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Environmentally Friendly Regenerative Circulating Piping Cleaning System Using HCFO-1224yd

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EXTENDED ABSTRACT

Background
During compressor replacement, existing piping is often cleaned to remove residual oil and contaminants. Conventional methods employ high-boiling solvents (boiling point ~50 °C), which may remain inside the piping after system restoration. Such residues lower refrigerant oil viscosity and have been identified as a cause of recurrent compressor failures. To overcome this, a unit was developed that circulates HCFO-1224yd (boiling point 15 °C, AGC Inc.), offering strong oil-cleaning performance and simultaneous solvent regeneration (Ref. 1). However, earlier prototypes faced practical challenges, including recovery of solvent volumes exceeding 10 kg and limitations in circulation capacity.

Technical Development
The newly developed unit incorporates several improvements to enhance regeneration efficiency compared with previous models. The primary advancement is the acceleration of the distillation–regeneration process. By actively reusing heat within a 1500 W power budget, the separation and recovery speed of HCFO-1224yd from oil-containing cleaning liquid has been significantly increased.

An oil-free compressor is employed as the system's core. A portion of the compressed gas is forcibly mixed with the cleaning liquid prior to regeneration, creating a gas–liquid mixture rather than applying heat alone. When this mixture is injected into the oil separator, the separation efficiency of HCFO-1224yd and oil is enhanced.

A large-capacity oil separator can retain up to 1000 ml of refrigerant oil returned from the refrigeration cycle. Equipped with an internal heat-exchange coil, it also enables recovery of HCFO-1224yd dissolved in the oil.

Results and Significance
These improvements allow the cleaning solvent to be continuously regenerated and reused during operation. Consequently, the required solvent volume per cleaning process is reduced, leading to lower overall solvent consumption. This technology not only improves cost efficiency but also contributes to environmentally sustainable maintenance practices for refrigeration systems.

Fig.1　Developed pipe cleaning device PSCR-YD

REFERENCES

[1] Prostep Co., Ltd., T.KITSUWA, "Refrigeration cycle cleaning and regeneration device for low boiling point fluorine solvent HFO1224yd」" JRAIA International Symposium, 2021.