Texas Natural Resource Conservation Commission

Subject: Particle Size Distribution Determination (PSDD) of Particulate Matter Emissions from Hazardous Waste (HW) Units

This summary is provided to inform you of PSDD data collection problems associated with particulate matter emissions from HW facilities in Texas and to provide additional information to help ensure that valid PSDD samples and data are collected.

Preferred Test Approach

The use of a cascade impactor is the preferred approach for PSDD data collection since it provides an aerodynamic sizing of the particulate matter during the collection itself. There are two instance where the cascade impactor approach may suffer problems. First, the presence of high moisture and/or low stack emission temperatures after a wet scrubber, will result in moisture saturated stack emissions which can impact the impactor's operation. Second, the sampling of dry emission streams with very low particulate matter emissions (< 0.01grains/dry standard cubic foot) may require an extended testing period (>2 hours) to collect sufficient mass for accurate PSDD. In these instances, an alternative test approach may be considered as valid to obtain the PSDD data.

Sampling under conditions of high moisture and/or low stack emission temperatures after a wet scrubber can result in poor results and invalid test runs due to the moisture condensing in the particle collection device.

The moisture can overload the sampling system and wash the sample off the impactor collection plates. Therefore, facilities with wet stacks may be unable to directly use this approach without some additional efforts to handle the moisture.

Additional procedures which have been proposed to address impactor sampling of moisture saturated streams include altering the stream conditions to get the sample above the dew point by:

- Increasing the sample temperature in the sample collection system prior to the impacotr as identified by the California Air Resources Board (CARB) as listed at the following website address: http://www.arb.ca.gov/resnotes/notes/95-6.htm , and/or

- Reducing the moisture level of the stream by sample dilution with a particulate-free nitrogen or air source.

In either case a "proper" gas sample velocity or flow must be maintained through the impactor for valid particle sizing. The sample collection is most easily accomplished by selecting a single collection point and sampling at a single constant, near isokinetic, collection rate, collecting large drops or particles in a pre-collector, and heating the sample stream to a higher temperature prior to the cascade impactor. The second procedure, the addition of a dilution gas, must be accomplished at a measured or known rate that maintains stream characteristics such as proper stream flow and particulate flow so that the particulate sample is properly transported to the impactor. The equipment to overcome emission stream moisture using either temperature elevation or stream dilution may not be readily available, or specialized test efforts may be required for valid PSDD data collection. Therefore, the use of a cascade impactor may not represent a feasible approach for PSDD data collection for all facilities.

Alternative Test Approacb

More easily, Environmental Protection Agency Reference Method 5 (RM-5) can be used to collect particulate matter on a filter, with the filter submitted for PSDD analysis by Scanning Electron Microscope (SEM). Based on problems with the filter matrix, the SEM analysis approach should not be used with either glass fiber or quartz filters. A polycarbonate filter has been successfully used by a number of facilities and appears to be a better substrate for particulate collection than the glass fiber or quartz filter matrices

The PSDD sampling is usually conducted over a shorter time period than traditional RM-5 sample collection, since the polycarbonate filter pores are smaller and result in an unacceptable pressure drop. The collection of too much mass can result in problems in counting the individual particles. It is very important that the PSDD filter have sufficient, but not excess, mass to submit for SEM analysis. To ensure that filters are not too heavily loaded with particulate mass, the collection of filters at several differing collection times is urged.

Pre-trial bum testing to optimize the collection of PSDD data is also recommended for facilities, since a modified RM-5 procedure is used and the sample collection times need to be determined to provide a filter with optimum mass loading for the SEM analysis. The filters, following transfer to the lab, should then be subjected to SEM analysis, with minimal handling and preparation.

The rinse of the probe and nozzle (PNR) should also be subjected to SEM analysis to provide size information. Care must be taken with the PNR to minimize excessive drying or excessive agitation, which can fracture the material particles. Review of the PSDD data submitted to date indicates possible contamination of the PNR from either the reagents or the brushing procedure used for the sample recovery. Therefore, results for a reagent blank sample and a field blank sample (including filter and PNR) must be submitted with the PSDD sample data to evaluate this possibility.

An optional procedure that some facilities may elect to follow to assess whether contamination of the filter or PNR is evident is to review the particle morphology, A review of particle morphology may indicate that material present in the samples (filter or PNR) is an artifact of the sample recovery procedures or the reagents, and not inherent in the particulate of the stack emissions. Some SEM systems include an X-Ray Fluorescence (XRF) analysis capability to identify the elemental composition of individual particles. SEM instruments may have the advanced capability to screen, identify, and reject those particles in samples if the XRF analysis of particles in a blank filter sample or a blank PNR sample indicate contamination is evident.

Data Objective

The air dispersion modeling requires at a minimum PSDD information on three separate size fractions. The fractions include those particulates less that two micrometers in size (<2 um), those between two and 10 um (2-10), and finally those greater than 10 um (>10). Therefore, either the impactor sampling or the particulate collection with SEM analysis must be conducted to collect particle size data and information in separate fractions of adequate size and number.

In conclusion, TNRCC requires the collection and analysis of PSDD samples from three separate runs so that variability of the results or any abnormalities in data can be reviewed and assessed in the data validation process. Each impactor sample set or RM-5 sample for PSDD analysis should be collected isokinetically, retained in ultra clean petri dishes, sealed during the transport and holding period, and handled so that extreme agitation will not impact the particulate results. Since most wet streams will have been well scrubbed to remove contaminants, a preliminary or pre-trial burn assessment of the stream particulate loading and/or the loading of the RM-5 filter may provide a rough estimate of the sample collection time necessary for the PSDD sample.

Should you have questions concerning this information or the PSDD testing requirements in the. risk bum, please contact Dean Morrill, Engineering Services Team at (512) 239-1611.

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