

CO² (R744) refrigerant



Introduction

Co₂ or carbon dioxide or to use its refrigerant name R744 has been re-introduced into the industry as a commonly used refrigerant, the retail environment in particular has decided to use it more commonly to operate all high temperature and in some instances low temperature equipment. Co₂ has been used less and less since the introduction of CFC's some time ago which were low in cost to manufacturer but the effects of CFC's on the environment with Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) have generally been acknowledged as harmful to the environment. For this reason, from 2010 only recycled HCFC's will be allowed, therefore the predominant refrigerant group would be HFC's such as R404a. HFC's are considered as not environmentally sustainable in the longer term due to their high GWP which has emphasised the need to switch to environmentally acceptable alternatives.



Photographs of the equipment we operate and maintain

Co₂ has been chosen by many retailers such as Sainsbury's, Tesco, M&S, Waitrose and Co-Op as their primary refrigerant due to its excellent coefficient of performance and very low GWP, as an example R404a has a GWP of 3750 whereas R744 has a GWP of 1.

R744 does however, have a negative side as it runs at very high pressures unlike the currently used CFC's, HCFC's and HFC's. Due to its high pressures if it is dispersed through accident or malfunction in the wrong environment it could result in serious injury or fatality. For this reason, very strict protocols have been set in place such as specific training courses and in the examples of M&S and Sainsbury's they have insisted engineers can only work or operate their Co₂ equipment if they have attended and passed their specific Co₂ course operated by an approved training body.

Westway Services currently maintain 3 M&S stores (Epping, Witney and Cambridge) that have Co₂ sub-critical systems and have 6 Co₂ trained highly skilled engineers to deliver reactive and maintenance on a 24/7 basis to these stores. We have repeatedly delivered fast and efficient repairs to these stores including replacing Co₂ after it has vented to atmosphere.

Results

One of our clients, M&S, has made a business decision to use a Co2 pumped system or otherwise known as sub-critical system. The Co2 pumped systems works in conjunction with a secondary pack operating on R404a that reduces the Co2 temperature before delivering it to the refrigerated fixtures, the operating pressures of this sub-critical systems must not exceed 73Bar. When charging Co2 liquid into a system the charging point must be pressurised with vapour to 4.2Bar (G) as a minimum to prevent the formation of dry ice that will have a detrimental effect on the system. The sub-critical system has 2 factors that have been highlighted as negatives against an alternative trans-critical, these are utilising a secondary pack with HFC's and sudden electrical power failure or main component mechanical failure which can result in rapid pressure rise and Co2 pressure being vented from the system via Pressure Relief Valves in very quick succession. The trans-critical system is seen as higher in cost to install that sub-critical but has no HFC's meaning low GWP and if designed correctly less chance to vent Co2 if electrical or mechanical failure has occurred.

Due to R744's high co-efficient of performances it has lower electrical loading and thus lower power consumption running costs but there are high financial costs involved with installing both sub-critical and trans-critical equipment.

Maintenance and reactive companies have suffered higher training budgets to get engineers qualified so that they are competent to work on these systems but face lower costs to replenish Co2 over CFC's.

There are high costs involved with installing both sub-critical and trans-critical equipment due additional components and high grade copper pipe that's required because of the high operating pressures.

All of the M&S Co2 stores that Westway Services maintain are still successfully operating with little issues other than those usually associated with high ambient conditions and standard reactive failures associated with refrigeration components .

Conclusion

So far the retailers and refrigeration design engineers are currently looking at different ways of using Co2 some have chosen to go with sub-critical systems, some trans-critical systems and others have gone away from Co2 and have chosen propane systems.

As CFC's, HFC's and HCFC's have been phased out retailers have decided to invest in new technology and refrigerants. Tesco and Sainsbury's have decided to go with the Co2 trans-critical and made public statements that this is their chosen refrigerant for the foreseeable future M&S have elected to go for Co2 sub-critical with either HFC or an alternative solution as the secondary system. Other retailers are going with these options or finding alternatives like propane and chilled water systems but whichever route is chosen the refrigeration industry is changing due to environmental pressure and legislative alterations.

Costs to install this equipment are high by comparison against HFC's but the benefits of reduction in environmental impact, taxations and operating costs is of greater value. There are limited refrigeration contractors in the field who can deliver design, installation and maintenance of these systems.

Recommendations

Westway have already invested by training some of the refrigeration maintenance team, this will be continued with the remainder of the engineers so that we continue to have fully skilled engineers in the ever developing industry.