Advice & Counsel

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Chromium MACT Performance Testing

Following up on the last two columns covering the Chromium Emission Regulations under the Clean Air Act (CAA), any plater/anodizer that relies on equipment or foam blankets (not wetting agents) to comply must conduct an initial performance test to verify that the equipment meets the discharge requirements.

The regulations require any plater/anodizer to make a plan available to the EPA Administrator upon request. Before conducting a performance test to be used as proof of compliance, it would be good to notify the control authority and the regional office of EPA that the test will be performed, and to have a test plan available for review. Such notification minimizes the possibility that the test results will be rejected or questioned.

The test plan should contain:

1. A brief process description.
2. Location and description of the sampling sites, including a drawing showing the location and number of traverses for velocity/pressure drop measurements.
3. A description of the intended sampling and analytical procedures.
4. Quality assurance procedures to be implemented.
5. Standards and calibration procedures intended to be used.
6. The operating conditions considered to be "normal" for the emission sources (number of parts in the tank, operating current density, temperature, plating time, ft^3/min exhaust rate).

Following the test, the same information should be provided, along with:

1. Test results
2. Raw data sheets for field sampling and field laboratory analyses
3. Calculations
4. Any other information required by the test method used.

Making the Initial Test

Most facilities will probably opt for the simplified emissions test developed by Frank Clay, EPA, Research Triangle Park, NC. He should be given recognition for realizing that many affected facilities cannot afford to spend the money it takes to do the stack test using traditional measuring methods. Mr. Clay developed a "home-made" sampling train (see figure) that can be assembled from materials costing about $1,000. Method 306A is summarized as follows (see *FR* Vol. 60, No. 16, Wednesday, January 25, 1995, page 4968, for the full procedure):

Principle. A sample is extracted from the source at a constant sampling rate determined by a critical orifice and collected in a probe and impingers. The sampling time at the sampling traverse points is varied according to the stack gas velocity at each point to obtain a proportional sample. The concentration is determined by inductively coupled plasma (ICP) emission spectrometry, graphite furnace atomic absorption spectrometry (GFAAS), or ion chromatography with a post-column reactor (IC/PCR).

Apparatus

Sampling Train. A schematic of the sampling train is shown in the accompanying figure. The components of the train are available commercially, but some fabrication and assembly are required.

Probe Nozzle/Tubing and Sheath. Use about 1/4-in. inner diameter (ID) glass or rigid plastic tubing about 8 in. long, with a short 90-degree bend at one end to form the nozzle. Grind a slight taper on the nozzle end before making the bend. Attach the nozzle to flexible tubing of sufficient length to collect a sample from the stack. Use a straight piece of larger diameter, rigid tubing (such as metal conduit or plastic water pipe) to form a sheath that begins about 1 in. from the 90-degree bend on the nozzle, and encases the flexible tubing.

S-Type Pitot. See section 3, 40 CFR Part 60, Appendix A.

Sample Line. Use thick wall flexible plastic tubing (*e.g.*, polyethylene, or polyvinylchloride) about 1/4-in. to 3/8-in. ID to connect the train components. A combination of rigid plastic tubing and thick wall flexible tubing may be used, as long as neither tubing collapses when leak-checking the train. Metal tubing cannot be used.

Impingers. One quart capacity "Mason" glass canning jars with vacuum seal lids are used. Three impingers are required: The first is for collecting the absorbing solution; the second is empty and used to collect any absorbing solution carried over from the first impinger; and the third contains the drying agent. Install leak-tight inlet and outlet tubes in the lids of each impinger for assembly with the train. For the inlet tube of the first impinger, heat the glass or plastic tubing and draw until the tubing separates. Cut the tip off until the tip orifice is 3/32 in. in diameter. When fabricating the first impinger, place the tip orifice 3/16 in. above the

bottom of the jar when assembled. For the second impinger, the inlet tube need not be drawn and sized, but the tip should be about 2 in. above the bottom of the jar. The inlet tube of the third impinger should extend to about 1/2 in. above the bottom of the jar. Locate the outlet tube end of all impingers about 1/2 in. beneath the bottom of the lid.

