CHEMICAL SOLUTIONS

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Mr. Gautam Patel
AIR TECHNIQUES INTERNATIONAL
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Dear Gautam:

I am enclosing documentation and my thoughts on the difference in safety between PAO and DeHS for you and your colleagues to review.

The first section deals with PAO, the second section discusses DeHS and the third section includes differences in safety between the two substances.

PAO

PAO or polyalphaolefin represents a class of compounds that are used mainly as base stocks in synthetic lubricants. PAO is offered in a number of grades each of which has a specific viscosity at 100 C.

The PAO used by ATI has a viscosity of 4 cSt at 100 C and is known as PAO 4. PAO has been widely used by the lubricant industry for nearly 50 years. The first known commercial application for PAO was in the Mobil 1 Synthetic Motor Oil which the company introduced into the marketplace in 1975.[1]

Since that time, PAO has been used in such lubricant applications as compressor fluids, hydraulic fluids, and gear oils without any known health issues for workers and consumers exposed to lubricants containing PAO.

The safety data sheet (SDS) for ATI PAO-4 contains the following global harmonized system (GHS) hazard classification: Aspiration Hazard: Category 1. Accompany this classification is the following hazard warning: H304: May be fatal if swallowed and enters airways.

A pictogram symbol shown on the next page also accompanies the hazard warning and must be shown on ATI PAO-4 literature.

Symbol:

Aspiration involves the entry of a substance directly into the upper respiratory tract. The substance can also be vomited after ingestion and then move into the upper respiratory and digestive tracts.[2] Aspiration can cause such health issues as pneumonia and lung scarring. This condition can lead to chest pain, fever, fatigue, coughing and shortness of breath.

The GHS classification designates any hydrocarbon substance as being an aspiration hazard if it exhibits a viscosity of 20.5 cSt (mm^2/second) or lower at 40 C.[3]

PAO 4 has a viscosity in the 16.8 – 17.4 cSt at 40 C range according to data sheets for two of the main manufacturers (Chevron Phillips Chemical and Ineos) which means that it meets the aspiration toxicity classification. Safety data sheets from these two companies include the appropriate hazard warning and the pictogram shown above.

A reference attributed to the Merck Manual indicates that aspiration due to hydrocarbon poisoning occurs most commonly to children younger than 5 years resulting in acute inflammation of the lungs which is known as aspiration pneumonitis. The most common hydrocarbons inhaled and ingested are gasoline, kerosene, mineral oil and paint thinners.[4]

This reference indicates that hydrocarbons with viscosity values less than 60 SSU at 40 C (which is approximately 10 cSt at 40 C) are most likely to spread rapidly over large surface areas and cause aspiration pneumonitis than hydrocarbons with a higher viscosity.

The Merck Manual is a reference text for physicians and pharmacists sponsored by the pharmaceutical company, Merck.[5]

This information indicates that while 4 cSt PAO can cause aspiration pneumonitis, the chances are low for two reason.

- Most cases involve hydrocarbons with a lower viscosity than 4 cSt PAO
- Most cases involve children

A worker uses ATI's PAO-4 only during filtration testing and is only exposed directly to liquid ATI PAO-4 during the addition to the aerosol generator used in filtration testing. The safety precautions listed in the ATI-PAO-4 SDS must be followed during this phase of the testing to minimize worker exposure.

ATI PAO-4 is aerosolized during filter testing which means that this product is diluted with air. The result is the formation of a polydisperse sub-micron PAO aerosol. The exposure for an end user, after dilution by the system air flow upstream of the filter is typically between 10 milligrams/cubic meter and 20 milligrams/cubic meter of ATI PAO-4.

A certifier downstream of the filter under test will be exposed to a level of ATI PAO-4 that is typically at maximum, less than 0.1% of the upstream aerosol concentration. This means that the maximum likely exposure downstream is 0.001 milligram/cubic meter of ATI PAO-4.

