UNIVERSITEIT GENT

FACULTY OF ENGINEERING AND ARCHITECTURE

Experimental investigation of heat transfer to supercritical organic fluid R125 in horizontal tubes for Organic Rankine Cycle applications

1st European Seminar on “Supercritical CO2 Power Systems”,
TU Vienna, 29-30 Sep 2016

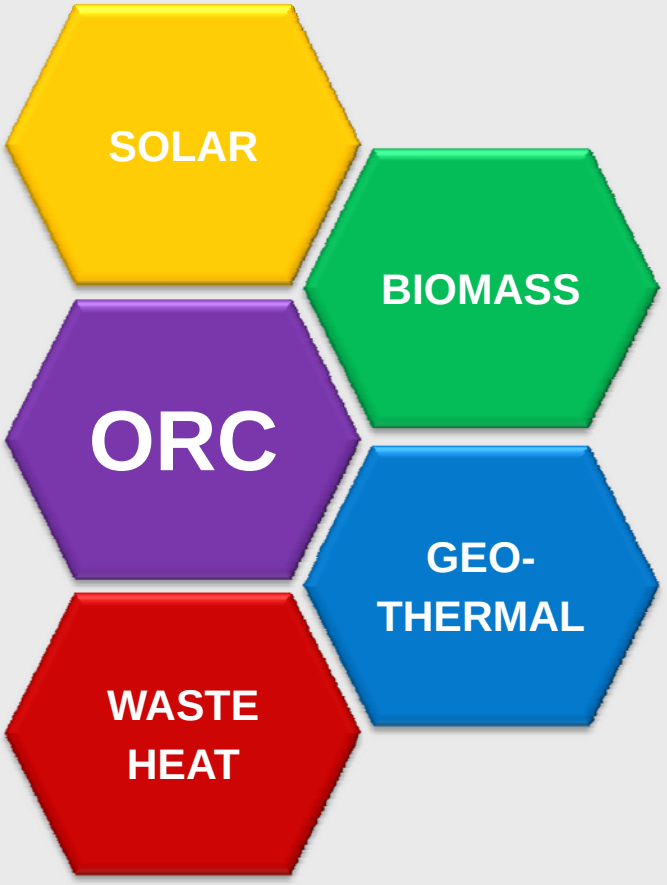
Marija Lazova, T. Stepman, A. Kaya, H. Huisseune, M. De Paepe

