Thermal Clothing Engineering by Using a Simulation-Based App

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Introduction The dynamic heat and moisture transmission characteristics of clothing are extremely important phenomena that control the thermo-physiological comfort of a person [ref. 1-3]. Heat and moisture absorption in hygroscopic materials are inseparably interrelated (fig. 1).

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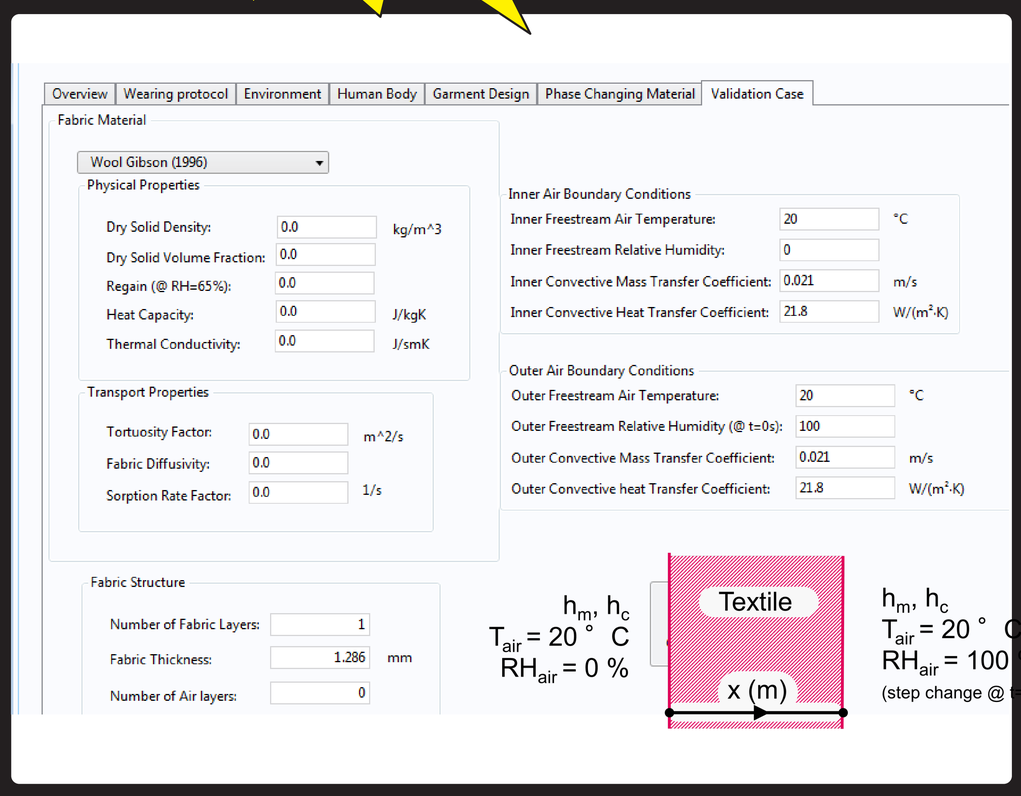
Computational Methods The COMSOL model accounts for **vapor-phase diffusion, heat transfer, liquid evaporation/condensation** and **sorption/desorption** through the **solid phase** (table 1). Complications due to **variable porosity** caused by swelling/shrinkage of the porous matrix are accounted for by the **source terms** in the transport equations [ref. 1 & 3].

