Updated Facts On 2015 HCFC-225 Usage Ban

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By Lindsey Shehan, Chemist, Techspray

Beginning January 1, 2015, HCFC-225 (also called "AK225"), a common precision solvent for high-end cleaning, will be banned for usage, per the Clean Air Act under the Montreal Protocol. What sounds like a straightforward statement, actually becomes more complex as one reads into the regulations and the Environmental Protection Agency's (EPA) definitions of key terms. This white paper delves into the regulations and provides clarification regarding the HCFC-225 phase-out's effect on end-users.

Background

In 1974, Sherwood Rowland and Mario Molina discovered that chlorofluorocarbons (CFCs) were depleting the ozone layer, and in 1995, they received the Nobel Prize in Chemistry for this work. In response, the United Nations Environment Programme (UNEP) called an international conference to discuss the issue. Shortly thereafter, the United States banned all non-essential uses of CFCs as propellants in aerosols. The Montreal Protocol on Substances That Deplete the Ozone Layer was signed by 24 countries in 1987, and required all developed countries to begin the phase-out of CFCs in 1993 and reduce CFCs to fifty percent of the baseline (1989 amounts) by 1998. Since 1987, over 190 countries have signed this treaty. A timeline for the phase out of hydrochlorofluorocarbons (HCFCs) was created in 1997 per the Montreal Amendment. To meet the 90 percent total reduction requirement for all HCFCs by 2015, HCFC-225 is now being phased out. In 1990 the U.S. Congress amended the Clean Air Act to include Stratospheric Ozone Protection. The Montreal Protocol is enforced in the United States under the Clean Air Act. The amendments to the Clean Air Act appoint the EPA to develop and carry out the regulations.[1,2]

What is HCFC-225?

HCFC-225 is a mixture of two isomers, HCFC-225ca and HCFC-225cb. A common source of HCFC-225 is from Asahi Glass Company as Asahiklin AK-225, a precision cleaning solvent. AK-225 has many unique properties, including its ability to form azeotropes (mixtures that act as one chemical, with unique and constant physical characteristics), good solvency, and thermal stability (which makes it good for use in vapor degreasing). AK-225 is nonflammable. AK-225 is VOC exempt, per the EPA. VOCs are smog producing compounds that are highly regulated. AK-225 also has a low acute toxicity (the exposure level of AK-225 is 100 ppm 8h TWA compared to 200 ppm for Trans), low viscosity (meaning that it flows well), high density (it's heavier than water, it will displace water), and low surface tension (meaning that it will flow well under low stand offs). Unfortunately, due to the ozone depleting potentials of HCFC-225ca and HCFC-225cb, 0.02 and 0.03, respectively, it is now being phased out.[3]

How is the HCFC-225 phase-out defined?

The Clean Air Act addresses the phase-out of HCFC-225 in section 605(a). The first part covers the restriction of use and states:

> Effective January 1, 2015, it shall be unlawful for any person to introduce into interstate commerce or *use* any class II substance unless such substance – has been used, recovered, and recycled; is used and entirely consumed (except for trace quantities) in the production of other chemicals; or is used as a refrigerant in appliances manufactured prior to January 1, 2020.[4]

In this case "use" refers to the use of the controlled substance (i.e. HCFC-225). In 40 CFR 82.3, the EPA defines a controlled substance as follows:

> …any substance listed in appendix A or appendix B to this subpart [both HCFC-225ca and HCFC-225cb are listed in appendix B], whether existing alone or in a mixture, *but excluding any such substance or mixture that is in a manufactured product other than a container used for the transportation or storage of the controlled substance.*[5]

The exclusions referenced in the second part (in italics) are a source of confusion and misunderstanding. Neat (without additives) HCFC-225 in bulk packaging (gallon containers, 5-gallon containers, 54-gallon containers, etc.) meets the definition of controlled substance. A blend, for example AK225 ATMS (Techspray blend of HCFC-225, trans-1,2-dichloroethylene, methanol, and nitromethane) is considered a mixture, or blend, of chemicals in a container, so it is also a controlled substance. An aerosol, on the other hand, is a chemical blend in a manufactured product (aerosol) and is therefore, excluded from the definition of controlled substance.[5]

