A NOVEL MICROJET HEAT EXCHANGER FOR DOMESTIC ORC UNIT

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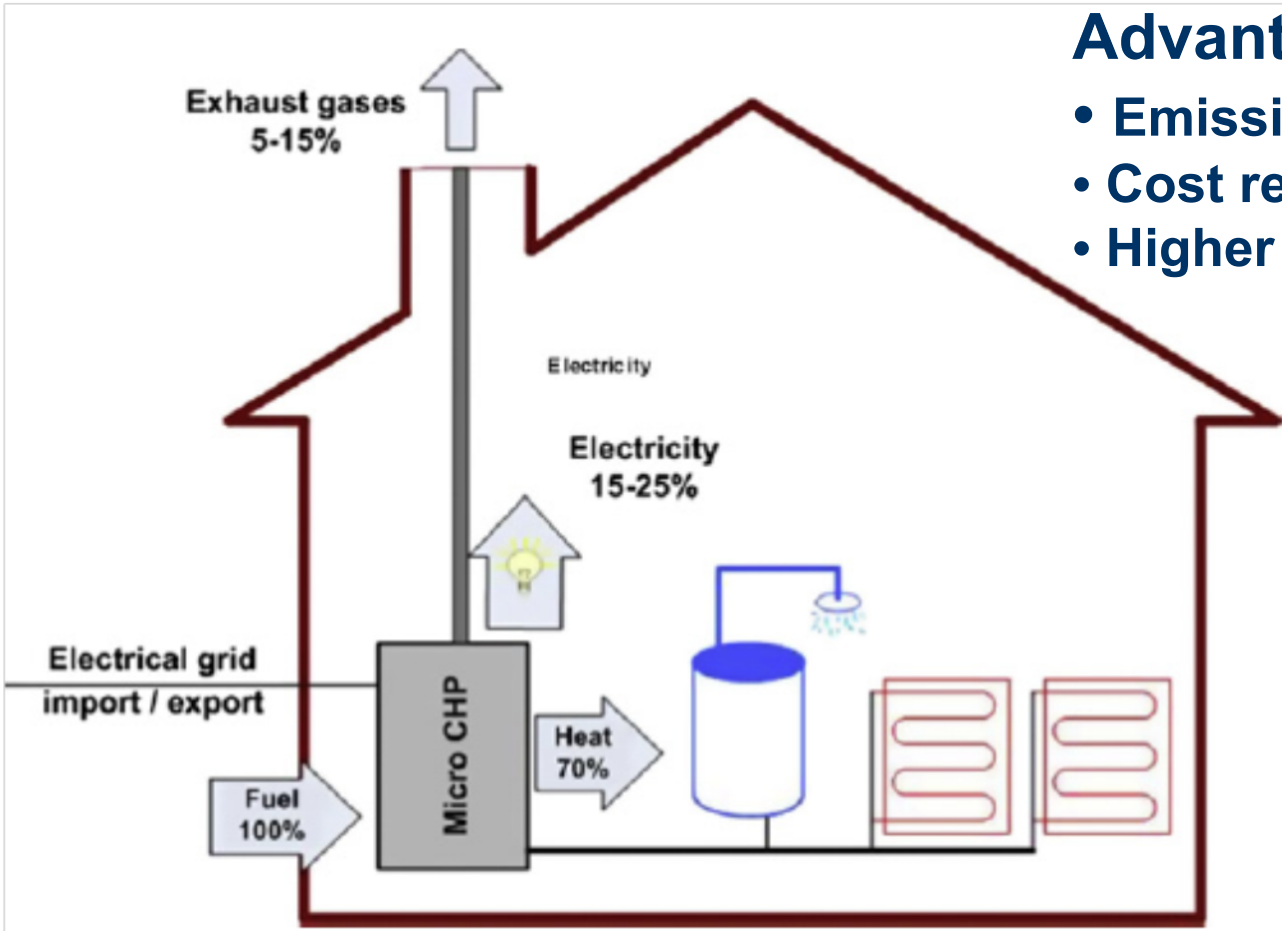
Outine of presentation

