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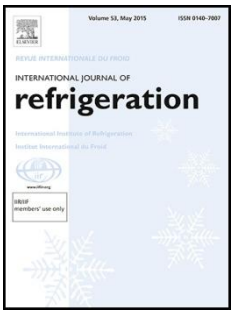

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Quantification of flow and retention of oil in compressor discharge pipe

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Highlights

- Introduce a new method to measure oil retention and OCR by visualization.
- Measurement result is validated by comparing with sampling measurement.
- This method is unique to determine OCR of compressors without liquid line.
- Analyze the oil flow in the compressor discharge pipe.
- Show the distribution of oil droplets and oil film in the annular mist flow.

ABSTRACT

This paper presents a new method to measure the oil retention and oil circulation ratio (OCR) in the compressor discharge pipe based on oil film thickness, oil film average velocity, oil droplet size, oil droplet velocity, and system mass flow rate. Oil flow parameters are quantified based on visualization using high-speed camera and video processing techniques. The estimated oil retention and oil circulation ratio results are compared quantitatively with the results from sampling measurements under different compressor speed and compressor types. The agreement between video results and sampling measurements verify the accuracy of this innovative method, which can also be applied in other annular-mist flow analysis. It also shows that most of the oil exists in film by mass while oil droplets contributes more to the oil mass flow rate because oil droplets travel in a much higher speed.

Keywords: oil; compressor; flow; droplet; discharge pipeline

1 INTRODUCTION

1.1 Impact of lubrication oil on refrigeration system

Most of the vapor compression systems need oil to ensure the lubrication of the mobile parts of the compressor, evacuation of the heat generated by frictions and sealing between the compression stages in compressors. Besides the compressor, oil also affects the performance of the system. Few researchers indicate that small amount of lubricant has positive effect on heat transfer in specific conditions (Nidegger et al., 1997; Zürcher et al., 1998; Kim and Hrnjak, 2012; Hrnjak and Kim, 2013). Also, the existence of oil has an impact on refrigerant distribution and capacity (Li and Hrnjak, 2014a; Li and Hrnjak, 2014b). Many researchers have identified experimentally adverse effects of oil on system performance, including reducing heat transfer coefficient and increasing pressure drop (McMullan et al., 1992; McMullan et al., 1988; DeAngelis and Hrnjak, 2005a; DeAngelis and Hrnjak, 2005b).

Therefore, in order to ensure the compressor reliability and reduce the negative effect of oil on system performance, it is important to reduce the oil in-circulating rate. One of the approaches is to separate the oil from the refrigerant vapor and drain it back to the compressor. Oil circulation in the system and oil flow at compressor discharge needs attention in order to better understand the potential method for oil separation.

1.2 Oil flow in compressor and discharge pipe