In summary, end-users may use and continue to purchase aerosols containing HCFC-225 made before January 1, 2015. After the cut-off date, manufacturers of products containing HCFC-225 can only make products containing HCFC-225 if the HCFC-225 has been used, recovered, and recycled. For bulk packaging of virgin neat and blended HCFC-225 (i.e. the controlled substance), the usage ban begins January 1, 2015; stock-piling of this material is not allowed.

How does this phase-out affect Techspray's products?

The table below summarizes the HCFC-225 phase-out's effect on Techspray's products.

Products in use after Jan. 1, 2015	Made before Jan 1, 2015	Made after Jan 1, 2015
Blend of virgin AK225 in aerosol	*√*	*x*
Pure (neat) virgin AK225 in aerosol	*√*	*x*
Blend of virgin AK225 in bulk packaging	*x*	*x*
Pure (neat) virgin AK225 in bulk packaging	*x*	*x*
Reclaimed AK225 in any type of packaging	*√*	*√*

What are the replacements for HCFC-225?

In 1994, the EPA implemented the SNAP (Significant New Alternatives Policy) Program to assist in the transition to "safer, practical, and economically feasible alternatives across multiple industrial, consumer, and military sectors." The SNAP Program either accepts or rejects potential substitutes using the following process. First, manufacturers submit information on substitutes to the EPA. The EPA then reviews these substitutes in terms of their health and environmental effects; the substitute's ozone depleting potential, global warming potential, toxicity, and flammability are all considered. After the substitute has been reviewed, the EPA issues a listing for the substitute. To date, the EPA has approved more than 300 substitutes for over 60 different uses. Potential substitutes for HCFC-225 include DuPont Vertrel Solvents, Techspray's Precision-V Solvents, n-Propyl Bromide, Trichloroethylene, 3M HFEs, and Honeywell's Solstice Performance Fluid.[2,6]

DuPont Vertrel Solvents

DuPont Vertrel Solvents have physical characteristics very similar to HCFC-225; however they are also much more environmentally friendly and currently have no use restrictions. Vertrel solvents have exposure limits ranging from 190 to 200 parts per million (ppm) 8 hour time-weighted average (TWA), HCFC-225's limit is 100 ppm 8 hour TWA. Vertrel solvents have a lower cleaning efficiency than AK-225; however, Vertrel/Trans blends are compatible in cleaning power to AK-225. Vertrel solvents also have similar materials compatibility to HCFC-225, which has broad materials compatibility.[7]

Techspray offers the Precision-V line of products, containing Vertrel XF, as a replacement for products containing AK-225. Products in the Precision-V line are Precision-V Vapor-Degreaser Parts Cleaner and Precision-V Vapor-Degreaser Flux Remover. These solvents have a lower boiling point than most other vapor-degreaser solvents. This reduces heat-stress on components being cleaned and reduces energy consumption for the boil sump and chiller coils.

n-Propyl Bromide (nPB)

Solvents containing nPB work well for difficult precision cleaning; however, they are not considered environmentally friendly. The acceptable exposure limit for nPB solvents is 25 ppm over an eight hour TWA.[2] Health hazards include damage to the reproductive system, liver, and nervous system. There is also evidence that nPB causes damage to the brain. These effects have been observed in animals with as little as 400 ppm exposure.[8]

Trichloroethylene (TCE)

From a health and environmental standpoint TCE is not a good replacement as it has been a suspected carcinogen for years and breathing even small amounts has several unpleasant side effects, including headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.[8] TCE has an OSHA permissible exposure limit (PEL) of 100 ppm TWA. ACGIH recently reduced TCE's threshold limit value (TLV) from 25 ppm to 10 ppm due to a recent EPA study that concluded, "…TCE poses a potential human health hazard for noncancer toxicity to the central nervous system, kidney, liver, immune system, male reproductive system, and the developing fetus…The human evidence of carcinogenicity from

epidemiologic studies of TCE exposure is strong for non-Hodgkin Lymphoma…".[9] TCE is an aggressive cleaner; this makes it unsuitable for use with most plastics and elastomers. A positive quality of TCE is its cost, as it is much less expensive than some of the modern chemistries.[10]

