The effect of channel contraction profile and turbulence on fiber orientation

Maria Putkiranta[1], Hannu Eloranta[1], Tero Pärssinen[2] and Pentti Saarenrinne[1]

[1]Tampere University of Technology, Department of Energy and Process Engineering
P.O. Box 589, Tampere, FI-33101, Finland
[2]Metso Paper Inc., P.O. Box 587, FI-40101 Jyväskylä, Finland

Corresponding author: maria.putkiranta@tut.fi

Fiber orientation distribution is known to determine paper strength properties and its dimensional stability . Fibers get aligned in the streamwise direction in the headbox slice due to an accelerating base flow. The final fiber orientation distribution is also affected by other factors, such as turbulence level in the headbox, the slicebar design and the jet-to-wire ratio.

This paper presents the development of fiber orientation distribution in streamwise accelerating flow fields in three different channel profiles. All measurements are repeated with four fiber types (long and short rayon, euca and pine) to see the effect of fiber properties. The fiber orientation in the flow is measured by taking images the fiber suspension and using image analysis to determine the local fiber orientation. The results show the differences in the magnitude of orientation between different fibers. There are also significant differences in orientation produced by the different channel profiles even though the contraction ratio in all channel profiles is the same. Also PIV measurements are done in all the profiles and the results are reflected to fiber orientation results.

After that the effect of turbulence on fiber orientation is studied in a channel profile with flat walls, which was found to be the profile producing the highest fiber orientation anisotropy. The turbulence in the channel is varied by changing location and the size of holes in a turbulence generator. Using smaller holes and locating the turbulence generator closer the contraction increases the turbulence level and randomizes the fiber orientation distribution. Results for euca fibers are shown in Fig. 1 for higher turbulence level (8mm holes) and lower turbulence level (12 mm holes) at two different flow rates. To investigate the differences in turbulence intensity, PIV measurements are done in all tested cases.

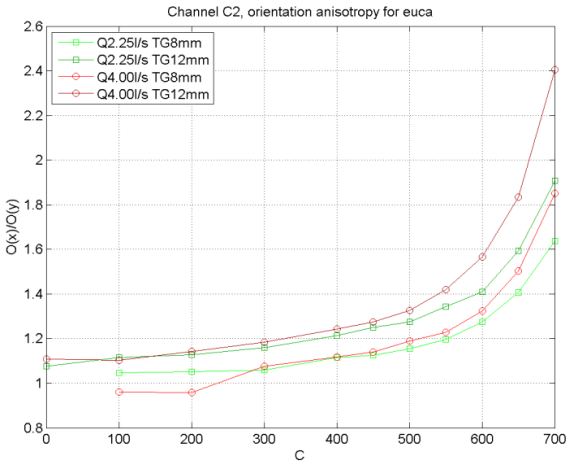

Figure . Effect of turbulence generator on fiber orientation anisotropy in channel C2.