The average permissible exposure limits over an 8-hour period for mineral oil which is a hydrocarbon that has a similar composition to ATI PAO-4 is 5 milligrams/cubic meter which is 5,000 times higher than the typical exposure found in filtration testing.

As an aerosol, ATI PAO-4 is present at concentrations that enable it to be classified as non-hazardous aerosol according to the EU GHS Aerosol Classification Criteria.[6] Based on the aerosol containing much less than 1% flammable components and a heat of combustion less than 20 kilojoules per gram, the classification is Category 3 when in use which requires no pictogram.

DeHS

DeHS is di-2-ethylhexyl sebacate which is chemical substance based on an ester. The European Regulatory Authority, ECHA, finds that this chemical substance is non-hazardous. No hazards including for respiratory exposure have been identified.[7] This also means that the safety data sheet for DeHS contains no pictograms.

DeHS has a viscosity of 12 cSt at 40 C which is lower than the aspiration hazard limit of 20.5 cSt at 40 C. Please note that DeHS is not classified as an aspiration hazard because it is not a hydrocarbon.

DeHS has a flash point of 235 C which is an indication that the ester is not flammable or even combustible. As a comparison, PAO 4 has a flash point of 220 C which also classifies it as nonflammable and not combustible.

Only a limited amount of data is available on the toxicity of DeHS. An assessment of DeHS' toxicity was published by Consumer Product Safety Commission (CPSC) an independent agency of the US Government in 2019.[8] The analysis concludes that DeHS is not acutely toxic but no data was available to assess the inhalation toxicity of this chemical substance.

A short-term study was reported that indicated the acute inhalation toxicity of DeHS to humans is not known. The study did not indicate what level of exposure was used in reaching this conclusion.

In summary, DeHS appears not be toxic to humans and there are no hazard warnings on the substance's safety data sheet.

Differences between 4 cSt PAO and DeHS

The big difference between 4 cSt PAO and DeHS is that PAO has a hazard warning for aspiration on its safety data sheet and DeHS has no hazard warnings. This difference might lead to the conclusion that PAO is not safe and DeHS is safe to use in applications where there is potential for exposure.

But this superficial statement does not accurately describe the history of PAO use and the specific application where PAO is used in testing filters.

PAO has been available for use in the marketplace for nearly 50 years. Please note that PAO has not been used for that long in testing filters but has been used as a synthetic lubricant base stock. This means that PAO has been blended with other components to manufacture synthetic lubricants, then packaged and shipped to an end user which put it into a machine such as a compressor or into an automobile.

During this process, there have been episodes of short-term exposure to PAO but to my knowledge, no negative effects have been reported. PAO is safe to use and contributes excellent performance in all lubricant applications where it is used. For these reasons, PAO use in lubricants is continuing to grow and three major chemical companies (ChevronPhillips Chemical, ExxonMobil and Ineos) all have large operations to produce it globally.

For ATI's application, PAO is present at a very low concentration and exposure is very brief. For this reason, based on ECHA guidelines, using PAO in an aerosol at ATI's recommended concentration is not hazardous. This is the most important consideration for ATI's customers.

PAO has been designated as an aspiration hazard because it is a hydrocarbon. But a study discussed in this summary noted that most hydrocarbons that generate aspiration hazards have lower viscosities than ATI PAO-4 and mostly involve children younger than 5 years old.

DeHS has a safe toxicity profile and its has been used but to a much smaller extent than PAO in lubricant applications. While there has not been a detailed inhalation study on DeHS, it appears to be safe to use.

DeHS is an ester which means that it will not be designated as an aspiration hazard even though its viscosity is below the 22.5 cSt at 40 C threshold.

In summary, there is no guarantee that using either PAO or DeHS will not lead to a health problem including the possibility of dealing with aspiration. But if ATI's guidelines are

followed in conducting filter testing, the chances of having a worker problem with PAO are minimal.

If there are any questions or need for additional information, please do not hesitate to contact me.

Thank you for your continuing interest in using my services.

Best Regards,

Neil

Neil Canter

NMC;jl

References:

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