Low grade temperature heat recovery

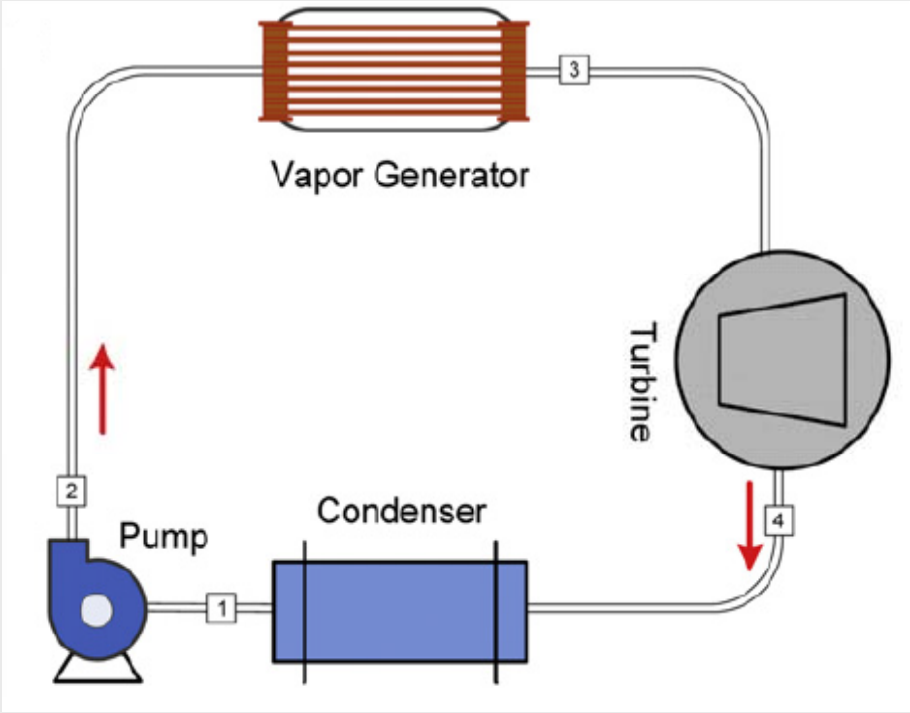
Organic Rankine Cycle

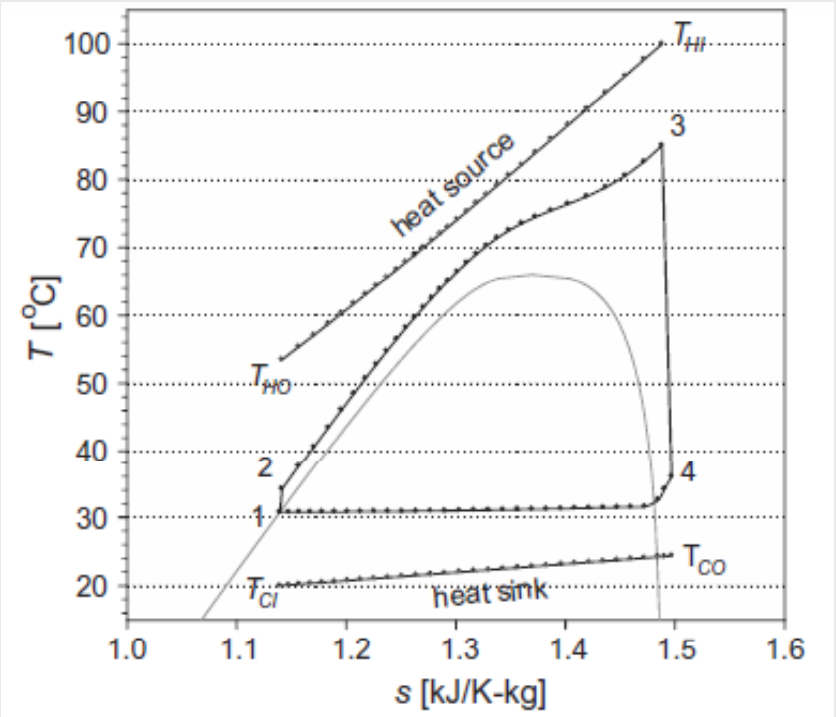
Low grade temperature heat < 400 °C

Temperature of interest 100 °C

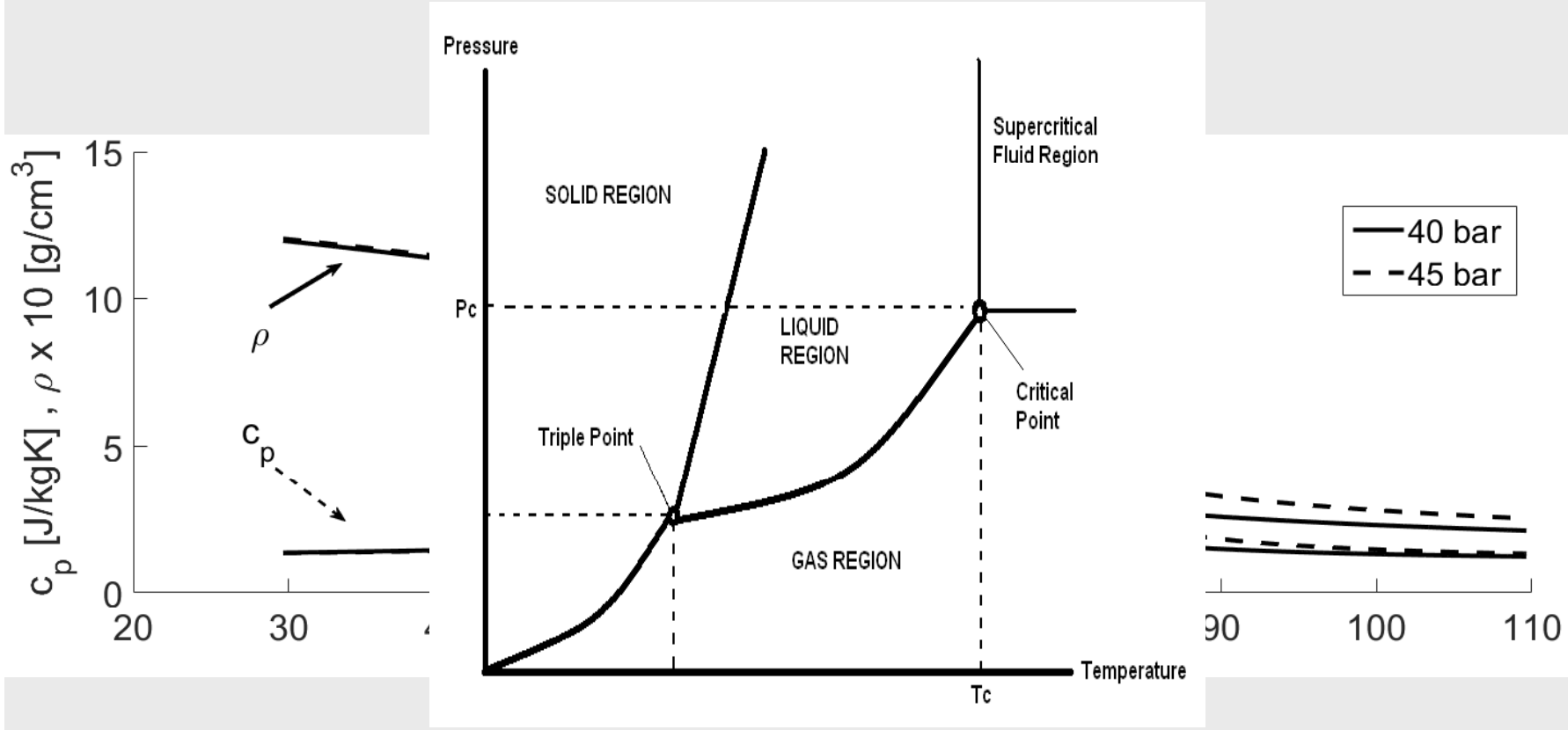