Manometer. Inclined/vertical type, or equivalent device, as described in Section 2.2 of Method 2 (40 CFR Part 60, Appendix A).

Critical Orifice. The critical orifice is a small restriction in the sample line (approximately 1/16 in. in diameter) that is located upstream of the vacuum pump and sets the sample rate at about 0.75 ft^3/min. An orifice can be made of 3/32-in. brass tubing about 9/16-in. long, sealed inside larger diameter (about 5/16-in.) brass tubing to serve as a critical orifice giving constant sample flow. Materials other than brass can be used to construct the critical orifice, as long as the flow through the sampling train is about 0.75 ft^3/min. You may be successful in creating a critical orifice by drilling a hole into a section of brass rod.

Connecting Hardware. Standard pipe and fittings, 1/4 in. or 1/8 in., are used to install the vacuum pump and dry gas meter in the sampling train.

Pump Oiler. A glass oil reservoir with a wick mounted at the vacuum pump inlet lubricates the pump vanes. The oiler should be an in-line type and not vented to the atmosphere.

Vacuum Pump. Gast Model 0522-V103-G18DX*, or equivalent, capable of delivering at least 1.5 ft^3/min at 15 in. Hg vacuum.

Oil Trap. An empty glass oil reservoir without wick is mounted at the pump outlet to prevent oil from reaching the dry gas meter.

Dry Gas Meter. A Rockwell model 175-S* test meter, or equivalent, with a thermometer installed to monitor meter temperature. The dry gas meter must be capable of measuring volume to within two percent.

Sample Recovery

Wash Bottles. These are glass or inert plastic, 500 or 1000 mL, with spray tube.

Sample Containers. The first glass jar impinger of the sampling train serves as the sample container. A new lid and plastic wrap are substituted for the impinger inlet/outlet assembly.

Schematic of the Sampling Train

Port Location. Locate the sampling ports as specified in Section 2.1 of method 1 (40 CFR Part 60, Appendix A). Use a total of 24 sampling points for round ducts and 25 points for rectangular ducts. Locate the sampling points as specified in section 2.3 of Method 1. Mark the pitot and sampling probe with thin strips of tape to permit velocity and sample traversing. For ducts less than 12 in. in diameter, use a total of 16 points.

Velocity Pressure Traverse. Perform a velocity pressure traverse before the first sample run. Figure 306A-2 may be used to record velocity pressure data. If testing occurs over several days, perform the traverse at the beginning of each day. Perform velocity pressure traverses as specified in Section 3 of Method 2, but record only the Δp (velocity head) values for each sampling point.

Check for cyclonic flow during the first traverse to verify that it does not exist; if cyclonic flow does exist, make sure that the absolute average angle of misalignment does not exceed 20 degrees. If the average angle of misalignment exceeds 20 degrees at an outlet location, install straightening vanes to eliminate the cyclonic flow. If it is necessary to test an inlet location where cyclonic flow exists, it may not be possible to install straightening vanes. In this case, a variation of the alignment method must be used. This must be approved by the EPA Administrator.

Point Sampling Times. Because the sampling rate of the train is held constant by the critical orifice, it is necessary to calculate specific sampling times for each point to obtain a proportional sample. If all sampling can be completed in a single day, it is necessary to calculate the point sampling times only once. If sampling occurs over several days, recalculate the point sample times each day, using velocity traverse data obtained earlier in the day. Determine the average of the Δp values obtained during the velocity traverse. Calculate the sampling times for each point using the equation:

$$\text{Min at point n} = \frac{(\text{point n } \Delta p)^{1/2} \times 5 \text{ min}}{(\Delta p)^{1/2}}$$

Where n = Sampling point number
Δp = Velocity head measured by type S pitot tube, in in. of water

Convert the decimal parts of min to sec. If the stack diameter is less than 12 in., use 7.5 min in place of 5 min in the equation, and 16 sampling points.