1. Introduction
2. Heat exchanger structure
3. Experimental setup
4. Experimental results
5. Conclusions

A general scheme of a micro CHP unit



Advantages of CHP

- Emissions reduction
- Cost reduction
- Higher fuel utilisation level

Introduction

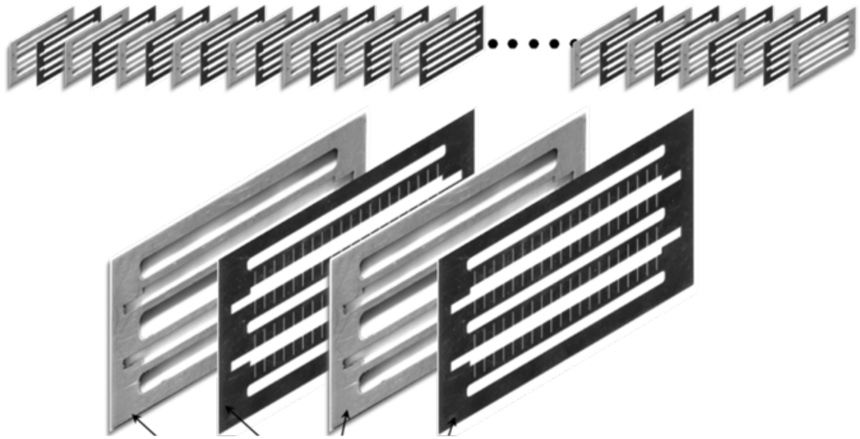
The simplest Rankine cycle was assumed. Each modifications of the cycle lead to additional heat exchangers and relatively small increase of thermodynamics efficiency.

The dimensions of the micro CHP are primarily determined by the sizes of heat exchangers. The turbine is relatively small.

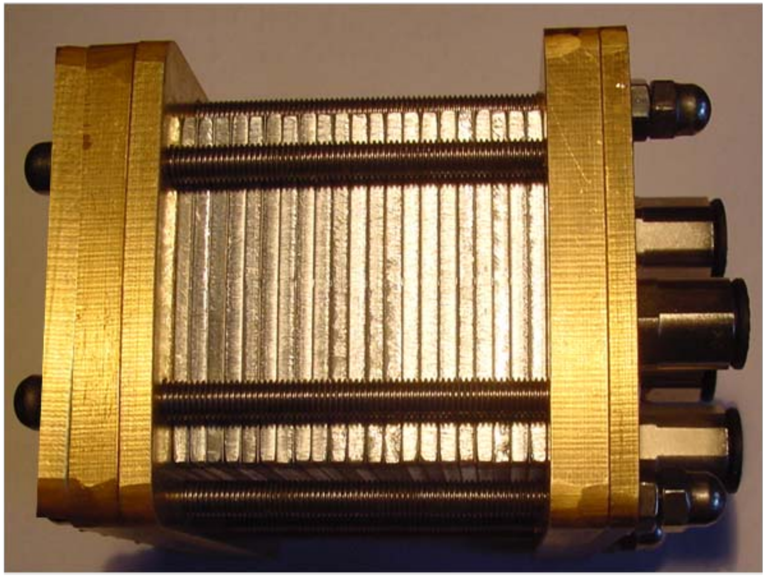
Small dimension of the heat exchangers (condenser and evaporator channels) require analysis of pressure drops in exchangers, which influence cycle parameters and as a consequence temperature differences in heat exchangers and also the exchanger dimensions themselves.

The calculations of thermodynamic cycle parameters are complex and iterative.

