EXAMINATION OF NATURAL REFRIGERANT APPLICATION IN PILOT FOOD REFRIGERATION EQUIPMENT

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Abstract

The cooling demand can be found in different parts of the food chain in different ways: One way is to cool down the raw materials as fast as it could be, another way to reach very low temperatures, and of course to provide nearly constant temperature for food product in case of transportation and distribution. Artificial cooling is widely used to solve these problems.

The limited data that is available suggests that currently the cold-chain accounts for approximately 1% of CO_2 production in the world, however this is likely to increase if global temperatures increase significantly. Using the most energy efficient refrigeration technologies it would be possible to substantially extend and improve the cold-chain without any increase in CO_2, and possibly even a decrease.

Unfortunately, there is more evidence to there is a large amount of obsolete refrigerant used in the food industry. R22 (chlor-difluormethane) is the second most used refrigerant –about 30% share-, except in the Wine and Fish sectors. It is in use in all the analysed sectors, is owed to its versatility and equipment age, essentially. Besides being found in older individual refrigeration systems, it is suitable for an enormous variety of refrigeration applications, across a wide range of temperatures. Controversially, R22 has an ODP of 0,05, so it destroys the ozone layer, and has a GWP of 1810. This value is relatively low compared to another CFCs or HCFCs, but much higher than the limit set by international regulations. Since 2010 it is prohibited to refill or service these cooling systems. They still in operation till some major failure occurs, then the refrigerant could be replaced to natural refrigerant.

In many cases, use of natural refrigerants involve some risks that conventional refrigerants do not. Two types of risks are considered: Flammability is characterised by the concentration of Lower Explosive Level (LEL). At this concentration in air by volume, the air-refrigerant mixture can ignite and explode by a spark. The higher the concentration, the less dangerous is the mixture. Another property is the burning velocity. If the burning velocity of the mixture is lower than 10cm/s, the mixture could not explode. Some regulations (Eg. 517/2014 EU) allows only 20% of the LEL in closed spaces, so the chance of an explosion is nearly zero. The chance of exposure can be minimized, for example by restrict the charge in a cooling system. This limit for household refrigerators is 150g flammable HC.

We found that there's a hard push by the regulations to apply more and more natural refrigerants, because of their direct and indirect impact to the environment is very low. By contrast, these have lot of risks to the health, therefore there's a big challenge in changeover to natural refrigerants. Hydrocarbon based natural refrigerants have a great advantage over conventional ones: the comparable system charge dropped by nearly 50% when replace HFCs by HCs. This significantly lower the risks to human health.

Key words: natural refrigerant, environmental load, flammability