PHOSPHATE BONDED CLAY BRICKS FOR BUILDING INDUSTRY

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The broad aim of this project is to fabricate low cost clay bricks for building industry using suitable minerals commonly available in Sri Lanka. Conventional clay bricks are fired at temperatures 800-1000 °C depending on the composition of the clay. The major cost is due to firewood and the cost can be brought down by decreasing the firing temperature. Manufacturing of clay bodies using suitable chemicals for strong bonding at low temperatures, is a suitable approach in reducing the high demand for firewood in the brick industry. This will intern help prevent deforestation. Fabrication of clay bodies using phosphoric acid is well-known for many years. Since the high production cost of phosphate-bonded-clay bodies, they are not commonly used.

It is expected that the addition of phosphoric acid forms a self reinforced microstructure with Fe^{3+} ions present in soil. Since red soil has relatively high amount of Fe^{3+} ions, commonly available red soil was used in the preliminary study. Phosphoric acid (3 M solution) and Eppawala Rock Phosphate fertilizer (ERP) were used as additives. Phosphoric acid and ERP added small size brick samples were fired for one hour at 300 °C and 500 °C, respectively. The important physical properties such as compressive strength, fracture toughness, modulus of rupture and water absorption of these brick samples were investigated. These values were also compared with those of conventional bricks made with the same soil fired at 800 °C. It was observed that the properties of phosphoric acid added bricks were superior to those of conventional bricks fired at 800 °C and to the ERP added bricks fired at 300 °C. However, there was a promising improvement of these properties of ERP added bricks when fired above 500 °C. Iron oxide (Fe_2O_3) present in the raw material was identified using the X-Ray Diffraction (XRD) analysis. Scanning Electron Microscopy (SEM) of phosphoric acid added fired brick samples showed that there were needle type elongated grains formed in the microstructure. Subsequent EDAX analysis revealed that these needle type grains were mainly composed of iron rich phosphate compositions.

Formation of needle type elongated grains of iron phosphates may act as a self reinforcement. This leads to increase the strength by crack branching, crack bridging and crack pullout.

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