ABSTRACT

The study's main aim is to research the performance of flax fibre and bio epoxy composites under harsh environmental conditions when used as confinement material in construction. Synthetic fibres, such as carbon fibre, and synthetic epoxy resins have been well-researched and proven to provide strong performance gains in concrete members when used as composites. Natural fibres like flax fibres and natural epoxy are a promising eco-friendly and economical alternative. However, because of inconsistent fibre quality and degradation in harsh environments, they cannot be readily used in construction. In order to use natural fibres and bio epoxy as a replacement for synthetic fibres, an experimental study of such materials in different harsh environmental conditions needs to be done and appropriate treatment methods should be applied if needed. However, experimental testing and study on natural fibres are limited, indicating the need for extensive study in this area.

In this study, the amount of performance loss in flax fibre and bio epoxy composites due to exposure to saltwater and high ambient temperature was studied through experimental testing. The effect of salt water and high ambient temperature for different lengths of time were compared with each other and finally compared with control samples not exposed to harsh environments. The experiment was undertaken in the lab by moulding concrete cylindrical specimens. Then, the unidirectional flax fibre sheet was wrapped in a hoop direction around the concrete cylinders with the use of bio-epoxy resin. The wrapped cylinders were then placed in a corrosion chamber and oven to simulate the corrosive environment of marine conditions and high ambient temperatures for 3, 7, 14 and 28 days. Compressive strength test was carried out on each sample and the results thus obtained for each sample were compared and evaluated. The degradation in performance of each sample exposed to harsh environmental conditions for different lengths of time is presented and discussed in this report. The amount of performance decline because of different harsh environmental conditions for different lengths of time was quantified. The Research was undertaken between September 2023 and June 2024 at Flinders University, College of Science of Engineering Laboratory located in South Australia, Australia.

Confinement of concrete cylinders using flax fibres and bio epoxy composite resulted in significant increases in compressive strength by up to 85%. Exposure of composite samples to saltwater for 28 days duration resulted in a minimal decrease in the ultimate strength of samples indicating the strong potential of such composites in construction applications. Exposure of samples to high heat of 80 degrees Celsius showed some gain in compressive strength, possibly because of the curing effect of bio epoxy, which could be advantageous in certain construction scenarios where heat resistance is required.