goodquarry.com Quarry Fines & Waste

Introduction

The **goodquarry.com** website section on Quarry Fines and Waste has been extensively revised and updated. Quarry fines and wastes are a largely unavoidable by-product of the extraction and processing of aggregates. They form a significant proportion of current quarry output. (see table below). They are defined as wastes because no market currently exists for them, but unlike many other wastes they are generally inert and non-hazardous. Materials that may be classified as quarry wastes include overburden (although this is frequently used in restoration) and interburden (material of limited value that occurs above or between layers of economic aggregate material) and processing wastes (non-marketable, mostly fine-grained material from crushing and other processing activities.)

Good practice calls for the minimisation of waste and fines production, although recent legislation has conflicted with this aim. Operators should also develop methods for the mitigation of any adverse effects on the environment and local communities by screening and careful management of waste production, movement and final use.

Quarry fines stockpile

Estimated production of aggregate, quarry waste and quarry fines in the UK

Rock type	*Annual production (million tonnes, 2005)*		
	Saleable aggregate	Quarry waste	Quarry fines
Sandstone	10.0	1.1	3.3
Limestone	67.3	7.5	18.8
Igneous and Metamorphic Rock	44.6	5.0	11.2
Sand and Gravel	82.4	9.2	20.6
Total	**204.3**	**22.8**	**53.9**

Natural reed bed in lagoon

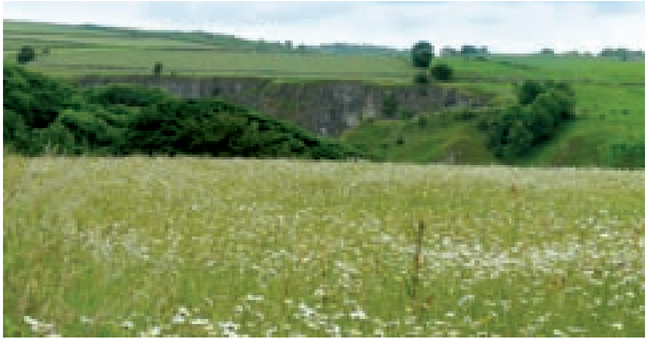
Quarry Fines & Waste

Environmental and Social Issues

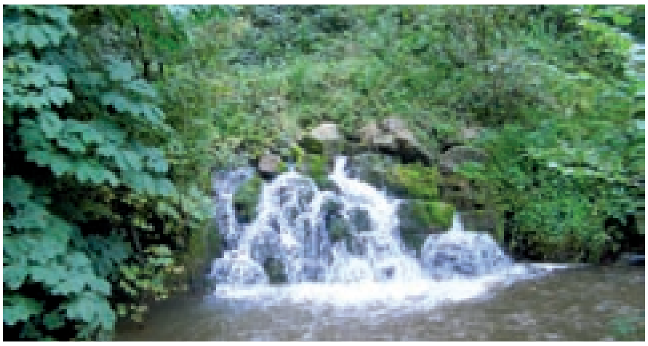
Although they are generally inert and non-hazardous, the generation, treatment and/or disposal of quarry waste and quarry fines can be a source of friction between aggregates companies, local communities and other stakeholders. This is particularly true if a site is producing more than originally planned or that can be properly accommodated within the site boundary. Therefore, ensuring that the site design is correct at the planning stage is essential.

The nature and extent of the environmental and social impacts will vary from site to site according to their characteristics and specific local context. The impacts experienced by the local community are likely to be significantly influenced by the nature and proximity of housing, amenity areas and local businesses. Different stakeholders will have quite different opinions regarding the impacts that they consider most important. Many of the potential impacts can be prevented or mitigated by the use of good practice. The acceptability of impacts that remain after good practice measures have been put in place should be considered in the context of the economic and other benefits that accrue from aggregates production.

goodquarry.com addresses and discusses all these issues.



Restored meadow on quarry site



Landscaped clean water discharge

Case studies – minimisation

Theoretical changes using industry-standard quarry management software

Case Study 1: *Sandstone quarry, mid Wales* producing high Polished Stone Value (PSV) roadstone and crushed rock aggregate. Replacing the secondary Horizontal Shaft Impact (HSI) crusher with a cone crusher enabled a 20% increase in production from 250 to 300 tonnes per hour and a 21% reduction in the fines content of the aggregate.

Case Study 2: *Sandstone quarry, Mid Wales* producing high PSV roadstone and crushed rock aggregate. Replacing two secondary HSI crushers with a single secondary cone crusher gave an 8% reduction in the fines content of the crushed material.

