

Using UOP XH-7™ Desiccant with Refrigerant R-1234yf

Beginning in 2017, all new air-conditioned vehicles in the European Union will be required to use a refrigerant with a global warming potential (GWP) lower than 150, based on the 2006 EU MAC Directive.

Most automobile manufacturers have selected R-1234yf as their low GWP refrigerant for automotive air-conditioning to replace R-134a. Manufacturers and component suppliers using UOP XH-7 desiccant with R-134a can continue using this desiccant with R-1234yf.

UOP XH-7 desiccant has been used with R-134a in automotive air-conditioners and domestic refrigerators since R-12 was phased out of use in developed countries in 1996. In XH-7, R-134a is excluded from the micropores of the molecular sieve while the smaller water molecules are adsorbed by the molecular sieve. As R-134a is not adsorbed into the molecular sieve, issues relating to chemical compatibility with the refrigerant, lubricants and additives are reduced. As expected from its larger size compared to R-134a, and confirmed by adsorption, compatibility and water capacity testing, R-1234yf is also excluded from the micropores of XH-7.

The physical and adsorption properties summarized in Tables 1 and 2 may assist automobile manufacturers and component suppliers in qualifying a desiccant for use with a new, lower GWP refrigerant, such as R-1234yf, and designing effective dryers.



HOW IT WORKS

Molecular sieve desiccants contain a zeolitic component that has a uniform crystalline micropore structure. The pore opening is controlled such that the desiccant can adsorb the small water molecule, while excluding the larger refrigerant, lubricant and additive molecules. This molecular separations principle is known as the “molecular sieve effect.”

Table 1: Nominal Properties of UOP XH-7 Desiccant

Property of UOP XH-7	Units	Value
Nominal particle size (8x12 beads)	mm	2
Water capacity (25°C, 613 Pa/4.6 torr)	g/100g	17.0
Bulk density	lb/ft ³	56
	kg/m ³	900
	kg/L	0.90
Crush strength	lbs	15
	kg	6.8
	N	67
Dry attrition	Wt%	0.7
Hydrated attrition	Wt%	1.0
Initial water content	Wt%	0.5

Note: Values shown are typical, not specifications

Table 2: Nominal Properties of UOP XH-7 Desiccant in Refrigerant

Property of UOP XH-7 in Refrigerant	Units	Value	Notes
Water capacity in refrigerant (50 ppm, 60°C)			- g/100g: grams water per 100 g dry desiccant beads - Subtract initial water loading from water capacity to obtain usable water capacity
R-1234yf	g/100g	18.1	
R-134a	g/100g	15.0	
Volumetric water capacity in refrigerant (50 ppm, 60°C)			g/L: grams water per liter of dry desiccant beads
R-1234yf	g/L	163	
R-134a	g/L	135	

Hydrated Attrition

The attrition test is a shake test with the partially hydrated beads shaken in a solvent

Crush Strength

Crush strength is the average force required to crush 25 beads individually

Water Capacity

Water capacity is measured at 25°C, 613 Pa (4.6 torr) water pressure. Water capacity in refrigerant is measured by a method based on ASHRAE Standard 35-2010.

Volumetric water capacity (VWC) in refrigerant is calculated as the water capacity in the refrigerant multiplied by the bulk density. The VWC is the capacity based on the space the desiccant occupies rather than the weight of the desiccant. The higher the volumetric water capacity, the lower the space required for the desiccant to supply a given amount of water adsorption capacity.

Summary

- The strong physical properties of UOP XH-7 desiccant help maintain the adsorption functionality within the automotive life cycle and help prevent any damage during the process of dryer filling
- Based on testing and commercial experience, UOP XH-7 desiccant works with both R-1234yf and R-134a
- XH-7 has higher water capacity and VWC in R-1234yf than in R-134a

UOP XH-7 desiccant has been trusted by original equipment manufacturers (OEM) for more than two decades for quality and performance, and has been used as a benchmark by some major manufacturers for setting OEM specifications for drying R-134a. For the new R-1234yf application, UOP is dedicated to providing the same quality, consistency and reliability that OEMs and dryer system manufacturers have come to expect through decades of experience. UOP is equipped with the advanced instrumentation and capabilities that enable sample analysis, new product development and customer problem solving, and has extensive experience in field testing for water ingress and root cause analysis for field failures.

For more information

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