

Retaining Mineral Oil In HFC Retrofits

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While all refrigerant and lubricant manufacturers insist that mineral oil (MO) be removed and replaced by polyol ester (POE) when changing from R-12, R-22 or R-502 to a pure HFC refrigerant or mixture of HFCs,¹ many compressor manufacturers are investigating the use of mineral oils with HFC refrigerants. At least one icemaker manufacturer has been reported to manufacture units with the HFC/MO combination. This ambivalence suggests the need for reexamination of the recommended retrofit process.

The retrofit process recommended by one company¹ requires an iteration of steps: **Draining** the MO from the compressor and other system points and replacing with POE; **Running** the system for a day or more with the old refrigerant; **Testing** for concentration of MO. Then repeating the draining, replacement, running and testing sequence until the concentration of MO drops below 5%. Only then can the old CFC refrigerant be removed and the system recharged with the new HFC refrigerant. Clearly, this process is not feasible for small or older systems.

Manufacturers are understandably cautious. However, reputable testers have reported satisfactory, even superior, oil return with HFCs and mineral oil.^{2,3,4} Further, worthwhile reasons exist for retaining the mineral oil.⁵

- **Better lubricity:** The low solubility of the MO for the HFC refrigerant avoids oil dilution and retains the original viscosity.

- **Much lower solubility for moisture:** Merely leaving a POE-coated pipe open to the atmosphere overnight may result in a moisture concentration in the POE of 1,500 ppm (1.5% moisture). By contrast, a MO-coated pipe would absorb only about 0.04% moisture.

- **Much lower chemical reactivity:** High moisture levels in POE foster increased chemical reactivity at higher temperatures. These reactions lead to formation of materials that plug capillaries and screens, abrade bearings, plug filter-driers and increase propensity for icing at expansion devices.

- **Reduced dirt transfer:** POEs have a higher detergent effect, thereby fostering movement of system dirt, dormant in MO systems, to valves and restrictors.

- **No suction reed sticking:** A manufacturer has advised of the redesign of suction reed seats to eliminate this problem.

- **Reduced crankcase oil dilution:** The lower solubility of MO for HFCs generates reduced oil dilution and higher oil viscosity for better lubrication at start.

- **Lower cost:** POEs can cost four to six times as much as either MO or alkylbenzene.

- **Simple replacement procedure:** Simple repair leaks. If necessary, remove the CFC refrigerant, replace expansion device, and recharge with HFC refrigerant.

MO can safely be retained on medium- and high-temperature systems that are either close coupled or that have oil safety protectors. Somewhat higher oil holdup in long suction and discharge lines and evaporators may occur. If excess oil loss occurs, add alkylbenzene.

If MO were truly immiscible with HFC, as the manufacturers allege, correct oil return in systems with liquid receivers would not be possible. However, at a receiver temperature as low as 60°F (15.5°C), the mass solubility of MO for R-134a is about 10%, and of alkylbenzene, about 16%.^{5,6} This solubility of R-134a for MO clearly exceeds, by a factor of 10 or more, the oil discharge rate of even old compressors, thereby assuring that MO will not layer on refrigerant stored in the receiver.

If the system requirements allow the use of R-22 or HFC mixtures containing a

large fraction of R-22 (R-401A; R-401B; R-402A or R-402B), then a simple oil change to low-cost alkylbenzene lubricant may be satisfactory.⁷

Caveat: Until further experiences are reported, it is probably advisable to change to POE on systems using flooded evaporators with surge drums and very low temperature freezers.

Conclusion: Manufacturers always move cautiously, but enough evidence exists that retrofits to HFCs, made without changing the oil, can be successful. In many cases, the advantages of MO retention outweigh the minimum risks.

References

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