Eco-friendly green composites reinforced with recycled polyethylene for engineering applications

Abstract

Polyethylene (PE) and cement are industrial products that promote environmental pollution. These products when exposed on the landfill have tremendous effects on the lives of humanity and other living creatures, including animals. Therefore, this research presents the results of experimental and theoretical modeling of green composites (without the inclusion of cement) reinforced with recycled polyethylene waste for applications in the Mechanical and Civil Engineering industry. The composites are produced using different weight fractions of laterite and molten PE mixed homogeneously to produce unique green composites with excellent mechanical properties. The green composite with 40 wt.% laterites and 60 wt.% PE exhibited the highest compressive strength, flexural strength and fracture toughness of 25 MPa, 7.3 MPa and 0.6M Pa$\sqrt{m}$, respectively. Additionally, the green composite recorded maximum yield stress of ~2MP. The maximum yield stress of the green composites falls under the minimum range of yield stress for traditional concrete structures. The SEM images reveal evidence of bonding and ligament bridging in the green composites reinforced with 40 wt.% laterites and 60 wt.% PE. The probability distribution plots show that the polyethylene in the green composites follows the Weibull distribution with low Anderson Darling Statics and p-values greater than significance level of 5%.

Graphical abstract