UNIVERSITY OF TWENTE.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

H.J.M. Baan

will give a presentation, entitled

Considerations on Design Jet Washer and Washing Section Layout of Twaron Production Process

Date: **Wednesday June 11, 2014**

Time: **14:00**

Room: **Carré 3H**

Summary:
Twaron para-aramid yarn is produced by a wet spin process. The polymer PPTA is dissolved in sulfuric acid and spun into a yarn bundle of thousand filaments with a diameter of 10 – 15µm. The production process consists of a spinning, washing, drying and winding section. In the washing section the Twaron yarn is led through a prewash section in which the sulfuric acid solvent is washed out of the yarn bundle. The remaining sulfuric acid is then neutralized in the neutralization section using caustic soda. The excess caustic soda is removed in the afterwash section.
Every washing section consists of a series of washers, each washer refreshes the liquid in the yarn bundle. For strength and durability of the yarn it is important that the sulfuric acid and caustic soda content of the yarn is below a certain limit.

The focus of this study is the scaling-up of the prewash section to higher spin velocities and the effect of various yarn bundle configurations on the washing efficiency of the total washing section.
The washing process is governed by diffusion and convection of sulfuric acid. Using Ansys CFX a numerical simulation has been set up to determine the effectiveness of a washer in refreshing the fluid inside the yarn bundle. The yarn bundle is modeled as an anisotropic porous medium using volume-averaged Navier Stokes techniques. This results in the so-called Darcy-Forchheimer substitution equation. For the filament bundle the model of Zhenhua is used. The diffusion process is modeled analytically using Fick's law of diffusion, which can be used to obtain characteristic diffusion times. Two versions of a washer have been analyzed using numerical simulations and have been tested in the laboratory: the currently applied washer and a newly designed prototype.

From the results of the numerical simulations it can be concluded that at spin velocities and for bundle configurations used in the production process certain regions in the yarn bundle are not refreshed by the washer. Experiments in which this effect is excluded reveal a two-regime diffusion process. Using this insight in the diffusion process the washing section can be optimized with respect to length and spin velocity.

Assessment committee: Chairman,
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