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黏弹性树脂基三维编织复合材料的变温松弛模量

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Relaxation Modulus of Viscoelastic Resin-based 3D Braided Composites Under Variable Temperatures

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摘要

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摘要 利用均匀化方法,计算了树脂基三维编织复合材料在不同温度下的恒温松弛模量,通过对计算结果的分析,提出了树脂基三维编织复合材料松弛模量具有时温等效性的假设,并用数值方法验证了此假设的合理性。以该假设为基础,建立了由树脂基三维编织复合材料恒温松弛模量确定其变温松弛模量的一般方法。对模型施加合理的周期性边界条件后计算了材料编织方向的变温松弛模量,并对比了不同温度变化速率对变温松弛模量的影响。结果表明,对应于不同的温度变化历史,树脂基三维编织复合材料有不同的变温松弛模量,但稳态值相同,且快速升温可明显缩短变温松弛模量到达稳态的时间。

关键词: 黏弹性 三维编织复合材料 时温等效性 均匀化方法 周期性边界 松弛模量

Abstract: Relaxation moduli of resin-based 3D braided composites under different temperatures are calculated using the homogenization method. Through an analysis of the calculated results, a hypothesis is proposed that the relaxation moduli of resin-based 3D braided composites have time-temperature equivalence, and the hypothesis is verified by numerical calculation. Based on the hypothesis, a general method is constructed for determining the relaxation moduli under variable temperatures from those under constant temperatures for resin-based 3D braided composites. The relaxation moduli under variable temperatures in the braiding direction are obtained by applying reasonable boundary conditions to the models, and the influence of temperature change ratio on the relaxation moduli is also studied. It is shown that for different temperature histories, the relaxation moduli of resin-based 3D braided composites are different, but the steady values tend to be the same; and the time for the relaxation moduli to reach the steady value can be significantly shortened when the temperature is increased rapidly.

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