplinary nature of research that looks at geology, minerals, processes and markets.

It would appear that real progress is only just beginning and that the development of aggregate fines as a resource rather than a burden seems to have potential. The realisation of this potential requires much further investigation, which will need to be tailored to each site, lithology and local economic situation.
