# Modeling and Analysis of a Direct Expansion Geothermal Heat Pump (Dx): Part II-Modeling of Water-Refrigerant Exchanger

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**Introduction**: In this section, we simulate the heat exchanger system in one dimension characterized by two coaxial tubes (Figure 2) with ribbed inner tube using the equations of conservation of mass, conservation of momentum and energy.

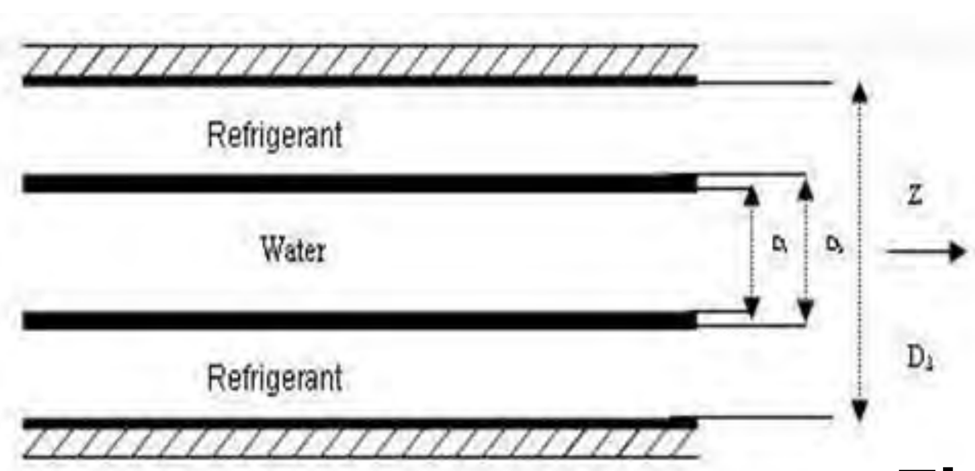


**Figure 1.** heat exchanger model

**Figure 2.** Exchanger diagram

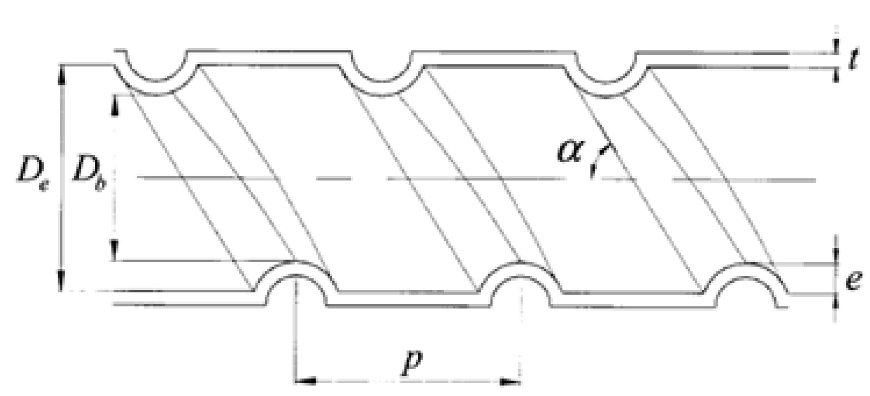

**Figure 3 .** Exchanger geometry

**Computational Methods**:

The COMSOL PDE interface and two heat transfer interface (solid, fluid) are used to solve the governing equations:

Refrigerant(R22)

$$S_f\frac{\partial\rho}{\partial t}+\frac{\partial\dot m}{\partial z}=0$$

$$S_f\frac{\partial\dot m}{\partial t}+\frac{2\dot m\partial\dot m}{\rho\ \partial z}-\frac{\dot m^2\partial\rho}{\rho^2\partial z}+S_f\frac{\partial P}{\partial z}=-S_f^2\ F_{vol}$$

$$S_f\rho\frac{\partial h}{\partial t}+\dot m\frac{\partial h}{\partial z}-S_f\frac{\partial P}{\partial t}-\frac{\dot m\partial P}{\rho\ \partial z}=S_fQ_v$$

$$h=(1-x)h_f+xh_g$$

$$\rho=(1-\alpha_b)\rho_f+\alpha_b\rho_g$$

Inner wall

$$\rho_pCp_p\frac{\partial T_p}{\partial t}-k_p\frac{\partial^2T_p}{\partial z^2}=-Q_{ep}+Q_{rp}$$

Water

$$\rho_e\left(\frac{\partial T_e}{\partial t}+v\frac{\partial T_e}{\partial z}\right)=\frac{4D_{1p}h_{ep}}{D_{1A}^2}\left(T_p-T_e\right)$$

