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ECO-EFFICIENT USE OF STONE MATERIAL FROM NATURAL STONE QUARRIES

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Managing of visual impact, leftover stone, and noise are environmental aspects that can be contributed to natural stone quarrying (Aatos 2003, Heldal and Selonen 2003). The recovery rate in the quarries varies from 10 to 70%, depending on stone type. Today, one of the most important issues for the European stone industry is to manage and to find ways to develop the use of the leftover stone (Selonen and Ramsay 2002). The solutions increase the overall acquisition of the deposit and contribute to a higher total recovery, and to a more eco-efficient and sustainable use of stone. Challenges connected to the use of leftover stone include, e.g. logistics and land use planning.

The amount of leftover stone is connected to the high quality demands for feasible stone in the world market. The suitability of stone for natural stone works is controlled mainly by two criteria: homogeneity of colour and size of block (Shadmon 1996, Selonen et al. 2000). If the extracted stone does not satisfy these two demands it cannot be used for production.

The leftover stone can be used either as such or after processing. The processed leftover is broken down to smaller blocks, after which they can be screened or crushed into different sizes. Rock aggregate is the most important product for leftover stone, especially regarding granite leftover. Aggregate products are used, e.g. for foundations of buildings, as underlayment and surface material for roads, and as raw material and surfacing for precast concrete (Räisänen 2004). The production of aggregate from Quaternary deposits is strictly limited in many parts of the Europe due to environmental concern, which favours production of crushed stone and use of leftover stone in aggregate production. Several natural stone quarries have a total recovery of 100 % through crushing of the leftover material.

Industrial mineral applications for the leftover stone are common in marble production as calcium carbonate. Slate, as well as granite and soapstone leftover can be used in ceramic application. Targets in environmental constructions include pavements, rubble walls, road embankments, sound walls, and decorations in traffic dividers, as well as yards and parks. This end use has an increasing interest for the European markets.

Due to the siliceous composition of granite and the mechanical quarrying process no polluting substances or harmful chemicals are found in the granite leftover, which makes it especially feasible in water construction, e.g. as armourstone. Furthermore, the blocks are quarried gently with explosives of low charge, hence the material is sound and durable, containing less incipient cracking than rock aggregate or weathered surface blocks. Water construction applications include river embankments, breakwaters, protective rock grading for flood areas, water treatment dams, harbour structures and docks.

The main challenge for utilization of the leftover stone is the logistical challenge. The use of the leftover is location specific because of the high transport cost. Natural stone quarries are often situated in rural areas far from construction sites. For the utilization costs to stay within reasonable limits more effective arrangements of the logistics both at the quarry area and from the quarry to the final site are needed. Furthermore, the logistical challenge implies a need for socio-economic planning for sustainable utilization of natural resources in a particular region.

On the other hand, the leftover stone is environmentally pure. Aatos (2003) has shown that, being composed of the same material as the bedrock from which it was originally extracted, the leftover stone is inert as material. No chemicals foreign to the environment are added to it during the quarrying process. Storage of the leftover stone causes no chemical impact on the soil or the groundwater. Hence, the leftover blocks or the storage of them poses no risk to the environment or to the human health.

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SELECTIVE CRUSHING OF QUARTZ BY EHD METHOD

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The report gives a comparison of distribution of powders of three types of quartz obtained by EHD method and by triple crushing in a roller-mill. Unlike mechanical crushing EHD method allows to produce relatively selectively quartz powers with grain size 0.1-0.2 mm

СЕЛЕКТИВНОЕ РАЗРУШЕНИЕ КВАРЦА МЕТОДОМ ЭГД

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Кварц широко используется в качестве абразива в пескоструйных машинах для очистки отливок, для удаления краски, ржавчины и пятен, а также для нанесения надписей и рисунков на камнях.

Требования к кварцу для этого вида работ нестрогие. Необходимы чистые, прочные, стойкие зерна, и в большинстве случаев, требуется определенный размер и форма зерен. Для пескоструйных аппаратов предпочтительнее угловатые зерна, для обработки небольших отливок, необходимы округлые зерна. Для наждачной бумаги используют главным образом угловатый кварц. Важно, чтобы зерна кварца тонко не прорастали другими минералами. Трещиноватость зерен может быть густой, но трещины не должны проникать глубоко в тело минерала. Глубокие трещины, как и прорастание другими минералами, ведут к передрабливанию, увеличивая количество мелких фракций, мало используемых промышленностью.

Нами проведены исследования возможностей использования электрического разряда в жидкости для решения технологических задач при переработке индустриальных минералов, в том числе и кварца, в абразивные порошки. Теоретические основы этого метода и его приложение для решения задач тонкого помола можно найти в работах (Величинская и др., 1980; Статистика ..., 1971; Курец и др.,1971; Малюшевский, 1981). В нашем случае электрогидродинамическое (ЭГД) измельчение проводилось на лабораторной установке. Разрядная камера имела размеры: диаметр 0.06м, высота 0,08м.

Режим измельчения материалов с размерами порядка 1см., выбран после оптимизации работы установки по удельным энергозатратам на измельчение искусственной керамики, следующий:

- $И_{разр.}$=40кВ,
- емкость накопительного конденсатора 0,025мкФ,
- частота разрядов 100 имп/мин, постоянная времени разряда $\tau \approx$10мкс;
- межэлектродный зазор в разрядной камере -3,5мм,
- среда - обычная вода.

В таком режиме удельные энергозатраты на получение керамических порошков с размером частиц меньше 500 мкм были минимальными и равнялись 7 кДж/г. Разрядная камера снабжена сепаратором, позволяющим отбирать из разрядной области порошки с диаметром менее 500 мкм.