Faculty Engineering Technology
Program Mechanical Engineering

University of Twente.

COLLOQUIUM

Group: **Engineering Fluid Dynamics**

As part of his MSc thesis assignment

Mark Voerman

will give a presentation, entitled:

Restart Phenomena of non-Newtonian Drilling Fluid in Pipe Flow

Date: Monday April 22, 2013

Time: 14:00

Room: **Zuidhorst 286**

Summary:
The research has been inspired by the field of oil and gas well drilling. Drilling wells requires a fluid for the transportation of cuttings from the bottom of the borehole to the surface. This fluid is called a drilling fluid, or drilling mud. Drilling fluids must be pumped through the circulation system efficiently, while at the same time they need to have a high cuttings carrying capacity. A combination of these properties is found in non-Newtonian fluids.
The viscosity of a non-Newtonian fluid changes with the amount of shear that is applied to the fluid. In the case of drilling fluids, the viscosity decreases with increasing shear. This is favorable for efficient pumping at high flow rates. On the other hand, the fluid turns into a gel when the amount of shear is sufficiently low. This is the case at low flow rates or when the fluid is at rest. The downside of this increase in viscosity is that it results in peak pressures when the drilling fluid is restarted. These pressures are considerably higher than the hydraulic pressure-loss during steady-state flow. This is because a certain force is required to break the microstructure of the gel before it starts to flow. When these peak pressures are too high, pump capacity might fall short, or the down hole formation might get damaged.
In order to better understand which parameters affect the restart pressure of drilling fluid in a wellbore, restart experiments have been performed employing a laboratory setup consisting of pipes with the same length-over-diameter ratio as pipes for real wells. During these restarts the pressure at different locations along the pipe has been monitored and the displacement of the gel has been recorded with a high-speed camera. Parameters that were investigated are the rest time of the gel in the pipe, the yield stress of the gel, the pump flow rate at which the flow is restarted, the pipe diameter and the pipe material.
It has been observed that established models for determining the restart pressure fail in terms of their definition of yield stress. Often, the yield stress of the gelled-up fluid is used, but it can be questioned whether the resulting yield stress indeed is the weakest link during a restart. Also, different types of start-up behavior have been observed for low versus high flow rates, which suggests that there is some optimum restart rate.

Assessment committee:
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d.d. April 23 2013