Preparation of Sampling Train. Secure the nozzle-liner assembly to the sheath to prevent slipping when sampling. Before charging, rinse the first glass jar impinger with either 0.1 N sodium hydroxide (NaOH) or 0.1 N

sodium bicarbonate ($NaHCO_3$); discard the solution (to waste treatment). Put 250 mL of 0.1 N NaOH or 0.1 N $NaHCO_3$ absorbing solution into the first glass jar impinger. Similarly, rinse the second glass jar impinger and leave empty. Put silica gel into the third glass jar impinger until the impinger is half full. Place the impingers into an ice bath and check to ensure that the lids are tight.

Train Leak Check Procedure. Wait until the ice has cooled the impingers before sampling. Next, seal the nozzle with a finger covered by a piece of clear plastic wrap, and turn on the pump. The vacuum in the line between the pump and the critical orifice must be at least 15 in. Hg. Observe any leak rate on the dry gas meter. The leak rate should not exceed 0.02 ft^3/min.

Sampling Train Operation. Record all pertinent process and sampling data on the data sheet. Ensure that the process operation is suitable for sample collection. Place the probe/nozzle into the duct at the first sampling point and turn on the pump. A minimum vacuum of 15 in. Hg, or 0.47 atmosphere between the critical orifice and pump, is required to maintain critical flow. Sample for the time interval previously determined for that point. Move to the second point and sample for the time interval determined for that point; sample all points on the traverse in this manner. Keep ice around the impingers during the run. Complete the traverse and turn off the pump. Move to the next sampling port and repeat. Record the final dry gas meter reading.

Post-Test Leak Check. Remove the probe assembly and flexible tubing from the first impinger. Do not cover the nozzle. Seal the inlet tube of the first impinger with a finger covered by clear plastic wrap and turn on the pump. The vacuum in the line between the pump and critical orifice must be at least 15 in. Hg. Observe any leak rate on the dry gas meter. If the leak rate exceeds 0.02 ft^3/min, reject the run. If the leak rate is acceptable, take the probe assembly and impinger assembly to the sample recovery area.

Sample Recovery Procedure

Container 1. After the train has been moved to the sample recovery area, disconnect the tubing that joins the first impinger with the second. The first impinger jar is also used as the sample container jar. Unscrew the lid from the first impinger jar. Lift the inlet/outlet tube assembly almost out of the jar, and using the wash bottle, rinse the outside of the impinger tip that was immersed in the impinger jar with extra absorbing solution; rinse the inside of the tip as well.

Recover the second impinger by removing the lid and pouring any contents from the second impinger into the first impinger. Rinse the second impinger, including the inside and outside of the impinger stem, as well as any connecting plastic tubing, with extra absorbing solution, and place the rinse into the first impinger.

Hold the nozzle and connecting plastic tubing in a vertical position so that the tubing forms a "U." Using the wash bottle, partially fill the tubing with sampling reagent. Raise and lower the end of the plastic tubing several times to cause the reagent to contact the major portion of the internal parts of the assembly thoroughly. Do not raise the solution level too high, or part of the sample will be lost. Place the nozzle end of the assembly over the mouth of the first impinger jar (sample container) and elevate the plastic tubing so that the solution flows rapidly out of the nozzle. Perform this procedure three times. Next, repeat the recovery procedure, but allow the solution to flow rapidly out the open end of the plastic tubing into the first impinger jar.

Place a piece of clear plastic wrap over the mouth of the first impinger jar. Use a standard lid and band assembly to seal the jar. Label the jar with the sample number and mark the liquid level to gauge any losses during handling.

Container 2 (Regeant Blank). Place about 500 mL of the 0.1 N NaOH or 0.1 N $NaHCO_3$ absorbing solution in a labeled sample container.

Dry Gas Meter Calibration

Dry gas meter calibrations may be performed by either the manufacturer, a firm who provides calibration services, or the tester. The dry gas meter calibration coefficient (Y_m) must be determined prior to initial use of the meter, and must be checked following each field use.

If the information presented here sounds confusing, you may want to order a video (available in May) about this subject from EPA. o

**Trade names appearing in this month's column are only for the purpose of providing specific information, and are not indorsed by EPA, AESF, or the columinst.*

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