Relation of Refrigerant to Water

Purity of refrigerant is the decisive factor for smooth operation of refrigeration equipment. Water is the most common and leading pollutant for refrigerant. Beyond all question, most troubles of refrigeration equipment is caused by water, even when hydrofluoroalkane (HFA) exists. Water can freeze the control equipment in the sealed-in equipment and can lead the filter to block, corrode, form copperplate and burn. Water can appear in the refrigeration cycle in different forms.

We need to know the polarity of water in order to find out the effect of water in the refrigeration cycle. Water has different polarities in different refrigerants and their polarities reduce with the temperature decreasing; besides, it also depends on the detailed condition of the refrigerant. Compared to fully halogenated CFC refrigerants, partially halogenated hydrocarbons have stronger polarity in the water, such as HCFC R22 and HFC R134a.

The extreme polarity of water in the liquid R22/R134a is 1,300 mg/kg when the temperature is 25℃, while the number will become 90 mg/kg in liquid R12. In short, the extreme polarity decreases with the temperature reducing. That is to say, extra water will possibly appear when the above temperature 25℃ reduces to 0℃. The extra water could freeze in the capillary tube or cause block in the valve after expansion. Apart from forming ice, the extra water can block when it goes through the large gelatinous hydroxide, which usually appears when the temperature is lower than the freezing point of water. Additionally, the extra water could also corrode the refrigeration equipment. Freezing of the control equipment indicates too high humidity when CFC refrigerant is used. However, less ice blocks could be seen in the expanding equipment when partially halogenated hydrocarbons like HCFC and HFC are used because of high polarity of the water. Hydrocarbon refrigerants' solvent power of water is inferior to CFC refrigerants; in other words, the above situation will be more frequent if the humidity is high.

Water content of fully halogenated CFC refrigerants is higher than liquid state in the steam stage; that of partially halogenated halocarbon refrigerants, such as R22, is higher in the liquid stage. Water content of the above two types of refrigerants are equal in the stage between steam and liquid. The distribution of water in the stage between steam and liquid depends on the temperature of sample container and the amount of liquid. Thus, in a jar nearly filled, most of the water is dissolved in the liquid even if the water content of the liquid is rather low. On the other hand, if the jar is only filled with a small amount of liquid, most of the water will be dissolved in the gas. This provides a direction for dry liquid CFC refrigerants, which can help reduce the water content by removing gases. A new balance of water content will form after the gases are removed lot by lot. As for partially halogenated CFC, such as R22, this method is inapplicable because its liquid water content is higher than

gas one.

Synthetizing of lubricant used in refrigeration equipment has been explained in Chapter 2 about "refrigerant oil", especially polyester lubricant, which should be used in HFC refrigerant. Polyester lubricant has certain water absorbability, so only dry polyester lubricant can be used as water might react with it and the hydrolysis product could corrode the parts of the refrigeration equipment, such as the compressor. CFC has better hydrolysis resistance compared to chlorinated hydrocarbons.

Water content in the refrigeration equipment should be reduced as fully as possible because the water polarity of HFC is rather high and polyester lubricant has certain water absorbability.