ABSTRACT

The present thesis deals with the fabrication and characterization of modified jute fibre reinforced concrete composite for structural applications. By optimizing the particle size gradation, fibre loading content, fibre dispersion and fibre-matrix modifications we have successfully fabricate modified jute fibre reinforced concrete where modified fibres are homogeneously distributed in concrete matrix. The fabricated concrete composite are characterized in terms of their mechanical properties. Chemically modified jute fibre (reinforcing agent), polymer latex (surface modifier both for fibre and matrix) and tannin (water reducing admixture), substantially improves the physical and mechanical properties of concrete with a mix design cement: fine aggregate: coarse aggregate: fibre: water::1:2:4:0.01:0.6. The workability of the concrete is found to increase systematically from 65 ± 5 mm (reference concrete) to 80 ± 3 mm (tannin and polymer modified jute reinforced concrete). Optimal polymer content in emulsion (0.0513%) and tannin content (0.25 wt%)with respect to cement is found to increase the compressive strength and modulus of rupture 20% and 35% respectively as compared to reference concrete. A plausible mechanism of the effect of modified jute fibre controlling the physical and mechanical properties of concrete composite has been proposed. The optimized fibre reinforced concrete was used to make paver blocks, pre-stressed concrete electric poles, pre-stressed concrete railway sleepers, and (non pressure) NP3 type concrete sewage pipes. The mechanical properties of these products were evaluated in terms of their bending strength, transverse load, centre top load and three edge bearing load respectively. The experimental results reveal that the bending strength of modified jute reinforced concrete paver blocks show 49% higher strength than that of reference blocks. For modified jute reinforced concrete electric pole, transverse load was found 3.3% higher with significantly improved deflection than that of the reference electric pole. Modified jute reinforced concrete sleepers achieved 24% higher centre top load than that of reference one. As compared to commercial non-pressure grade pipes (NP3 type), significant strength improvement, under three-edge-bearing test (129.4%), is achieved in the pipes made using the modified concrete mix. NP3 pipes made using this modified concrete exhibit similar mechanical properties to that of NP4 pipes resulting an effective reduction of 31.6 wt% of steel used for reinforcement in NP4 pipes.

Keywords: Jute fibre, concrete composite, durability, polymer latex, tannin, paver blocks, prestressed concrete electric poles, concrete railway sleepers, concrete sewage pipes.