Case Study 3: *Sandstone quarry, south-west England* producing high PSV roadstone and horticultural sand. A simulated process change replacing the tertiary and quaternary cone crushers with a single tertiary Vertical Shaft Impact (VSI) crusher showed that this would enable a 18% increase in the production of saleable aggregate and a 29% decrease in fines production.

Case Study 4: *Limestone quarry, East Midlands* producing roadstone, crushed rock aggregate and agricultural lime. Replacing the secondary HSI crusher with a cone crusher reduced the fines content of the crushed material by 34% and enabled a 50% increase in concrete aggregate production.

Case Study 5: *Sand and gravel quarry, East Midlands* producing ready mixed concrete, graded sand and gravel, and bagged aggregate. Increasing the size of the screen used to remove oversize (>100 mm) and replacing the VSI crusher with a cone crusher increased the production of saleable aggregate by about 9% and reduced the fines content by 50%. The proportion of material coarser than 20mm in the crushed product was also reduced by 80%.

Community visit to quarry site

Quarry Fines & Waste

Minimisation

The Landfill Tax and Aggregates Levy have encouraged the use of secondary and recycled material, but also depressed the use of quarry wastes in lower value construction applications. However, quarry wastes (and quarry fines) continue to be produced and stockpiles of these sub-economic materials are increasing at some locations. Consequently, there is a developing business case for minimising quarry wastes and quarry fines generation. Business-related drivers include the need to comply with the planning process and regulation, the need to maximise revenue in the form of saleable products and the need to avoid resource sterilisation within the quarry boundary through fines disposal.

Equally, the need to minimise fines is driven in part by the environmental and social consequences of their production and the costs of dealing with increasing volumes. While difficult to quantify in financial terms, such consequences may represent a substantial business risk for companies, not least through damage to corporate reputation when impacts occur. Regulatory compliance is another major driver and is likely to remain so – water and air quality are highly regulated, for example.

The **goodquarry.com** website has a number of theoretical case studies relating to waste minimisation, as shown in the accompanying table, and also other process optimisation options and alternative uses for quarry fines

Mitigation

A mixture of approaches are required to deal with quarry wastes; the mix being determined by what is technically and economically feasible, taking into account the concerns of local communities and other stakeholders and planning obligations.

Plan for quarry waste disposal
Disposal of quarry wastes must be carefully planned. If the design is not right, site development problems are likely to arise from waste disposal issues. Waste tips should be located to minimise potential effects on the landscape and surface water flow and quality and consider potential conflicts with local communities and stakeholders.

Find beneficial uses
Quarry wastes can often be used on the site and to screen the workings. Good practice should prevent environmental and social impacts from wastes for which no beneficial uses exist. Waste tips should be revegetated as soon as possible to prevent wind and water erosion. Non-vegetated waste tips are liable to erosion and collapse. On closure, tips should be regraded where necessary to create a stable final landform and to prepare them for revegetation and integration with the surrounding landscape.

Investigate alternative methodologies or technologies
The BGS carried out a series of trials of air classification to investigate the method's potential for fines reduction as shown in the table below. This, and other examples, are shown in **goodquarry.com.**

Case studies – alternative methodologies

Testwork to determine the technical feasibility of using a dry process to remove fines from sand was carried out using a tonne of sand from four sand and gravel quarries in Britain. The sand samples were dried and processed using laboratory and pilot-scale air classifiers. The results are as follows:

