**DESIGN OF HEAT EXCHANGERS – A CFD APPROACH**

Sandeep Siwach, Mark Jermy\*

Department of Mechanical Engineering, University of Canterbury

Private Bag 4800, Christchurch 8140, New Zealand

\*[mark.jermy@canterbury.ac.nz](mailto:mark.jermy@canterbury.ac.nz)

In the Organic Rankine Cycle (ORC) a working fluid is evaporated, expanded through a turbine, condensed and pumped back to the evaporator, just as in the conventional Rankine Cycle used in steam power plant, with a low-boiling-point organic fluid instead of water.

The low boiling point of the fluid allows low temperature heat sources to be used (a remarkable example being the plant at Chena Hot Springs, Alaska, generating 500 kWe from a geothermal spring of 73.3oC.) ORC plant are used in large geothermal installations, either as the sole means of electricity generation (e.g. Mighty River Power’s Nga Tamariki plant in NZ) or as a bottoming cycle to exploit the remaining heat in geothermal brine after expansion through a conventional steam turbine (e.g. Ngawha & Kawerau Power Stations in NZ). ORC plants are also used in industrial waste heat recovery.

A significant capital cost in any ORC plant is the heat exchanger(s) – evaporator and condenser. A successful evaporator should:

* Be of appropriate size: no larger than necessary to reduce material cost and footprint
* Produce vapour of high quality (no liquid droplets)
* Be easy to clean if the hot source fluid has the potential to scale or foul the evaporator.

In this project, the aim is to learn about internal flow patterns in full scale vaporizers by developing a validated model for CFD analysis of STHEs used in ORC power plants. CFD simulations are a necessity to improve upon existing designs and test new designs for any industrial equipment due to the fact that it is economically non-viable to manufacture full scale prototypes of all the conceivable designs and so CFD forms a filter mechanism at a fraction of a cost of actual manufacture and testing to narrow down on a few final designs that can be then manufactured and tested upon. The CFD modeling of the phase change process in vaporizers is complicated with a number of user-defined parameters that make the model case-dependent and also experimental data is required to validate the parameters. Once the model is validated it will be used to conduct CFD simulations of a Pentane boiler to gain insight into the flow patterns, relation between liquid level and heat transfer performance and probability of droplet carryover in the vapor stream extracted from the vaporizer.