Heat exchanger view

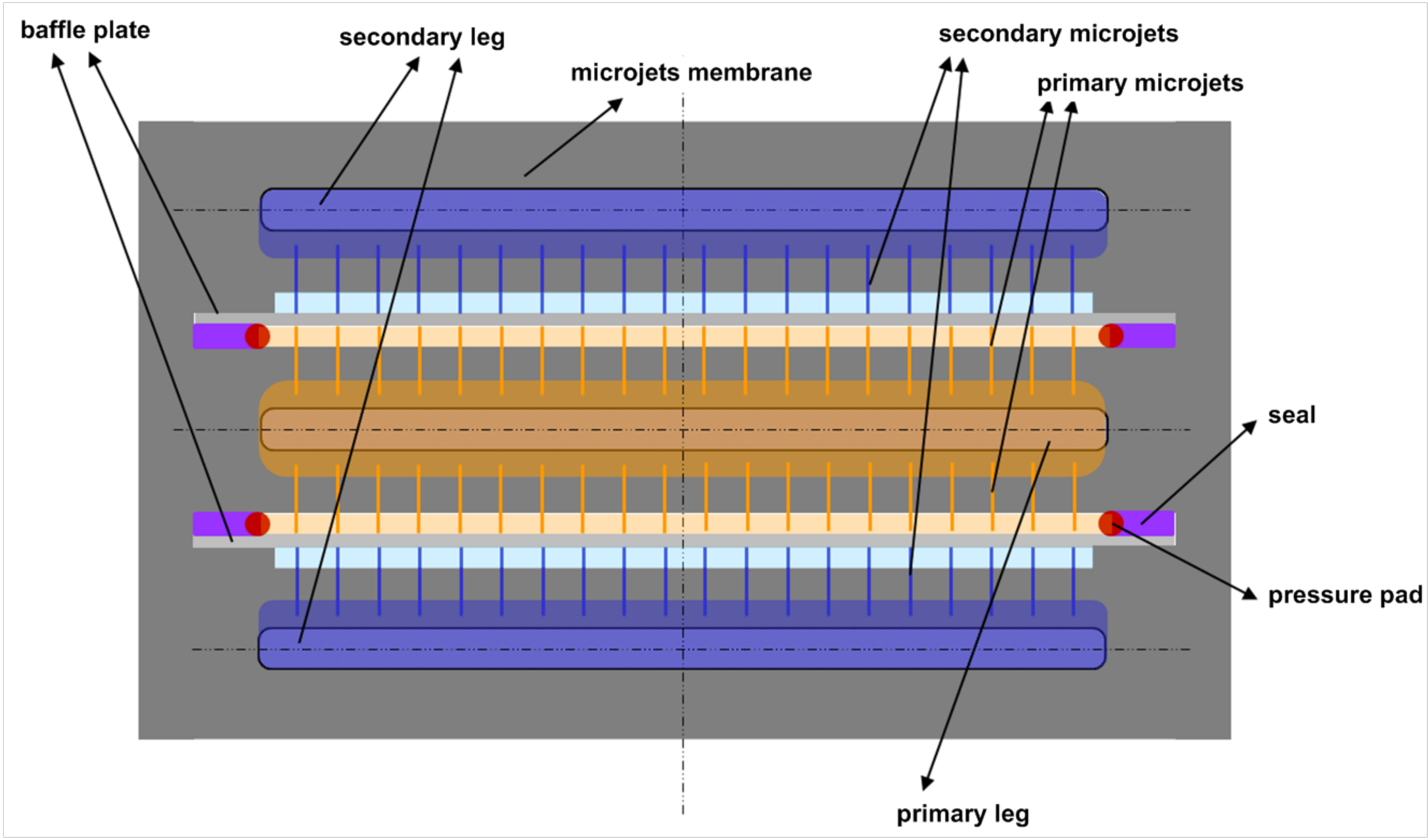


inlet

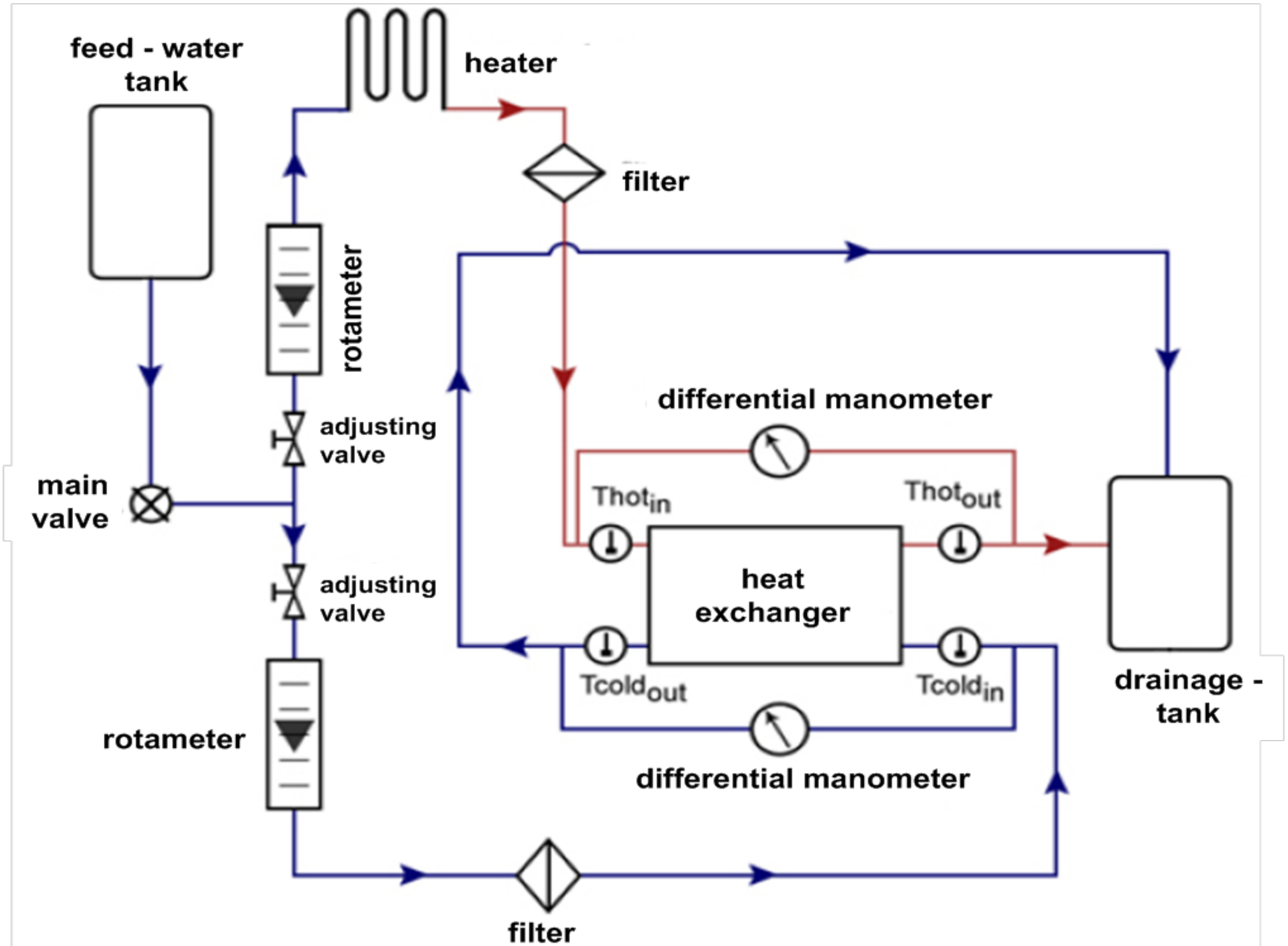


