

Summary

This project was supported by the National Assembly for Wales, via the Aggregates Levy sustainability Fund for Wales. In 2000 the Welsh Assembly acknowledged the need to find a sustainable use for the growing stock piles of crusher fines in Wales, and commissioned research into the use of these fines as a replacement for natural sand. The 2000 study showed that whilst certain crusher dusts were acceptable for use in concrete, they still needed to be blended with natural sands to satisfy the required fine aggregate specifications and desired fresh concrete properties. The report highlighted the need for sand products of consistent quality and acceptable grading and suggested that the manufacturing and screening processes were fundamental to achieving these attributes. It is now believed that this technology has been developed and improved to the point where reprocessed crusher dusts can completely replace natural sand in concrete.

An extensive Cardiff University led laboratory programme, with input from industrial project partners, formed the basis for the evaluation of the primary aim of this project which was to examine the potential for Kayasand to completely replace natural sand in concrete. The results obtained from the laboratory testing of a range of samples collected for this project provide additional data on grading characteristics and pre and post-processing physical properties of the Kayasand product.

Four different rock types were considered in the present study, gritstone (sandstone), limestone, basalt and granite. In order to evaluate the use of Kayasand in concrete a suite of physical characterisation tests were performed which were used to identify the effect of the physical sand properties on the fresh and hardened properties of concrete. Mix proportions were established for each individual rock type and a w/c ratio selected to achieve a fresh concrete slump of 50-90mm.

Additional laboratory tests were performed in order to observe the performance of the various Kayasand concrete mixes with the use of plasticisers at a fixed water/cement (w/c) ratio. These mixes allowed the potential for cement savings to be addressed.

The test results demonstrate that with appropriate adjustment to the mix proportions it is possible to replace marine sand in concrete with 100% Kayasand with no detrimental effects on the development of workability as measured by the slump test, compressive or tensile strength. Moreover, there was no apparent relationship between fines content and 28-day compressive strength in any of the Kayasand concretes. This suggests that there are no negative effects of higher fines contents on the compressive strength for the given mix compositions and range of fines contents investigated in the study. An increase in the fines content of the Kayasand mixes generally resulted in a small reduction in the slump of the mix, however only 1 of the 16 Kayasand mixes fell outside of the S2 slump range with some evidence of the fines acting as lubricants in Kayasand concretes with medium fines contents. From the results it also appears that there may be the potential to further enhance the compressive strength of the Kayasand concretes in comparison to their marine sand counterparts by reducing the w/c ratio, or as an alternative match the compressive strength level of the marine sand concrete by reducing both the w/c ratio and cement content in the Kayasand concrete mixes. However, further investigation is required to verify this.