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STATE OF WASHINGTON DEPARTMENT OF ECOLOGY

SOURCE TEST METHOD 8

PARTICULATE SAMPLING BY AN IMPINGER TRAIN

1. Principle

This method utilizes condensation and impingement to collect a particulate sample.

2. Description

The stack gases are sampled isokinetically while traversing the stack. Particulate is collected by a series of Greenburg-Smith impingers. The sample gas volume is determined by a totalizing gas meter. The amount of particulate collected is determined by evaporating the impinger catch to dryness. This method should only be used on stacks with less than 5 ppm SO₂'

3. Equipment and Reagents

Equipment:

- a. Stainless steel nozzle at least 1/4 inch in diameter.
- b. Stainless steel probe.
- c. Flexible nonreactive tubing such as Teflon.
- d. Condensate system comprised of three Greenburg-Smith impingers and drying tube. The first and third impingers can be modified by replacing the tip with half-inch I.D. glass tube extending to one-half inch of the bottom of the flask.
- e. Leakless valve to regulate flow.
- f. Leakless pump.
- g. Dry test gas meter with thermometer to indicate temperatures.
- h. Liquid storage containers.
- i. 250 ml graduated cylinder.
- j. Balance capable of weighing 300 gm ±0.5 gm.

k. Analytical balance to weigh the weighing dish ± 0.5 mg.

l. Weighing dish.

m. Oven to maintain $105^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

Reagents:

a. Indicating type silica gel, or equivalent.

b. Distilled water..

c. Crushed ice.

4. Procedures

Using the DOE Methods to obtain representative points, measure the stack pressure, temperature, moisture and range of velocity head. On the first run, the moisture may be estimated.

Preparation of Sampling Train: Place 100ml of water in each of the first two impingers. Leave the third impinger empty and place at least 200g. preweighed to the nearest 0.5g. of silica gel in the drying tube. Set up the train as in Figure 1. Leak-check the sampling train by plugging the nozzle. A leakage rate not in excess of 0.02 cfm is acceptable. The nozzle, pitot tip and the thermocouple tip should be in the same plane at least 3/4-inch apart. Place crushed ice around the impingers. Add more ice during the run to keep the temperatures of the gases, leaving the last impinger as low as possible, preferably at 70°F or less.

Train operation: For each run, record necessary data; such as, location, time, date, operator, nozzle diameter, initial impinger volume, and relevant process information. At each sampling point, and when significant changes in operating conditions necessitate, take readings such as traverse point, sampling time, stack temperature, and velocity pressure. Record temperatures within at least 5°F and pressure $\pm 10\%$. To begin sampling, position nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least two minutes at each traverse point. Sampling time should be the same for each point, unless some points represent more area than others. In such a case, sample proportionally longer at these points. Adjust the sampling rate to isokinetic as necessary. Turn off the pump at the conclusion of the run and record the final readings. Remove the probe and nozzle from the stack.

Sample Recovery: When the sampling period is over, turn off the pump, record the final meter readings, and remove the probe from the stack. Measure the condensate volume and place it in a suitable container. Also place the silica gel in a suitable air tight container. Rinse the probe with distilled water into the container with the impinger catch.

5. Analysis and Calculation

Analysis:

Dry the impinger catch, less any aliquot taken for chemical analysis, at 105°C. For example, samples from kraft recovery furnace stacks might be analyzed for sodium, calcium, magnesium and potassium.

Calculation:

Calculate the particulate concentration by dividing the weight of the impinger catch by the volume sampled corrected to standard conditions. The stack moisture is determined from the volume of condensate unless the stack is saturated. If the stack is saturated, then moisture is determined by saturation as in DOE Method 4.

6. Calibration

The dry gas meters should be calibrated against a wet test meter. If the correction is greater than 2%, adjust the dry gas meter until the correction is less than 2%.

Calibrate temperature gages against a standard thermometer for at least two points; i.e., an ice bath and boiling water. The gage should read within 1.5% of the absolute temperature.

Barometers should be calibrated against a mercury barometer.