Transcritical Organic Rankine Cycle





Thermophysical properties of supercritical R125

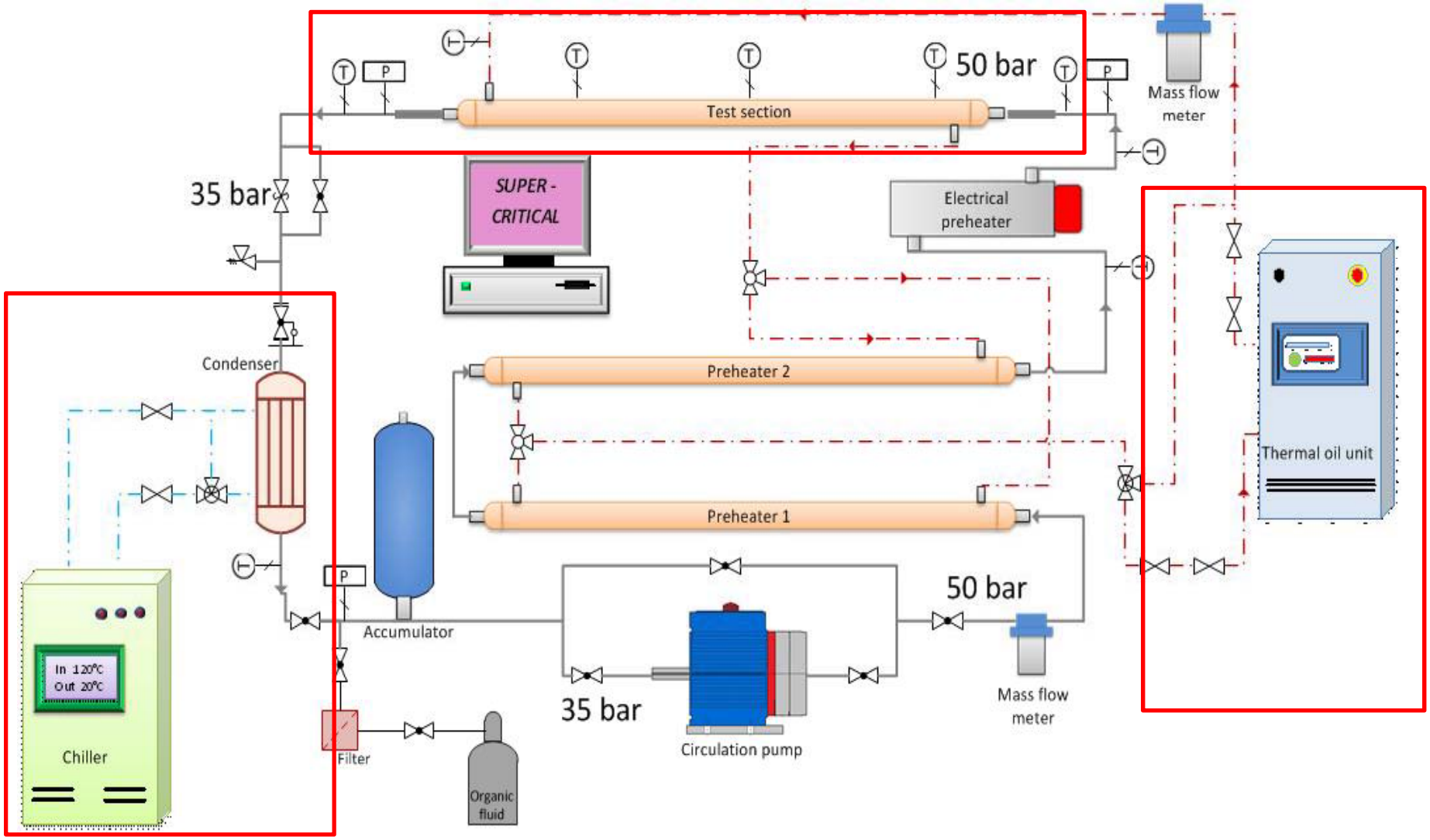


Organic fluids that will be investigated

- Good thermophysical properties

