AN INTEGRATED PERMEABILITY TESTING DEVICE FOR TEXTILE REINFORCEMENTS UNDER HIGH TEMPERATURE

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Keywords: permeability measurement, textile preform, high temperature, device design.

Abstract

Evaluating the permeability of textile reinforcement is a subject of significant interest. Following numerous regional and global permeability benchmark exercises, the first international standard for in-plane permeability, ISO 4410, was released in July 2023 [1]. However, there is a scarcity of reports on the high-temperature permeability behavior of fibrous preforms. High temperatures can cause fiber slippage and binder melting, leading to potential significant differences in meso- and micro-structure of fibrous preform and thus change the permeability compared to room temperature conditions. This scenario imposes new requirements on the selection of materials for the testing device and the operating temperature of the sensors. This work developed an integrated permeability testing device in which in-plane permeability and transverse permeability test molds were installed on a piano-style workbench. Both permeability components are measured according to the unidirectional method and determined by 1D Darcy's law. The in-plane permeability test mold was designed according to ISO 4410, while the transverse permeability mold was optimized using the method presented by Yang et al. [2, 3]. Heating modules were designed in the testing devices and the injection apparatus. The operating temperature ranges from room temperature to 100 °C. Additionally, a flow system driven by a gear pump is designed to enable the automatic circulation of the testing fluid from the collection pot to the injection pot, with a filter installed between the two to facilitate fluid recycling. The development of this device offers a tool for the accurate measurement of permeability under high-temperature. Future work will focus on Future work will focus on using this device to study the permeability of textile preforms under high-temperature conditions.

Reference

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