EFFICIENT USE OF REFRIGERANTS

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In his third article for ACR Today Peter Dinnage, Technical Director Climalife at IDS Refrigeration considers maximising refrigerant efficiency

Refrigeration and air conditioning equipment in general are energy efficient and most new equipment available today is significantly more efficient than that sold 10 years ago, particularly as new technology improves and continues to advance. Collectively however, they are an unseen consumer of energy to the extent that it has been estimated that approximately 16% of all UK electricity is used by RAC equipment.

With the entire spotlight recently on the refrigerants themselves, the energy consumed has largely taken a back seat. However, energy costs will only keep increasing and with climate and energy goals for 2020 and 2030 set at very tough levels there remains a need to keep efficient cooling, as over their lifetime their energy use is a major contributor to CO_2 emissions.

The choice of refrigerant can play its part, although for a given system and operating conditions any improvement in COP with one refrigerant due to equipment design, should also be achieved with others. Unfortunately no one size fits all and some refrigerants are more efficient than others at chosen operating conditions.

The Aim for efficiency

To achieve maximum efficiency from a system it should always be commissioned correctly and operate in accordance with the original control settings. Regular and effective maintenance practices can assist in reducing energy usage over the operational lifetime and there are a number of things that can be done to keep a system working efficiently.

Blocked or dirty condensers can increase discharge pressure which will in turn increase electricity consumption. Old and degraded oil not only increases wear on the compressor but also reduces heat transfer and efficiency. Correctly set and adjusted expansion devices, also aid efficiency, while electronic devices that continually monitor and adjust to achieve optimum superheat for the load conditions can potentially give savings of 10-14%.

Changes to control settings should not be made without a thorough investigation into the reason why it may be necessary as in most circumstances it will not eliminate the problem, only hide it and usually lead to an increase in energy.

One of the most common causes of increased energy consumption is an under-charged system. The correct charge will reduce operating time and will also ensure that correct suction and discharge pressures are utilised. Indeed, every Spring many systems need topping up because they have insufficient charge when the cooling load increases.

The most common places leaks occur are mechanical and flare joints, shut off valves, pressure relief valves, fusible plugs, condensers and return bends on evaporators and condensers. Reducing leaks from these places with effective maintenance may go a long way to achieving the objectives of F-Gas, but a leak free system is also a more efficient one and can save money. Likewise running with a 1 degree lower evaporating temperature may bring down the temperature quicker but it can increase cost if it is not needed but it may also be hiding other system deficiencies.

Opening and closing doors either in an air conditioned room or a cold room adds to the load and if doors are left open for longer than necessary then the equipment will have to work much harder to maintain temperature.

Setting up a system properly and keeping it set up properly can quite often achieve in the region of 10% energy reductions.

The right choice of refrigerant

Refrigerant choice is usually one of the equipment manufacturer. In air conditioning and heat pumps, R410A is ideally suited to give very good COPs when sized accurately according to needs.

In refrigeration applications there are significant energy savings to be made by using R407F instead of R404A in new equipment, irrespective of the impending changes to the F-Gas legislation that will eventually ban the use of R404A.

The benefits of using R407A or R407F over R404A are now well documented in a range of applications where R404A has been traditionally used, with R407F showing that it is slightly more efficient than R407A. Compressor manufacturers now approve these refrigerants in a range of their compressors and give selection recommendations.

Energy savings of 12-15% have been documented in supermarket applications. These savings have also been seen on other application areas such as cold storage. In 2012 a customer replaced old R22 plant and instead of using 404A used Performax LT (R407F). Improvements were also made to the controls and equipment and they were able to show that the new equipment was able to return energy efficiency 25% better than what was being achieved with the old R22 plant that was replaced. Such savings are not one-offs as others are also reporting similar energy savings when using R407F. If the equipment is well maintained as suggested above then rising energy bills can be minimised and at the same time help comply with the future requirements of F-Gas Legislation.

The full implications and consequences from the revised F-Gas agreement will be discussed next month.