

# COLLOQUIUM

Group: Engineering Fluid Dynamics

As part of his MSc thesis assignment

**Koen Reimert**

will give a presentation, titled:

## **Modeling Convective Flow in a Yarn Washing Process**

Applying Darcy-Forchheimer equation to numerically simulate the convective flow

**Date:** Friday June 8, 2012

**Time:** 14:00 u

**Room:** Horstring N 109

### **Summary:**

In its quest for global leadership in high performance yarns, Teijin Aramid is developing a new yarn. Just like the existing yarn (Twaron) the new polymer is dissolved in sulfuric acid in order to extrude it into thin filaments that form the yarn. Remaining sulfuric acid in the yarn has negative effects on the properties of the yarn, therefore it must be removed from the yarn in a washing section. Unfortunately the current layout of the washing section for the Twaron yarn does not perform well enough for the new yarn presently developed.

During the washing process two important phenomena determine the amount of sulfuric acid that is removed: diffusion inside the filaments and convection in between the filaments of the yarn. The focus of the present study is on the convective flow of washing water in between the filaments of the yarn.

A typical yarn consists of about 1000 filaments, each of which can be considered as a long and thin cylinder of a diameter of approximately 15 micron. Directly solving the Navier-Stokes equations for the flow in a bundle with around 1000 filaments is nearly impossible due to the excessive number of elements needed to resolve all relevant length scales and the computational resources required for such a numerical simulation. Therefore the yarn is considered as a cylinder of a porous material, using the Darcy-Forchheimer equation to model the flow through the yarn. The geometry of the yarn inside the washer is determined experimentally by taking images of a yarn in a Perspex washer using a microscope.

From the results of the present study it is concluded that the convective flow inside the yarn, passing through a washer, can still be improved. Geometrical changes to the current washer are recommended to improve the washing efficiency. The improvements can lead to a feasible washing process for the new yarn or increased production velocity for existing yarns like Twaron.

### **Assessment committee:**

Prof.dr.ir. H.W.M. Hoeijmakers (chairman)  
Dr. Ir. C.H. Venner (mentor)  
Dr.ir. R. Loendersloot  
Ir. M.J.A. Jaarsveld (mentor Teijin)  
Ir. J.J. Meerman (mentor Teijin)

### **Chairman:**

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