Results



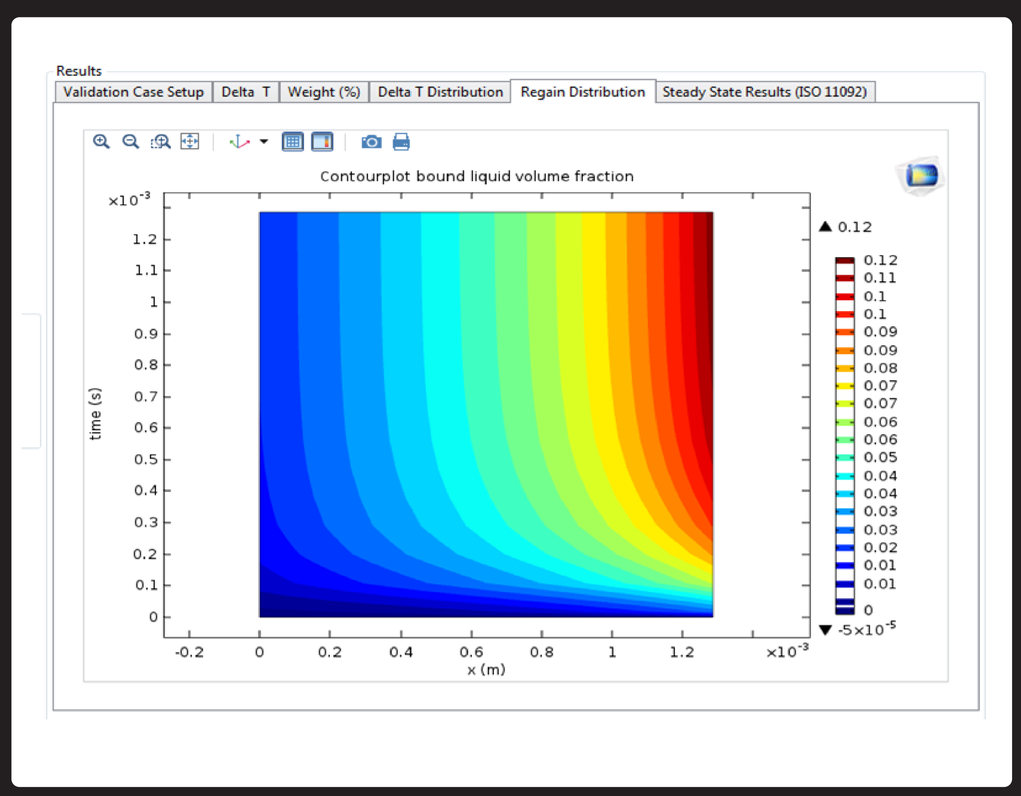


Figure 1. Comsol web application

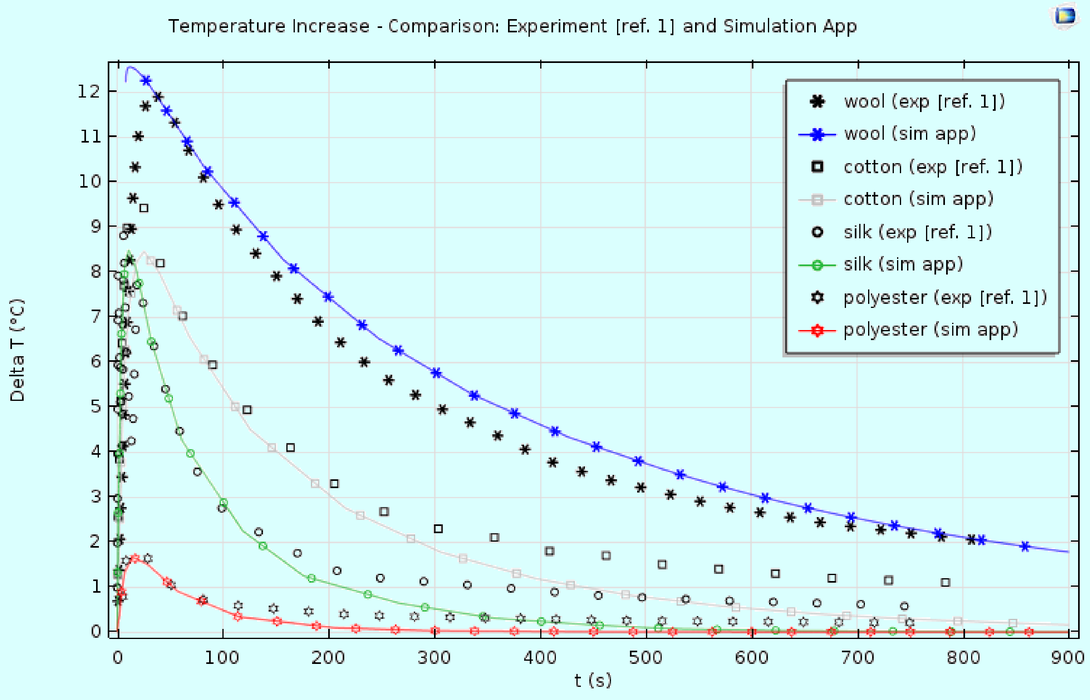


Figure 2. Validation with [ref. 1]

Validation case Different fabrics are subjected to a step change in relative humidity [ref. 1], see (fig. 1).

Conclusions Coupled diffusion phenomena of heat and moisture in hygroscopic materials are successfully modeled. More fabrics and validation is underway.

References

1. Gibson, P.,Charmchi, M., The Use of Volume-Averaging Techniques to Predict Temperature Transients Due to Water Vapor Sorption in Hygroscopic Porous Polymer Materials, Journal of Applied Polymer Science, 64, 493-505 (1997)