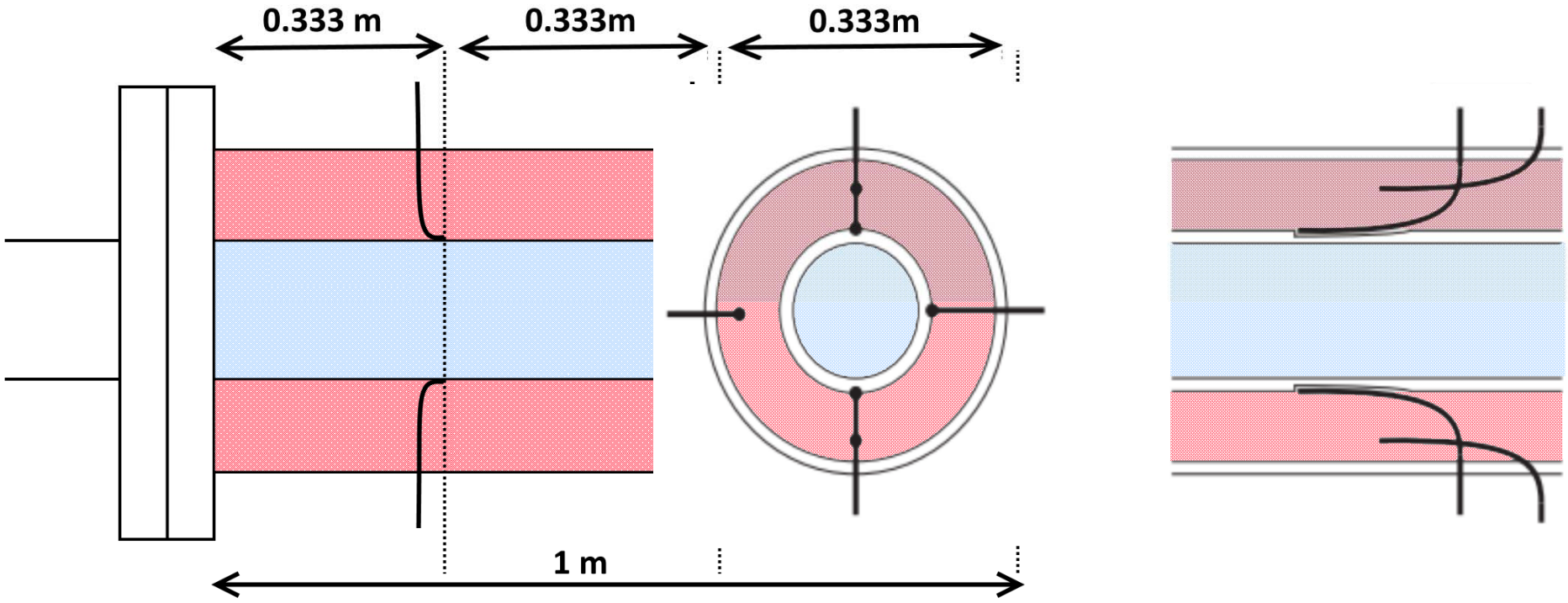
Refrigerant	R125	R134a
Chemical formulae	C2HF5	CF3CH2F
Temperature Tc (°C)	66,0	101,1
Pressure pc (bar)	36,2	40,6
Mol. Weight (g/mol)	120	102,03
Boiling point (°C)	- 48,5	- 26,15
GWP (within 100 y)	3400	1430
ODP	0	0

