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Synergist® Solutions: Mixed-phase Contaminants

Sampling Solutions for Mixed-phase Contaminants

By Debbie Dietrich

Some air contaminants can be found simultaneously in both the aerosol phase and vapor phase due to the vapor pressure of the compounds and/or the operation or job activity. Examples of mixed-phase contaminants include pesticides, polyaromatic hydrocarbons (PAHs), inorganic acids, and explosives.

Sampling mixed-phase contaminants in air is challenging. During sampling, it is possible that the distribution of the two phases may change: aerosol droplets may evaporate and vapors may condense.

Addressing the Challenge with Standards/Guidelines

European Standard BS EN 13936:2014 was published to address these sampling issues. The standard specifies that sampling for mixed-phase contaminants be performed in a way that represents the *sum total* of vapor and aerosol. The question is: How do you know target compounds exist in a mixed phase?

The 2017 ACGIH TLVs and BEIs book provides some assistance in this matter. The publication states on pages 72–73 that a compound that "exerts sufficient vapor pressure such that it may be present in both particle and vapor phases, with each contributing a significant portion of the dose" is assigned a TLV with the Inhalable Fraction and Vapor (IFV) designation. Other applications for mixed-phase sampling include exposures from spraying operations or processes that involve temperature changes that may affect the physical state of the air contaminants.

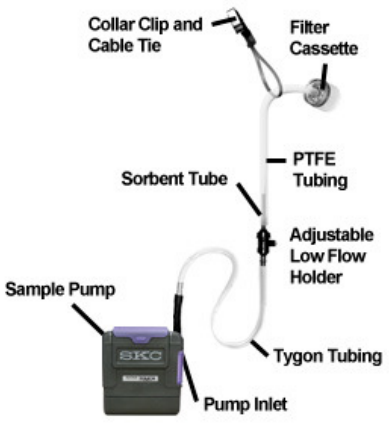

Figure 1. *Sample pump in train with sorbent tube and pre-filter.*

Sampling Options that Provide Solutions

Traditional

Historically, industrial hygienists have used a sampling train comprising a pre-filter and sorbent tube connected in series for simultaneous sampling of mixed-phase contaminants (Figure 1). However, this train is tedious to assemble and cumbersome to use in the field.

Specialty Tube in U.S. Agency Methods

In recent years, both NIOSH and OSHA developed sampling methods using a new type of sample tube called an OSHA Versatile Sampler or OVS (Figure 2). OVS tubes contain two layers of solid sorbent designed to capture the vapor phase of target compounds and an internal filter to capture the aerosol phase at a flow rate of 1 L/min. If the distribution of the two contaminant phases changes, they are still retained within the OVS tube for analysis.

Both OSHA and NIOSH have published methods for sampling several pesticides using the OVS tube. Other methods that specify OVS tubes include OSHA methods for TNT and DNT and a NIOSH method for glycols.

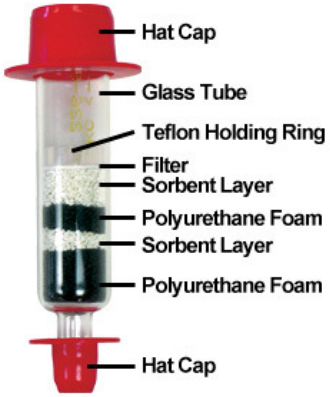

Figure 2. *OSHA Versatile Sampler (OVS) Tube.*

New German Sampler

A German agency developed a new sampler after the release of the BS EN 13936:2014 standard. This sampler, the GGP-Mini, was designed to meet the following requirements in the standard:

- simultaneous sampling of the vapor and aerosol phase
- collection of the inhalable fraction of the aerosol phase

The GGP-Mini Sampler uses 13-mm filters for the inhalable fraction and sorbent tubes for the vapor phase at typical flows of 0.333 L/min. The GGP-Mini has been shown to be an effective sampler for mixed-phase contaminants.

New U.S. Sampler

SKC research scientists have recently developed a sampler for the collection of mixed-phase contaminants. This new and cost-effective sampler, the IFV Pro (Figure 3), offers some improvements over the GGP-Mini that include an IOM-type front-facing inlet instead of the straight-up design of the GGP-Mini, use of 25-mm filters for the inhalable aerosol fraction that generate less back pressure than the 13-mm filters used with the GGP-Mini, and a wide range of sorbent tubes for sampling the vapor phase contaminants at a flow rate of 1 L/min. This flow rate supports effective size-selective sampling of the aerosol, ensures that vapors are retained on the sorbent in the tube,

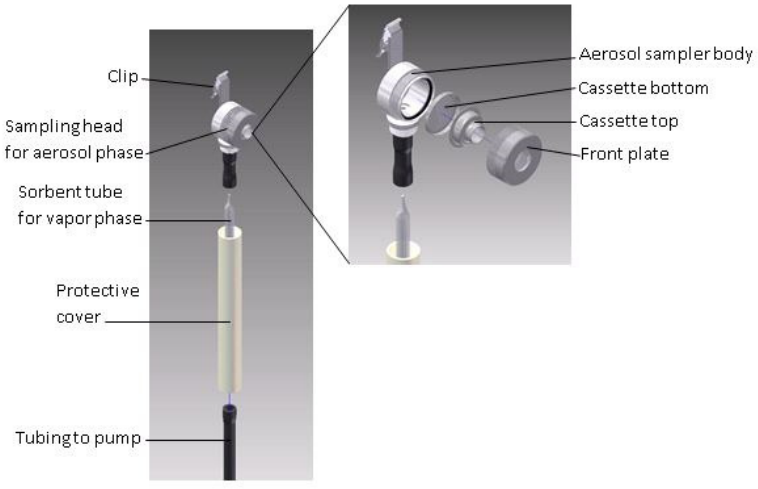

Figure 3. *The IFV Pro sampler.*

and provides for a lower detection limit in terms of what it can detect compared to the relatively low flow rate of the GGP-Mini. The IFV Pro will be available in early 2018 and a paper presented at AIHce 2018.

Takeaways

Sampling mixed-phase contaminants is a challenge due to the changing distribution of the phases. A European standard was developed in 2014 to address sampling issues. ACGIH assigned a TLV with the IFV designation to mixed-phase contaminants. The traditional sampling train is cumbersome; therefore, other samplers were designed. The sampler developed by a German agency meets requirements in the European standard. A new U.S. sampler is cost-effective and offers design improvements including an IOM-type front-facing inlet, less back pressure, a wide range of sorbent tubes, and a flow rate higher than that of the GGP-Mini for lower detection limits.

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