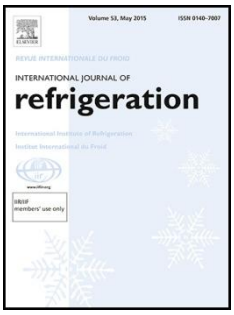
Accepted Manuscript



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PII: S0140-7007(17)30365-1
DOI: https://doi.org/doi:10.1016/j.ijrefrig.2017.09.018
Reference: JIJR 3758

To appear in: *International Journal of Refrigeration*

Received date: 26-3-2017
Revised date: 1-8-2017
Accepted date: 24-9-2017

Please cite this article as: Jun Li, Pega Hrnjak, Visualization and quantification of separation of liquid-vapor two-phase flow in a vertical header at low inlet quality, *International Journal of Refrigeration* (2017), https://doi.org/doi:10.1016/j.ijrefrig.2017.09.018.

Visualization and quantification of separation of liquid-vapor two-phase flow in a vertical header at low inlet quality

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Highlights

- This paper presents visualization of vapor-liquid separation in a vertical header.
- Excellent separation occurs at low inlet mass flux of the header (D=15.8 mm).
- Recipe for separation is to allow upward vapor and downward liquid pass each other.
- Liquid reach is higher with higher vapor upward velocity or higher liquid load.
- When liquid reach touches the top end, separation becomes the most ineffective.

Abstract

This paper presents the experimental study of separation of two-phase flow in a vertical header of microchannel heat exchanger based on quantified visualization using fast camera. A prototype unit, representing the real condenser has an inlet in the center of the header. Downstream of the intermediate header are two branches: lower for liquid and upper vapor flow. The header for experiment provides full visual access. R-134a is used as the fluid and mass flux through the inlet microchannels is controlled at 54 kg m^{-2} s^{-1} – 193 kg m^{-2} s^{-1}. The results indicate that within the range of lower inlet quality (5-25%), good separation in that header can happen at low mass flux up to 90 kg m^{-2} s^{-1}. Results are presented in function of liquid and vapor separation efficiencies (η_l, η_v). Two-phase flow characteristics inside the header are analyzed for better understanding of separation efficiencies η_l and η_v. The efficiency deteriorates dramatically when liquid reaches the vapor exit, with increasing inlet flow rate and/or quality. Better two-phase separation can be achieved by reducing the liquid upward momentum or the vapor, and decreasing liquid and vapor interaction.

Key words: Two-phase flow; Separation; Microchannel condenser; Visualization; Intermediate header