Test rig


Test section
50 bar
Mass flow meter
35 bar
SUPER - CRITICAL
Electrical preheater
Condenser
Preheater 2
Thermal oil unit
Preheater 1
Accumulator
50 bar
In 120°C
Out 20°C
Chiller
35 bar
Circulation pump
Mass flow meter
Filter
Organic fluid

Test section

Length	Type HX	TC spacing wf	TC spacing hf
4 m	Tube-in-tube	0,333 m	1 m




ITE
ite-tools.com

Uncertainty analysis

Property	Relative error	Property	Relative error
$p_{wf,in}$	0,69 %	$p_{wf,out}$	0,68 %
$T_{wf,in}$	0,15 %	$T_{wf,out}$	0,11 %
$\dot{m}_{wf}$	0,07 %	$\dot{m}_{hf}$	0,08 %
Q_{hf}	9,8 %	Nu_{hf}	10 %
Q_{wf}	26,34 %	Nu_{wf}	12,14 %

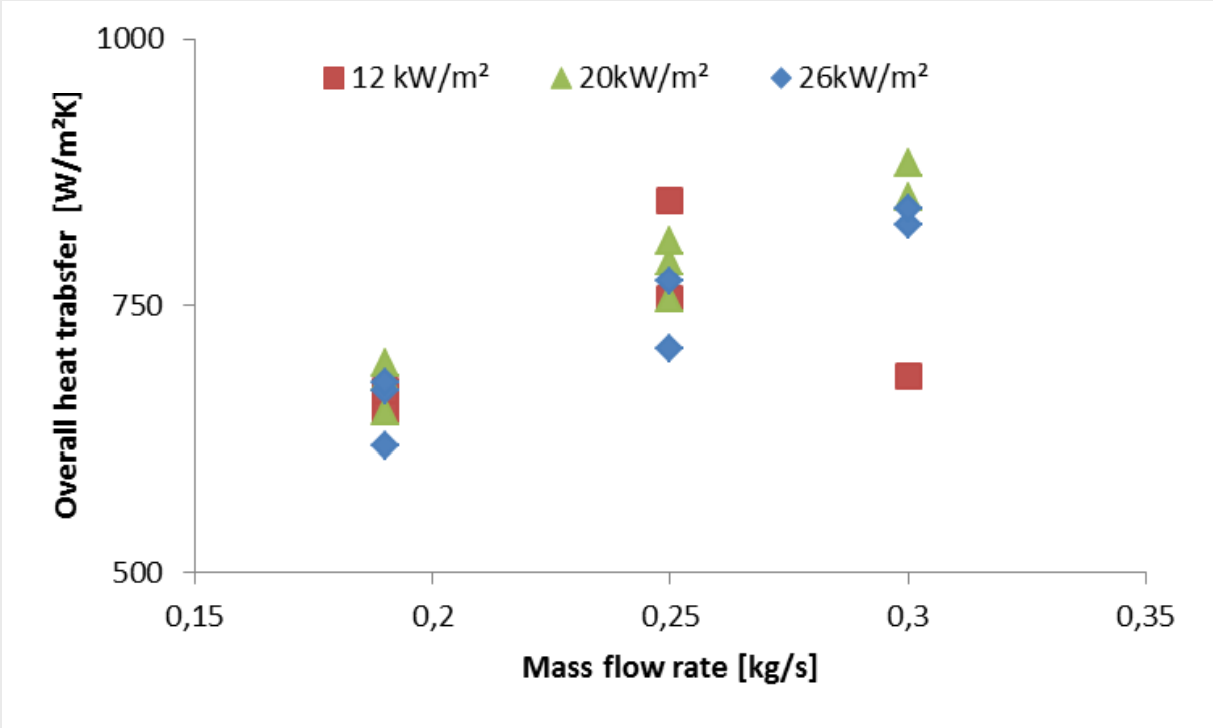
Data reduction

Overall heat transfer coefficient → LMTD method

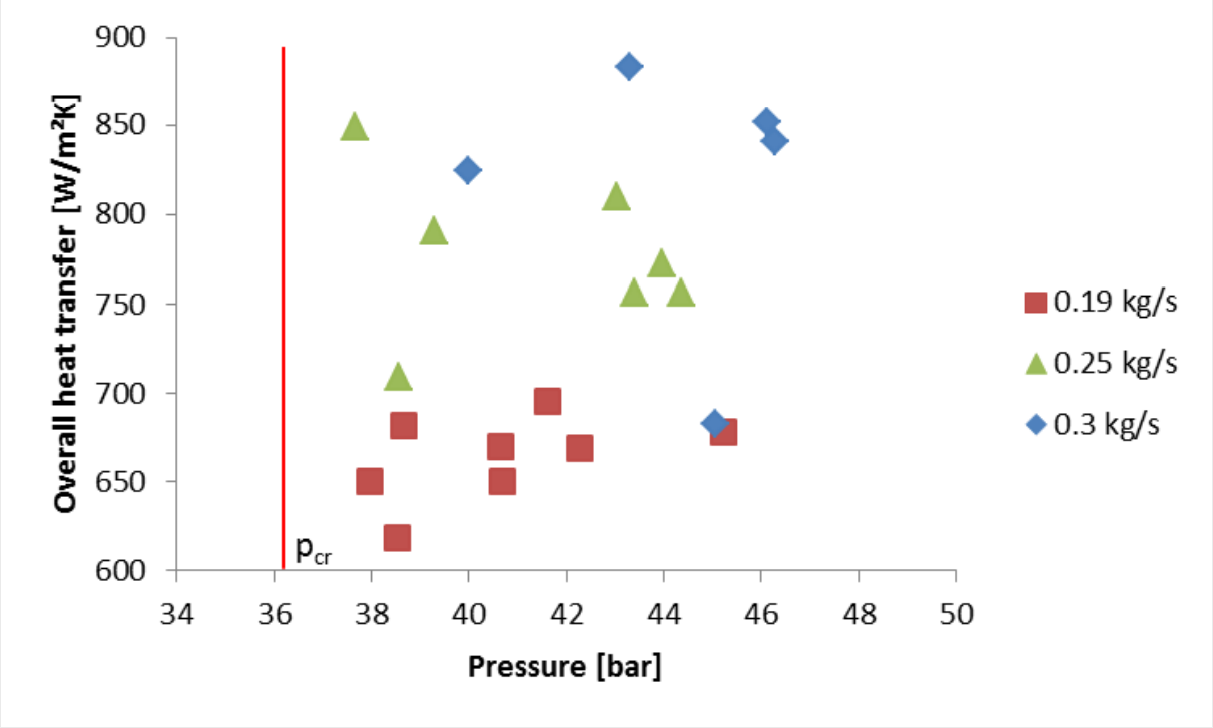
$$Q = U \cdot A \cdot LMTD$$

$$U = \frac{Q}{A \cdot LMTD}$$

Heat transfer coefficient as function of the mass flow rate of the working fluid



Heat transfer coefficient as function of the inlet pressure at different mass flow rate



Acknowledgement

- The results presented in this paper have been obtained within the frame of the IWT SBO-110006 project The Next Generation Organic Rankine Cycles, funded by the Institute for the Promotion and Innovation by Science and Technology in Flanders.

UNIVERSITEIT GENT

FACULTY OF ENGINEERING AND ARCHITECTURE

Experimental investigation of heat transfer to supercritical organic fluid R125 in horizontal tubes for Organic Rankine Cycle applications

1st European Seminar on “Supercritical CO2 Power Systems”,
TU Vienna, 29-30 Sep 2016

Marija Lazova, T. Stepman, A. Kaya, H. Huisseune, M. De Paepe