Calibrate pitot tubes against a standard pitot over the normal working range. The pitot coefficient should not differ by more than 0.01 for each side.

7. References

a. "Comparison of Source Particulate with Emissions Measurement Methods at Lime Kilns and Smelt Dissolving Tank Vent Stacks." NCASI Atmospheric Quality Improvement Technical Bulletin No. 68, New York, May 1973.

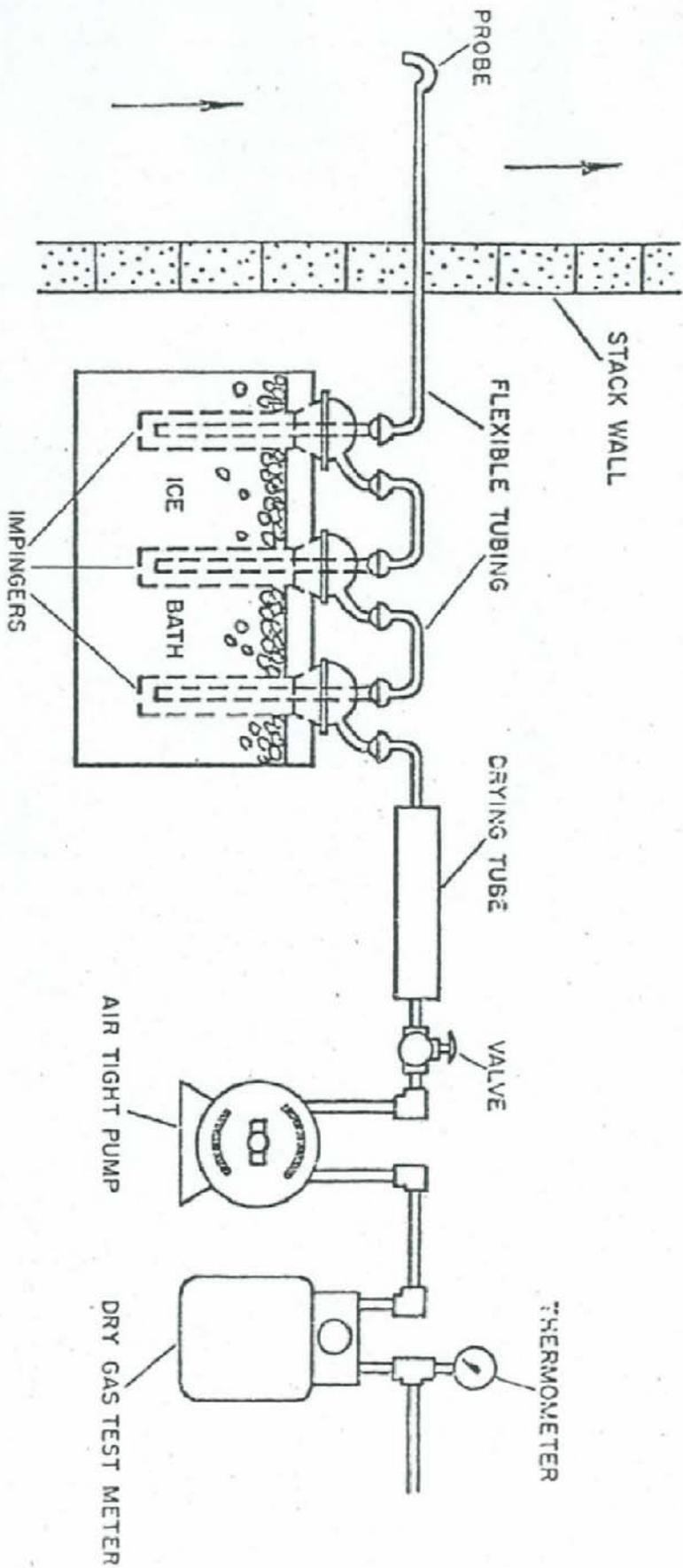


Figure 1 : DOE METHOD 8 - PARTICULATE SAMPLING TRAIN WITHOUT A FILTER