WEEG NEWSLETTER June-August 2019

The newsletter is published monthly by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: We all know that computers run on electrons, using semi-conductors, resistors, integrated circuits etc. There are however logical elements which use a fluid rather than electrons, and there have even been full computers employing that principle – known as fluidics. We came across fluidics when looking at stand-alone control systems for small hydropower installations: read on...

Hydraulic Engineering International: *Fluidics*

In the 19th Century, many physicists compared electric currents with fluid flow – the current was the flow volume, the voltage the gradient or pressure difference. Nicolai Tesla, famous electrical engineer and inventor from Croatia (unfortunately also rather mad, especially in his later years), developed a fluid diode, an element which has a high flow resistance in one, and a low resistance in the other direction, see Fig, 1.

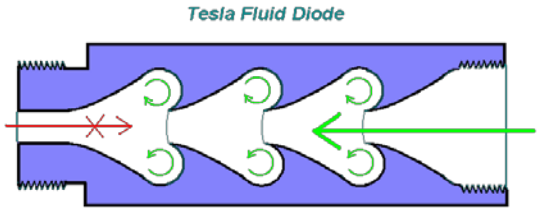

Fig. 1: A Tesla diode: high flow resistance from left to right, low resistance in the other direction.

Such elements however only work for higher Reynolds numbers than can reasonably be achieved with water.

In the late 1940s, a researcher from New Zealand at the London School of Economics used fluid flow to build an analogue model of the British economy, the MONIAC. Water constituted money flowing from the Government to industry, industry to employees, employees to economy and pumped back to the government as taxes etc. The flow was controlled through floats, counterweights etc. When too much money was spent, the water level in the Government container dropped, pressure was reduced and flow reduced and so on. It was a self-regulating fluid network with lots of feedback loops and very complex interactions, which allowed users to simulate the economy, and to assess the effects of changes very quickly. The MONIAC was actually used as a decision-making tool by the UK Government, and 15 such computers were sold to other countries.

Fig. 2: The MONIAC analogue fluidics computer

In the 1960s, fluid elements which allowed amplification of signals were developed in the US, and this in turn led to the development of digital computers. A digital computer was actually build to demonstrate the concept, but... miniaturisation is of course an unsurmountable problem with the use of fluids, so that electronic computers took over that field. There are however several areas of technology where fluidic elements or even fluidic circuits are currently used, such as aircraft flight controls, jet nozzles etc. The advantage of fluidics elements here is the simplicity: they mostly function without moving parts. And reliability.

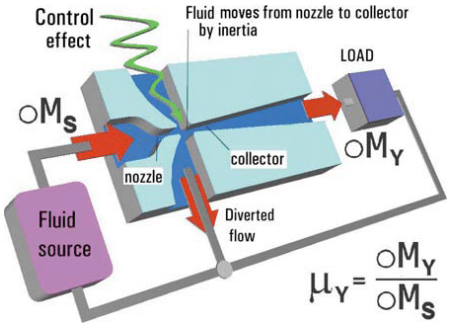

Fig. 3: Fluidic valve flow control

In our work, we looked at fluidics solutions since we needed some control functions for small waterwheels for pumping (i.e. without electricity generation) in remote locations. For this, we developed a fluidic solenoid or magnet which holds a pin in place until the wheel stops (e.g. by blockage caused by floating debris). Then the system pressure drops, the pin is released and the wheel lifted out of the water. So although fluidics computers may never happen, it is good to know that you can use fluid flow for simple control problems which can make life a lot easier if you are in remote places, or if you want to avoid having electric subsystems in your hydraulic installation.

Recent Group Design Projects: *The human powered shredding mill for rice straw*

Yes, this was the project where the Bioenergy Group had a particular problem of shredding rice straw for biogas production, whereby the mill should be powered by sustainable energy. We looked at human power, and designed a treadmill that optimises the power generation – and looks quite futuristic too.

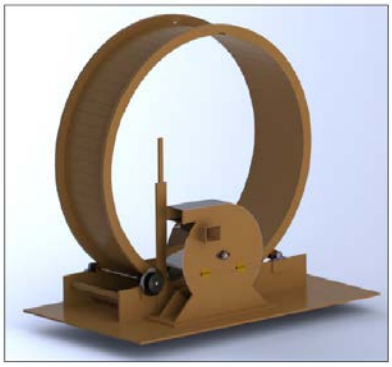

Fig. 4: Human powered shredding mill

An interesting aspect here is that the efficiency of human power production in walking has an average of 38%, whilst a cycling motion only reaches 7 to 15%. So the treadmill does actually have an advantage! The work was very interesting: we had to look at everything from the mechanism of power transmission from the human body to the treadmill to theoretical models and the actual shredding of the rice straw itself. The students then built and tested the shredding mill (Fig. 4).

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Gathering lecture materials

It is summer time so no Year 3 individual Projects are running, though students have their topics and are starting to make plans. Staff are in the lab, supervising MScs, and/or scattered around the globe working on research projects and proposals. This does not stop them thinking about modules and lecture materials, however. Fig. 5 below shows a composting toilet at a remote location in an Australian National Park - a neat way to provide sanitation without electricity or mains water. You can see the two compartments, with vent pipes at the top and composting units below.

Fig. 5: Composting toilets

In CENV6158 we briefly cover various forms of on-site sanitation, including the Ventilated Improved Pit Latrine (VIP latrine) which is used in National Parks in the US as well as widely in developing countries. Expect fresh material on composting toilets in Semester 2 next year!

Jobs in water engineering:

This section gives you an idea of the type of work you can do when working in industry.

Advert: Welsh Water is looking for staff

Dŵr Cymru
Welsh Water

Hydraulic modelling Engineer

www.icerecruit.com/job/189945/hydraulic-modelling-engineer/

Civil and Environmental Engineering at Southampton University:

WEEG: the Civil and Environmental Engineering pathway offers the chance to deepen your knowledge in water-related areas, and gives you a better preparation for environmental engineering projects.

Contact: Dr Sonia Heaven, s.heaven@soton.ac.uk, Bldg. 7, Room 5004

Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

www.facebook.com/environmental.lab.university.of.southampton/

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