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Development of a phosphate treated clay-based glass fibre reinforced roofing tile

An investigation was carried out to determine the properties of a phosphate-bonded clay based, low temperature fired glass fibre reinforced, roofing tile. Available literature shows that the strength of phosphate bonded clay bodies are shown to be related to the equilibrium pH of the clay mix. The highest strengths were obtained for mixes with equilibrium pH 7.4 fired at 500C^{o} which has given a modulus of rupture value 60% higher than the untreated clay fired at 850C^{o} temperature. The above results based on available literature were limited to one type of clay. The NBRO research was extended to cover other common types of clays available in Sri Lanka with the two main objectives;

(i) Reduce the sintering temperature of clay form about 1000 C^{o} to 500 C^{o} by using phosphate treatment, which would eventually result in considerable savings energy in the manufacturing of roofing tiles.

(ii) To produce fibre reinforced tiles (larger than conventional calicut tiles) which can be used to reduce the overall cost of roof structure by increasing the purlin spacing. Clay samples were collected from Hanwella, Ja-Ela, Kochchikade and Bangadeniya areas; orthophosphoric acid ($H3PO_4$ – 1.75g/cm^3) and di-ammonium hydrogen phosphate ($(NH_4)^2HPO_4$) were used as phosphoric binders. For the purpose of reinforcement glass fibre (s.g.2.5g/cm^3) was used.

0 M Solution of orthophosphoric acid (pH0.9) and di-ammonium hydrogen phosphate (pH 8.03) were prepared using distilled water and mixed together to adjust the pH value of bulk solution to 7.5 Laboratory test specimens (125mm x25mmx20mm) were prepared by using different fibre volume percentages(0.5%-3.5) but fibre length was kept constant (15mm-20mm). Specimens were allowed to air dry, and finally oven

dried, for 24 hours at 100C^{o} and fired in a laboratory electrical muffle furnace at 500C^{o} with a 2-hour soaking period.

Strength achieved in phosphate treated samples fired at 500C were marginally lower than in the samples prepared by conentional method of firin gat 850. Modulus of rupture values did not show a linear relationship with fibre volume percentages, probably due to random orientation of fibres. Further trials are being carried out by incorporating fibres aligned parallel to the longitudinal axis of the test specimens.