outlet

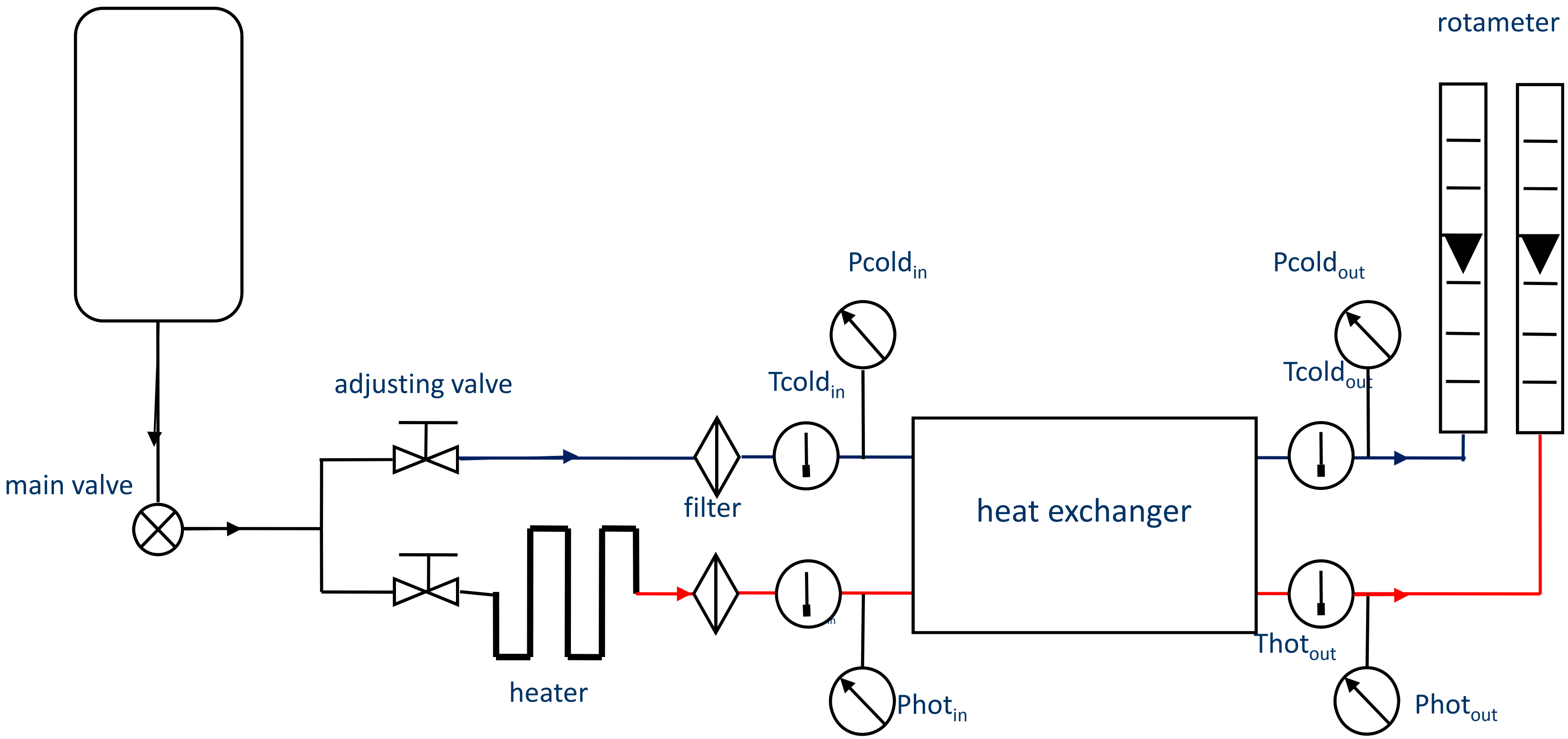
Arrangement of flows in the microjet heat exchanger



