Phosphate bonded clay bricks

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The broad aim of this project is to fabricate chemically hardened clay bricks for building industry using suitable minerals commonly available in Sri Lanka. Conventional clay bricks are fired at temperatures 800 ^{0}C-1000 ^{0}C depending on the composition of the clay. The major cost of clay bricks is due to the firewood utilisation in the firing process and hence the cost can be brought down by reducing the firing temperature. Manufacturing of clay bodies with strong bonding at low temperatures using inexpensive chemicals and minerals is a suitable approach in reducing the high demand for firewood in the brick

industry. This will in turn help prevent deforestation. Due to the high production cost of phosphate bonded clay bodies, they were 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 as the starting material whereas phosphoric acid (3M/1M solutions), Eppawala apatite mineral (EAM) and Eppawala rock phosphate fertilizer (ERP) were used as additives. Phosphoric acid, EAM with phosphoric acid added small size brick samples were prepared and fired at 300 ^{0}C for one hour. ERP added samples were fired at 500 ^{0}C for one hour. The important physical properties such as compressive strength, modulus of rupture and water absorption of these brick samples were investigated. These properties were compared with those of conventional bricks made with the same soil fired at 800 ^{0}C. It was observed that the properties of phosphoric acid added bricks and both apatite and phosphoric acid added bricks were superior to those of conventional bricks fired at 800 ^{0}C. On the other hand, the ERP added bricks fired at 300 ^{0}C did not show any promising improvement. However, better performance of these bricks was observed when fired at 500 ^{0}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 (3M) 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 and hence leading to increase the strength by crack branching, crack bridging and fiber pullout.

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