KAYASAND

Project Proposal

To verify a sustainable replacement for natural sand – from surplus or waste quarried crushed rock.

Current sand supplies for both concrete and asphalt use come from natural reserves, either from gravel pits or from sea dredges. New gravel pits are becoming more difficult to open due to environmental constraints, and the increasing volume of dredged sea sand is not a long term sustainable solution to meet the ongoing demands for the construction industry. Already dredging licenses are being revoked due to beach erosion, and as dredges go further out to sea, the expense and carbon footprint of dredged sand will increase. If the Japanese experience is anything to go by, then as fishing grounds become affected, then dredging is likely to be limited to keeping shipping lanes clear.

Most quarries were designed to make coarse aggregates, fine aggregates are the bi-product, which usually make up some 40% of the quarry output. The fine aggregates do find markets, but in the main they are lower value products, and often a percentage can be classified as surplus or even waste products. The UK has significant reserves in its quarries, which could easily produce the majority of the sand required by industry, using the same sales and delivery channels as it does now for its coarse aggregates…. However the problem lies in the quality of those fine aggregates.

The issues surrounding the use of crusher dust in concrete have been well documented. The dust is not well shaped and is unevenly graded, which results in a coarser concrete mix as more crusher dust is added to the mix. Coarser means more cement and water is required, as the mix becomes less workable. As a general rule 20 – 25% of crusher dust can be used in a concrete mix design without any serious detrimental effect on the concrete. Reprocessing crusher dust through autogenous VSI crushers has enabled more dust to be used in the mix design. Shape is improved down to 500 micron fractions, but generally the gradation is not improved and a great deal more filler is generated. Usually the filler is removed through a washing process, or more recently by air classifiers. The resulting sand can usually be used in a mix design up to 50 or 60% without any ill effects in the concrete.

Kemco of Japan have perfected a new type of sand making plant that can produce a well graded, well shaped sand with precise control over the amount of filler in the sand. Tests around the world have shown that this sand can not only replace its natural counterpart, but as it is so consistent, the amount of cement used in the mix designs can be reduced significantly.

All sands and indeed crushed rocks break differently which results in various gradations and particle shapes. As a result every jurisdiction provides different sand gradation specification "envelopes", some are wider than others, but in the main they have been based upon natural sand gradations. We are aware that the best performing sands have good shape and an even gradation, but very little work has been done on actual concrete performance using manufactured sands. With small changes in **gradations**, cement contents in concrete can be minimised in a way never done before. It is also well known that **consistency** in sand is a key consideration when deciding upon the amount of cement to be used in a mix. Savings in excess of 10% in the cement content have been commonplace in recent tests, but a great deal of test work needs to be done to formulate a model to find the ideal sand gradation for each stone type, including the highest tolerable level of filler content to minimise waste. The results of such an analysis could well lead to specification changes, if we are to make significant reductions in our cement use generally. The same may be said about oil savings in asphalt, but we have no information to support such claims at this time.

It is also thought that the carbon footprint of Kayasand is significantly less than that of dredged sand, which is likely to increase as dredges are forced further out to sea. From third parties we understand that dredging can consume up to 15 Kgs of carbon per tonne, while Kayasand is likely to be 7 – 8 Kgs of carbon per tonne, added to which are the significant carbon savings that relate to the reduced use of cement when using Kayasand.