3M's HFEs (hydrofluoroethers)

From an environmental standpoint 3M HFEs are great as they have been granted VOC exemption. They are described by 3M as having "no ozone-depleting components, a shorter atmospheric lifetime, and a lower global warming potential than CFCs."[11]

Honeywell's Solstice Performance Fluid

Honeywell's HFO-1233zd(E) is a low global warming potential, non-flammable solvent. The EPA has recently found HFO-1233zd(E) to be acceptable as a substitute for HCFC-225ca and HCFC-225cb, and blends thereof for use as an aerosol solvent. Its cleaning effectiveness is somewhat lower than that of HCFC-225. In addition, HFO-1233zd(E) has a low boiling point. Due to its low boiling point, it works well in an aerosol system; however, it is not suitable for use as a vapor degreaser. It is expected that this material will be VOC exempt. It also has low toxicity characteristics, making it preferable to several of the other alternatives.[6]

What does this mean to the end-user?

The first section of the Clean Air Act 605(a) restricts use. In this case, "use" refers to the use of the controlled substance, HCFC-225, not to manufactured products containing HCFC-225. Because bulk blends containing HCFC-225 meet the EPA's definition of controlled substance, they may not be used after the cut-off date. Aerosols containing HCFC-225, made before January 1, 2015, may continue to be sold and used by end users indefinitely. For Techspray products, this means that all aerosol products containing HCFC-225 made prior to the cut-off may be sold after December 31, 2014. Sales and use of bulk products containing virgin HCFC-225 in either blended or neat state (e.g. 1664-5G, 1663-G, etc.) will end on December 31, 2014. Beginning on January 1, 2015, HCFC-225 can only be used in the manufacture of cleaning products if it has been used, recovered, and recycled, per the Clean Air Act 605(a).[4,5]

Because HCFC-225 is commonly used in high end, class 3 applications, like aerospace, medical, and biotech, qualification of replacement solvents is a long, arduous process. It is not too early to start the process, and there are many choices to meet most every requirement.

Update

On December 24, 2013, the EPA published a proposed rule in the Federal Register which would change use rules for HCFC-225 after 2014 by allowing end-users to continue to use bulk (or bulk blends) of HCFC-225 that are onsite and entered into inventory prior to January 1, 2015. If finalized, this rule would not change the rules pertaining to import or manufacturing, it would simply allow the end-user to continue to use anything that they had onsite as of December 31, 2014 into 2015. Comments pertaining to this proposed rule can be sent to a-and-r-docket@epa.gov and must be received by February 24, 2014; unless a public hearing is held, in which case comments must be received by March 10, 2014. A public hearing must be requested by 5 pm EDT on January 8, 2014. If a hearing is requested it will be held on January 23, 2014. If held, more information pertaining to a public hearing would be found at www.epa.gov/ozone/strathome.html. The proposed rule in its entirety and more details concerning comment submittal can be found at http://www.gpo.gov/fdsys/pkg/FR-2013-12-24/pdf/FR-2013-12-24.pdf beginning on page 519.

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Lindsey Shehan works in Techspray's Amarillo-based R&D lab and is responsible for tracking regulations, product testing, and special projects. Lindsey has a BA in Chemistry from Texas A&M University.

Techspray, a division of Illinois Tool Works (ITW), is a leading manufacturer of chemical products for the electronics industry. Techspray formulates, blends, and packages a wide variety of chemicals and assorted support products for the electronics industry, heavy industry, and plant and equipment maintenance including degreasers, defluxers, conformal coating, dusters and water-based cleaners. More information can be found at http://www.techspray.com.

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