**Results**: We present the results of the heat exchanger in the heating mode when it acts as a condenser.

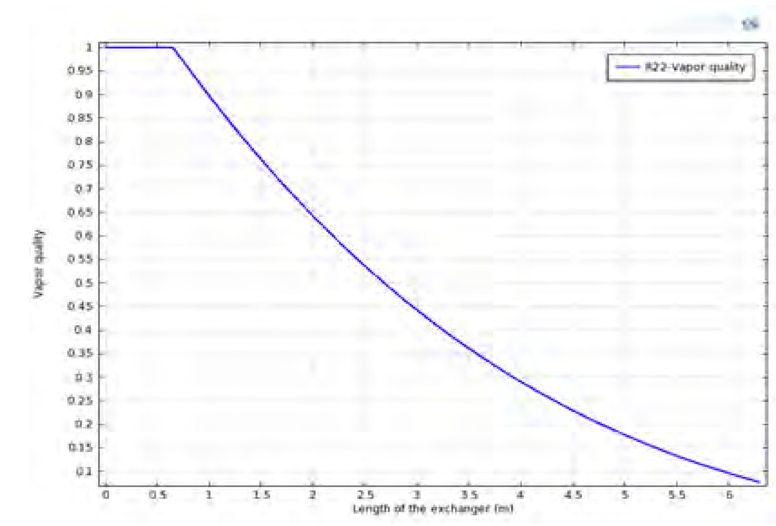

**Figure 4**. Vapor quality

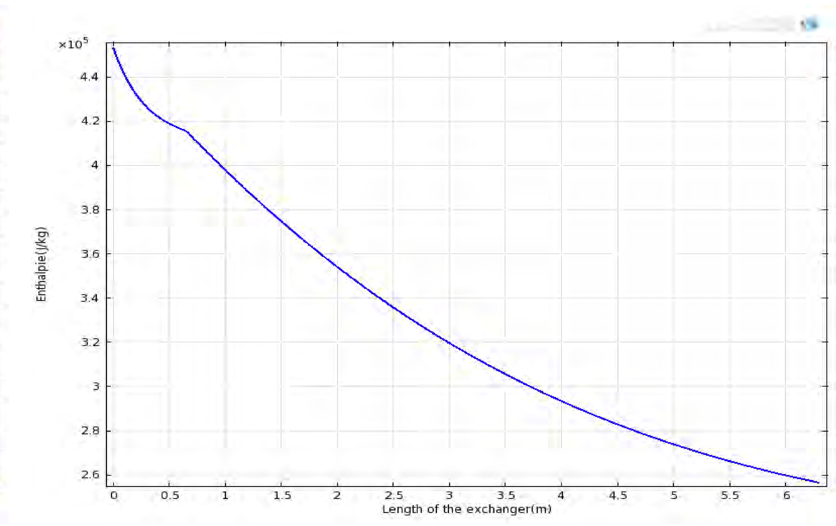

**Figure 5.** Enthalpy

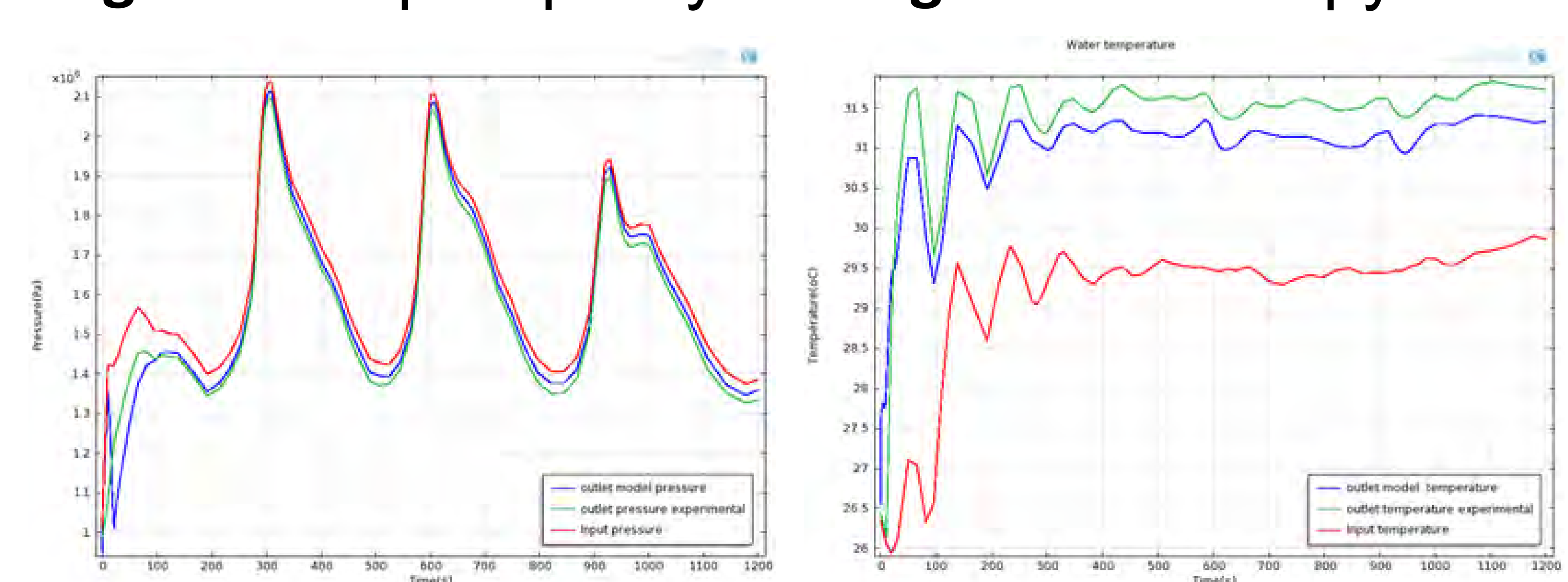


**Figure 6.** Experimental validation

**Conclusions**: The numerical model of water-refrigerant heat exchanger with Comsol.

The validated numeric model obtained will be coupled with the ground heat exchanger for developing the global numerical model of direct expansion geothermal heat pump.

**References**:

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