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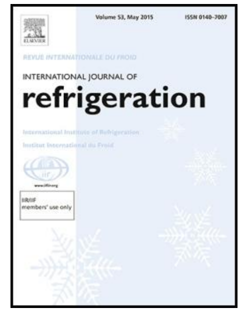

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AN INVESTIGATION OF REFRIGERANT LEAKAGE IN COMMERCIAL REFRIGERATION

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Highlights

- Comprehensive analysis of a large number of F-gas leakage records was conducted.
- A methodology of categorizing refrigerant leakage incidents is summarized.
- Common locations and system components prone to leakage are identified.
- Long term solutions to control refrigerant leakage are discussed.

ABSTRACT

Given that refrigerant demand is set to rapidly increase, long term solutions for leakage prevention are required to effect change in the industry. This paper presents the results of a project which investigated refrigerant leakage within two of the UK's major supermarket chains. Leakage data from 1,464 maintenance records were analysed. The analysis categorized the type, location of each leak and volume of refrigerant replaced during repair. Over 82% of the recorded leaks were from R404A refrigeration systems, and mainly consisted of *pipe or joint failures* or a *leaking seal/gland/core* located in the compressor pack and the high pressure liquid line. It is recommended that the industry focuses on improving design, installation and maintenance of pipework and valves, at the components that most often develop faults to minimize refrigerant leakage.

KEYWORDS
Refrigerant, leakage, F-gas emissions, supermarkets

1. INTRODUCTION

A study by Gschrey *et al.* (2011) indicated that the contribution of fluorinated gases (F-gases) to global warming will increase from approximately 1.3% (2004) to 7.9% (2050) of projected total anthropogenic CO_2 emissions in a business-as-usual scenario. Gschrey *et al*. highlighted that additional efforts are required from both developed and developing countries in order to achieve significant reductions in F-gas emissions. Many refrigerants used in RACHP (refrigeration, air conditioning and heat pump) systems are F-gases (Bauer *et al.*, 2015). Leakage of refrigerant gases from these systems impacts the environment in two ways (Koronaki *et al*., 2012). Firstly there is a direct effect due to the global warming potential (GWP) of the leaked gas, and secondly, there is an indirect effect due to the decreased efficiency of the refrigeration system (due to the loss of charge) which leads to increased energy consumption (Grace *et al.*, 2005). In particular, emissions of hydrofluorocarbons (HFCs) refrigerants have been increasing mainly due to their widespread use as replacements for chlorofluorocarbons (CFCs), and hydrochlorofluorocarbons (HCFCs) (Montzka *et al*., 2014). This is in addition to the rapidly increasing demand for RACHP systems in emerging economies (Davis and Gertler, 2015).

Commercial refrigeration is considered to be one of the applications that contribute most to global warming (Mota-Babiloni *et al.*, 2015a). The growth in the commercial refrigeration sub-sector is of concern, since it is reported to have the highest CO_2-equivalent emissions for the whole RACHP industry equivalent to 40% of total annual refrigerant emissions (UNEP, 2014), despite it being responsible for only 22% of worldwide refrigerant consumption (Devotta *et al.*, 2005). Leakage in commercial refrigeration systems varies greatly from one system to another (Coulomb, 2008). Annual leak rate can be an average of 11% (Koronaki *et al.*, 2012) and up to 30% in some cases (Beshr *et al.*, 2015). Refrigerant leakage can also have a significant