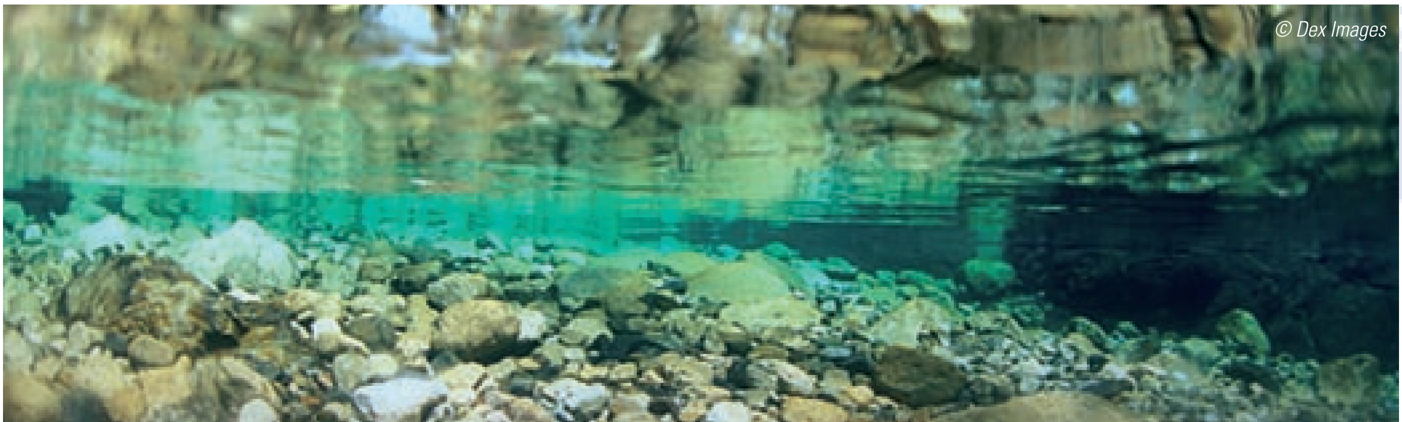
Case study 1: a sand and gravel quarry in south-east England using a standard washing plant to produce building and concrete sand. The sample was a 2 mm wet-screened sand, which contained 3% of material finer than 63 microns. The laboratory and pilot-scale processing trials reduced the fines content in the sand product by 44% and 72% respectively.

Case Study 2: a sand and gravel quarry in north-east England using a standard washing plant to produce concrete sand and dry screening to produce building sand. The sample taken was a 4 mm dry-screened sand, which contained 6-7% of material finer than 63 microns. The laboratory and pilot-scale processing trials reduced the fines content in the sand product by 12% and 29% respectively.

Case Study 3: a sand and gravel quarry in south-east England using a standard washing plant to produce building and concrete sand. The sample taken was a 6 mm dry-screened sand, which contained 9-10% of material finer than 63 microns. The laboratory and pilot-scale processing trials reduced the fines content in the sand product by 20% and 12% respectively.

Case Study 4: a sand and gravel quarry in south-east England using a standard washing plant to produce building and concrete sand. The sample taken was a 4 mm wet-screened sand, which contained 0.6 to 3% material finer than 63 microns. The laboratory and pilot-scale processing trials reduced the fines content in the sand product by 33% and 84% respectively.

Clean water discharged from sand and gravel operation



Production & Process Technology

Products

Quarries generally sell a range of products which differ according to the local rock type and the location of the quarry. The products are defined by their particle size grading, based on the lower and upper screen sizes, which represent the smallest and largest particle sizes

Product	Grading (minimum-maximum) mm						
Armourstone	45-125	63-180	90-250			45-180	90-180
Graded	5-40		5-20			5-14	
Railway ballast	28-50						
Single sized	40	28	20	14	10	6	3

10 mm aggregates

Future Technology

Future developments in quarrying technology are discussed in the **goodquarry.com** Production and Process Technology section. They are likely to be dominated by energy and water use due to the increasing importance of climate change and the increasing cost of energy. Energy efficiency and reduction can be effected through more detailed analysis of energy usage, replacement of high energy consuming plant by newer, more efficient equipment and changes to the material handling and processing routes. Carbon offsetting of industry energy use may become more common with an increase in current tree planting schemes and calculation of carbon equivalent for each product.

Water use will involve more recycling and reuse of process water, increased capture of rainfall and investigation of additional 'dry' (or water efficient) processes to replace current 'wet' processes.

Recycling of concrete to reuse its contained aggregates is increasing. However the product generally has a lower compressive strength and bulk density and higher water absorption than primary aggregate due to the cement content. Separation of the cement would enable the production of something closer to natural aggregate.

Summary

There are many ways by which the operation of a quarry can be made more efficient, more productive and less intrusive on the local environment. All stages of the quarrying process should be carefully examined; from initial overburden stripping to final restoration and aftercare. The choice and operation of crushing equipment can minimise the production of fines, whilst maintaining the required throughput of particular sized products. All energy-intensive processes, such as hauling, crushing and especially drying, should be carefully and regularly examined to eliminate bad practice and encourage savings where possible. Water consumption should be monitored and, if possible, reduced by recycling, reusing and adoption of waterless fines processing. Monitoring of all stages of the process should enable bottlenecks to be identified and the comparative performance of all the separate components to be measured.

The **goodquarry.com** section on Production and Process Technology has a large amount of information, key findings and summaries to assist operators in improving their quarry's performance.

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