General schematic of test facility



General schematic of test facility



Experimental parameters range

Water – water configuration:

Water mass flow rate:

V_h = 75, 100, 125, 200, 250 [l/h]

V_c = 75, 100, 125, 200, 250 [l/h]

Hot water inlet temperature: t_c=30°C÷97°C

Cold water inlet temperature: t_c=4°C

Air-air configuration:

Hot and cold air volumetric flow rate:

V_h = 3 – 6.4 [m^3/h]

V_c = 3 – 8.25 [m^3/h]

Hot air max. inlet temperature: t_c=174°C at 6.4 [m^3/h]

Cold air inlet temperature: t_c=22°C

Air-water configuration:

Hot air volumetric flow rate:

V_h = 3 – 6.4 [m^3/h]

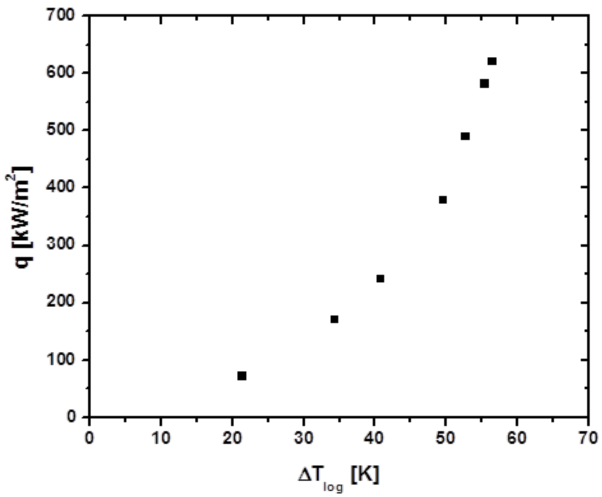
Cold water volumetric flow rate:

V_c = 40 – 250 [l/h]

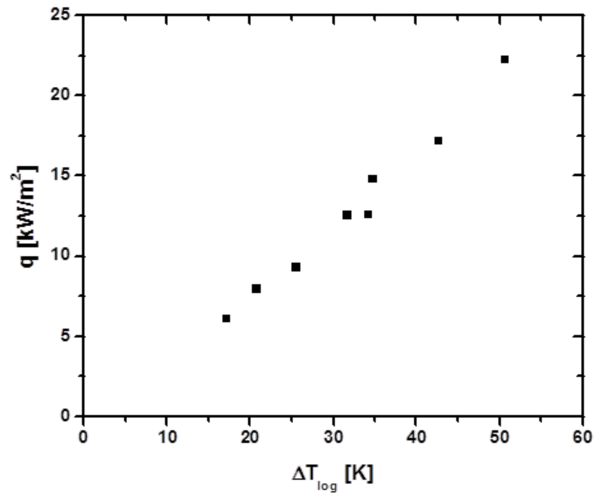
Hot air max. inlet temperature: t_c=164°C at 4.65 [m^3/h]

