CONTROLLING CHEMICAL HAZARDS

Guidance Sheet

SUBSTANCE SPECIFIC **OIL MIST**

What is Oil Mist Monitoring

The upstream oil and gas industry in Canada has done extensive work on oil mist exposures in particular those associated with oil-based drilling fluids. Oil-based drilling fluids are commonly referred to as invert, because it is an emulsion of mostly oil with some water rather than mostly water with some oil. This past work including CAPP's Oil Mist Monitoring Protocol forms, in part, the basis for this guidance sheet.

This previous work identified some unique challenges that exist with oil mist sampling in the oil and gas industry that personnel planning to conduct oil mist monitoring as part of an exposure assessment need to be aware of to collect valid data.

Where is it Found

When working with or near hydrocarbon (oil) products exposure to vapours and aerosols (mist) may be a concern. With both vapours and mist, what is in the oil determines what hazards and the potential health effects that may be present. This guidance sheet focuses specifically on oil mist and therefore does not address vapour exposure monitoring; however, it is important to note that as part of a comprehensive exposure assessment all phases and routes of exposure need to be considered.

Oil mist constituents depend on how the oil was created and if any additives or contamination are present typically with how the oil is used. Oil that has been created from petroleum products may contain long-chain aromatic hydrocarbons depending on the refining process. These long-chained hydrocarbons are often referred to as polycyclic aromatic hydrocarbons (PAH) and are important, because many of them are carcinogens (cause cancer).

Additives and contamination can vary greatly depending on the oil and how it is used. Some of these additives and contamination may include the following: metals such as lead and mercury, solids such as silica (quartz), bacteria, light and heavy formation hydrocarbons such as benzene and PAHs and naturally occurring radioactive materials (NORM).

The Risks
Health Effects

The health effects of oil mist exposure are dependent on what is in the oil. As discussed above this can vary significantly either because of how the oil was created or how the oil is used. These health effects can range from irritation of skin and eyes to more severe health effects such as lung cancer. Various jurisdictions have created occupational exposure levels (OELs) for oil mist based on how refined the oil is for PAHs with less refined oil products having comparatively lower OELs. It is important to recognize that both the oil and what additives or contamination that is in the oil may have additive health effects resulting in more precautionary controls. For more information on health effects please see the Appendix 7, Invert Exposure Control Plan Template or IRP-14: Non-Water Based Drilling Fluids.

Exposure Characterization

The generation of oil mist can occur by two primary means: agitation and condensation. Oil mist created by agitation typically involves energy being imparted into the oil such as at mud tanks on a drilling rig or when using a pressure washer to clean-up a crude oil spill in a pipeline right of way. Agitation will generate oil mist that contains any additives and contamination.

Oil mist generated by condensation such as over top of the mud tanks is predominantly generated by condensation where the hydrocarbon vapour is condensing into a droplet. This oil mist will be free of any additives and contamination.

One unique situation where both a mist and vapour exist that otherwise would not be expected is when diesel is used as a drilling fluid. Typically diesel in its pure form is predominantly in the vapour form; however, when diesel is mixed with water and solids its volatility is reduced (flash point raised) such that a mist hazard may exist. In fact, the presence of water and solids is used to moderate the diesel drilling fluid flash point to help manage the risks of a flash fire.

Fire and Explosion

In regards to the use of diesel or other flammable fluids in pressure washers. This type of activity is well known to carry with it risks of exposure to oil mist as well as vapour. In addition, there are also fire hazards that may not be as well understood. When hydrocarbon mists are created using high pressure sources such as pressure washers the flash point of the fluid can be lowered increasing the risk of a flash fire. In addition static electricity can be generated and therefore the gun must be grounded. For more information please see the Health and Safety Executives 2013 publication entitled "Generation of flammable mist from high flash point fluids: Literature review". http://www.hse.gov.uk/research/rrpdf/rr980.pdf

The use of flammable or combustible fluids in pressure washers is prohibited!

Oil Mist Monitoring Methods

There are two main methods in use for oil mist sampling, National Institute of Occupational Safety and Health (NIOSH) 5026 and NIOSH 5524.

NIOSH 5026, "Oil; Mist, Mineral" is commonly the first method that personnel investigate to conduct an exposure assessment and can use a variety of filter media extracted with carbon tetrachloride and then analyzed by infrared spectrophotometry. This method is not applicable to semi-synthetic or synthetic cutting fluids and is not recommended for use with water-based fluids. It is not for use with water-based fluids, because it uses a non-polar extraction solvent (carbon tetrachloride) that is not soluble with water (polar). As a result, using this method with fluids that contain some water may result in sample results being biased low. Unfortunately this limitation is not identified in the 5026 methodology, but rather is identified in the 5524 methodology under the "Other Methods" section. This method has not been included in the NIOSH Manual of Analytical Methods, 5th Edition.

NIOSH 5524,"Metalworking Fluids (MWF) All Categories" indicates that it applies to fluids containing varying amounts of mineral oil, emulsifiers, water, alkanolamines, polyethoxyethanols, biocides, surfactants, pressure additives and boran compounds. This method uses a polytetrafluorethylene (PTFE) filter with a ternary extraction solvent analyzed gravimetrically. NIOSH 5524 requires the collection of a bulk sample to verify compatibility with the extraction solvents and requires that samples are refrigerated after collection to minimize evaporative loses. NIOSH 5524 allows for the use of a thoracic sampler or total sampling. This method is the most up to date (2014), is included in the NMAM 5th Edition and is the preferred method for oil mist sampling and analysis.

Use NIOSH Method 5524 – Metalworking Fluids (MWF) All Categories

NIOSH 5524 allows for the use of a thoracic sampler or total sampler, but personnel should be mindful of the differences and what OEL that they are going to compare against.

Size-Selective sampling

When OELs are established they are created in alignment with sampling strategies. Size-selective sampling has traditionally been more commonly understood as respirable verses total. However, total samplers are not "total" as the name implies, but less than total. According to Werner et. al. the difference from total to inhalable for many oil mist exposures can be as much as two times, with inhalable being two times that of total.

More recently inhalable sampling has been recognized as the standard that many OEL setting organizations or jurisdictions are moving towards such as the American Conference of Governmental Industrial Hygienist (ACGIH). The ACGIH's exposure limit for oil mist is an inhalable criteria. Inhalable sampling, although the preferred method, because it captures more of the mist is complicated by other factors such as reduced flow rate, higher filter loading and reduced laboratories capable of providing sampling media and conducting the analysis.

Occupational exposure limits for mist exposure in western Canada are total and not inhalable and as such the work done on drilling fluid exposures to date by Industry has been sampled using total samplers.

Total is not Total!

PRECAUTIONS YOU SHOULD TAKE

- ❒ What is in the oil?
- ❒ Health effects vary depending on what is in the oil
- ❒ Have you considered the additive health effects?
- ❒ Depending on how the oil mist is being created will determine what is in the oil mist
- ❒ Oil mist generated by a pressure washer can represent significant exposure and increase fire risks
- ❒ Use NIOSH Method 5524
- ❒ Understand what OEL you are going to compare your results to