HCl Monitoring – A Best Practice Guide for Measurement

As a soluble and reactive gas, hydrochloric acid (HCl) presents some challenges for continuous measurement in stack gases. Excessive response times and measurement inaccuracies have been reported that would result in failures according to EPA Performance Specification 18 (PS18) as well as 15 (PS15). These challenges are not insurmountable and with some good measurement practices and system design, issues associated with HCl measurement can be overcome. Below are the MKS recommendations that will greatly enhance the ability to measure HCl in stack gases.

1. **Purge the Dual Stage Regulator with Nitrogen**
   Purging the regulator with dry nitrogen while installing onto the HCl cylinder will remove ambient moisture from the open space and internal surfaces of the regulator. Water vapor in the regulator will condense when cylinder pressure is applied causing the formation of aqueous water droplets. These water droplets will absorb HCl and thus cause excessive response times and condensed HCl will cause corrosion of the regulator internals. Once the regulator is attached to the HCl cylinder, close the regulator outlet valve then open the pressurized HCl cylinder valve. Once the regulator is pressurized, close the pressurized HCl cylinder valve. Open the regulator outlet valve and discharge to vent. Repeat this process 10 times prior to starting your analysis.
2. **Select the Appropriate Wetted Materials**
   Appropriate material selection is paramount in obtaining fast and accurate measurements. Testing conducted by MKS has shown that using a PTFE calibration line and PTFE sampling line will provide the best results when measuring for HCl. Nevertheless, other materials were found to be acceptable.
   - ***Acceptable Unheated Calibration line Material:*** PTFE (polytetrafluoroethylene/Teflon®), PFA (perfluoroalkoxy) and HDPE (high-density polyethylene)
   - ***Acceptable Heated Sample line Material:*** PTFE (polytetrafluoroethylene/Teflon®) and Electropolished Stainless Steel lines with SilcoNert® treatment (while not tested, is expected to be acceptable).
   - ***Filter Material:*** Heated 1µ PTFE filters at the probe, and heated 0.01 - 0.1 µ Borosilicate glass can be used at the entry to the gas cell of the FTIR provided there is very little HF in the gas stream.
3. **Operate at High Flow Rates**
   Calibration gas and sampling flow rate have shown to have the greatest effect on system response time. Flow rates greater than or equal to 3.5 liters per minute for sample lines of 100 feet should be maintained at all times. Flow rates up to 7 LPM, however, will greatly enhance system response time.
4. **HCl Calibration Gas: Dry or Humidified?**
   EPA PS18 allows for the humidification of dry calibration gases to enhance HCl calibration gas transport throughout the sampling system. MKS conducted a number of tests in order to quantify the effect of humidification on HCl transport and concluded that it is not necessary. Any observed improvements were marginal and could be easily overcome by operating at higher flow rate. As a result, because of the additional cost, complexity and potential inaccuracies such a system might introduce, MKS does not recommend humidifying dry HCl calibration gas.
5. **Temperature**
   MKS recommends operating an extractive system which includes the filters and sample lines at 191 °C. Sample probes can be run hotter if needed.