Cold air inlet temperature: t_c=16°C

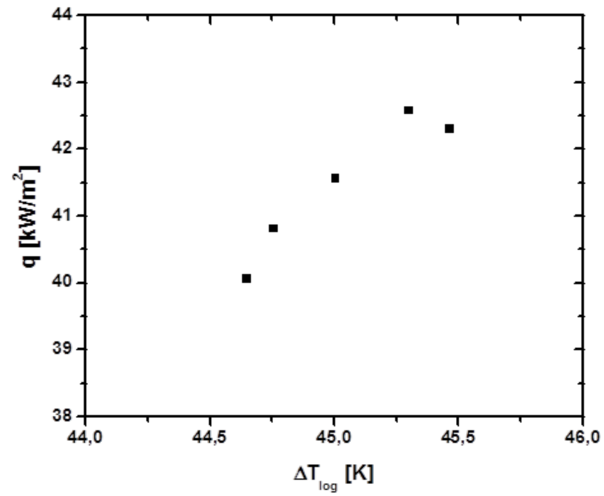
Experimental results



water-water



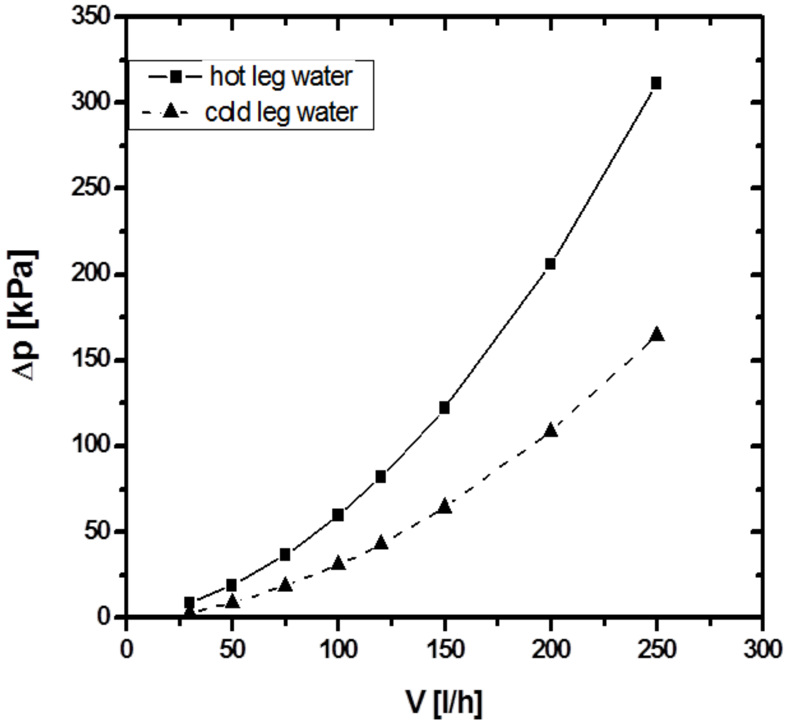
air-air

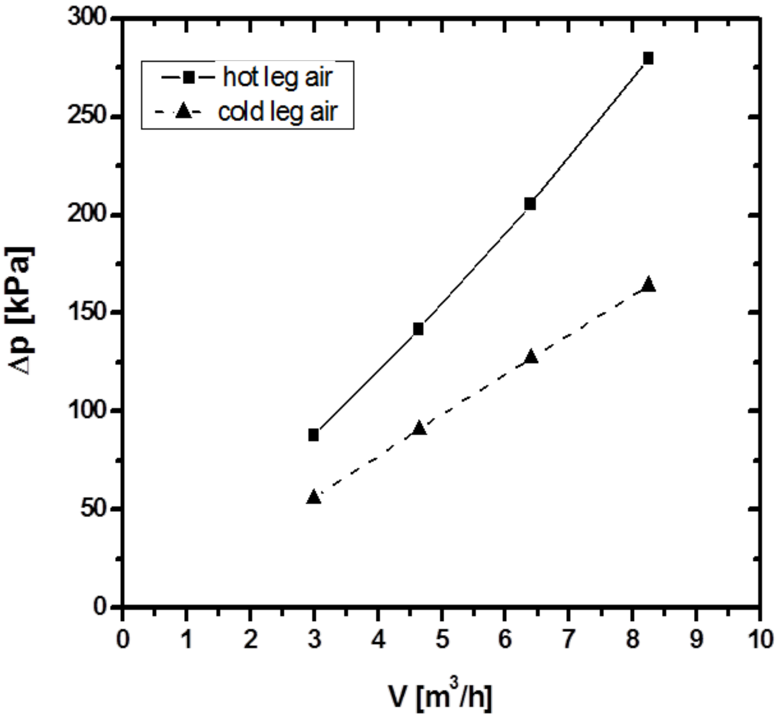


air-water

Heat flux versus log-mean temperature

Experimental results



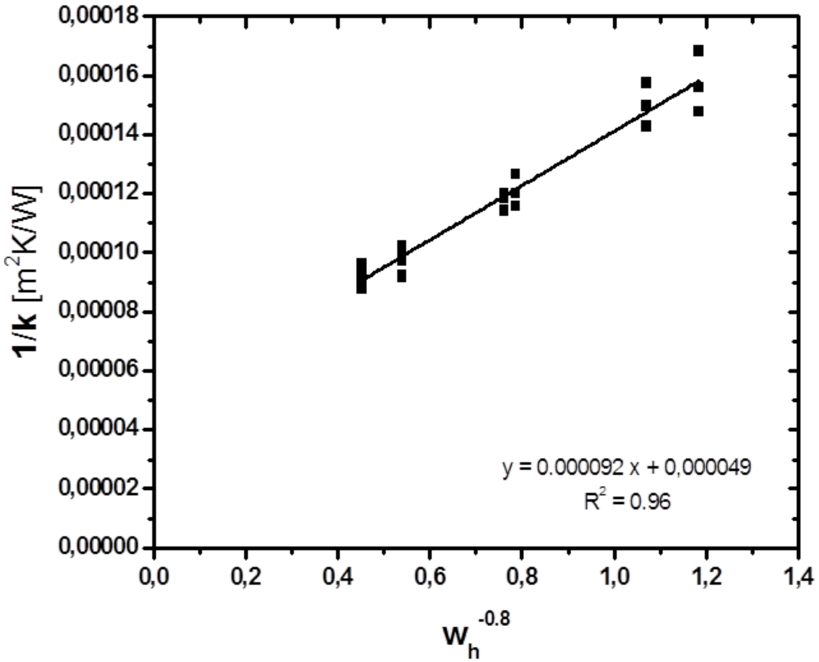


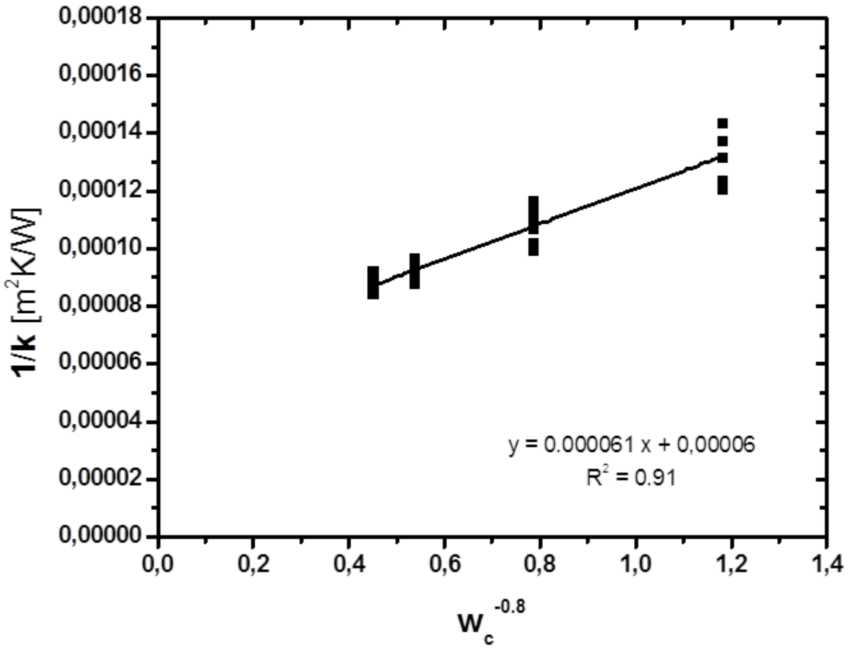
water-water

air-air

Flow characteristics for hot and cold circuit

Experimental results





water-water

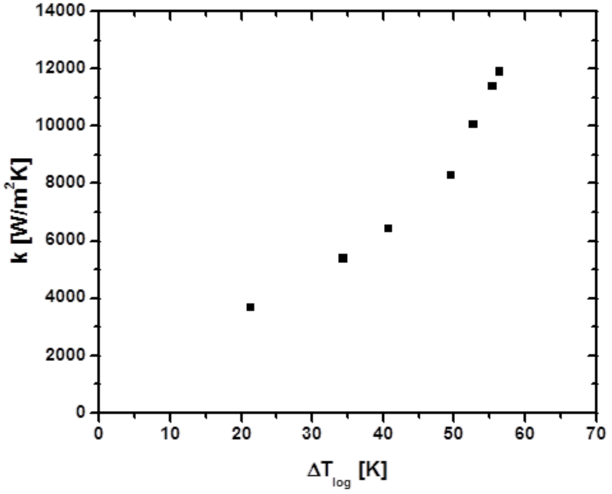
m_c= 200 l/h, m_h= 75÷250 l/h

