Modeling Heat Transfer Through Filament Yarns By Random Geometry Creation

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Abstract

Filament yarns are a collection of microfibers of set diameter and material held together by tension and/or intra-filament attraction. This results in a stacking patterns which can be random with different degrees of freedom. A slight change in tension or attractive forces may mean a different arrangement of microfibers in the cross-section. Since, the yarn would normally be suspended in air, the gaps between the microfibers is obtained by air. Hence the effective thermal conductivity of the yarn would be a function of the arrangement pattern of the microfibers and influencing variables, like the cross section etc. We have devised a random geometry creation model in the COMSOL Multiphysics® software using model methods to create random arrangements of microfibers. We vary the influencing variables, while enforcing geometrical constraints and then determine the effective thermal conductivity of the yarn. We use the Heat Transfer Module along with the parametric sweep feature to generate microfiber geometry, which would then be coupled with model methods to create a random arrangement. This would help us to determine the extent of dependence of effective thermal conductivity of the yarn cross section on the different parameters and obtain an accurate model for it.