Contribution ID: **204**

Type: **Oral 20 Minutes**

Microstructural Modeling and Simulation of Heat Transfer in Wood Fiber based Insulating Materials

Wednesday, 16 May 2018 11:17 (15 minutes)

Wood fiber based materials are of high interest in building insulation. Their application is desirable due to the sustainability of renewable resources. Furthermore, wood fiber based materials outmatch petrochemical based materials with respect to health aspects during process and application.

The insulation properties of such fiber based materials are often characterized experimentally, which has certain disadvantages. For instance, the experimental characterization requires a high effort to characterize only few produced material variants. The connection between the properties of the fibrous microstructure and the effective thermal conductivity is hardly enlightened.

To overcome these disadvantages in the current presentation a microstructural modeling and simulation approach for the determination of the effective heat transfer is presented. The development of imaging procedures and powerful computer simulations allow the characterization of structure property relationships even for highly complex fiber networks.

The following work flow is applied.
First of all, the single fibers which form he compund are geometrically analyzed. Furthermore, highly resolved three-dimensional computer tomography (μCT) images of wood fiber based insulating materials are generated.
From these geometrical characterizations the fiber network and the pore volume distribution are evaluated.
In a second step based on these characterizations virtual realizations of the materials are generated.
Subsequently, the microstructural simulation of the heat transfer in these virtual representation is carried out and compared to experiments. An advantage of this microstructural simulation technique is that as input only the conductivity of the wood fibers is required.
Studies on the influence of different process parameters as fiber length distribution, fiber orientation and raw density are possible by generation of appropriate virtual microstructures.
Furthermore, effective (global) as well as local quantities are evaluated.
Therefore, this virtual material testing approach allows the prediction and optimization of insulating material without extensive trial and error approaches.

The presented simulations are prepared by using the commercial software tool Geodict [1] and the fast microstructure Solver FeelMath [2].
This efficient solver directly operates on voxel images and thus no effortful generation and storage of meshes is required. Thus, very large microstructures, either virtually generated or directly obtained from μCT images, can be simulated fast and memory efficient.

[1] www.math2market.com
[2] www.itwm.fraunhofer.de/en/departments/sms/products-services/feelmath.html

References

Acceptance of Terms and Conditions

Click here to agree

Primary author: STAUB, Sarah (Fraunhofer ITWM)

Co-author: Dr ANDRÄ, Heiko (Fraunhofer ITWM)

Presenter: STAUB, Sarah (Fraunhofer ITWM)

Session Classification: Parallel 7-B

Track Classification: MS 2.07: Prediction of the thermal conductivity of porous materials