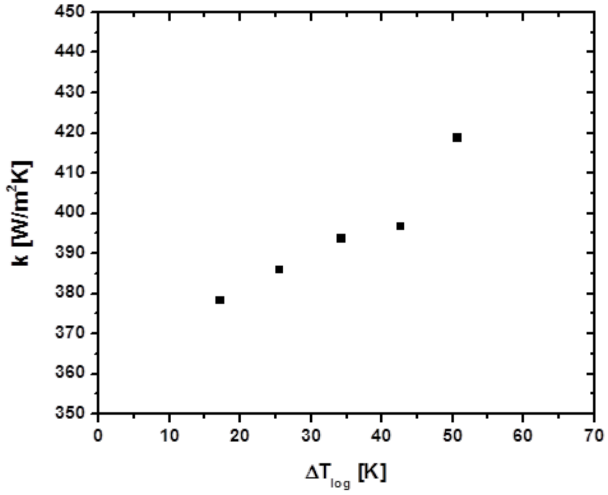
water-water

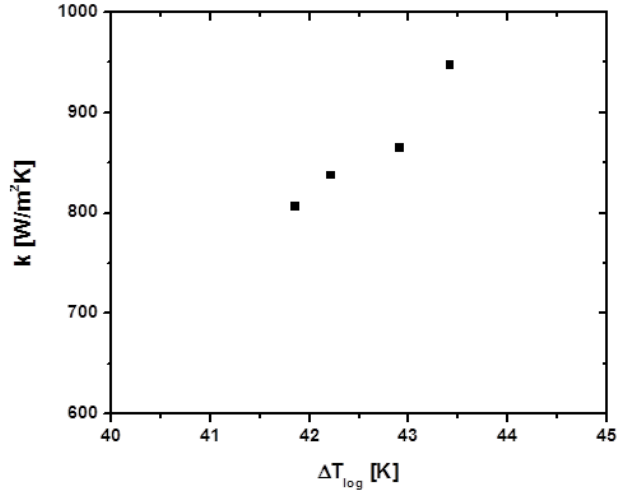
m_h= 250 l/h, m_c= 75÷250 l/h

Flow characteristics for hot and cold circuit

Experimental results







water-water **air-air** **air-water**

Overall heat transfer coefficient versus log-mean temperature

Conclusions

In the paper the original compact heat exchanger with microjets was proposed. Its primary application is for the domestic ORC. Other applications are also possible.

Flow and thermal characteristics of the prototype were presented for water-water, air-air and air-water configurations.

The heat exchanger is capable of exchanging 5 kW of thermal energy at LMTD of 60 K for water-water setup. Overall heat transfer coefficient, calculated using the Wilson method reaches 12000 W/m^{2}K.

The heat exchanger design will be further pursuit in the optimization with respect to the length of nozzles to reduce the pressure drop and increase heat transfer rates.

Thank you for your attention

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