



ICR Treatment Study Fact Sheet: The Simulated Distribution System Test

The purpose of the ICR Treatment Studies is to evaluate the ability of GAC and membranes to remove DBP precursors. The removal of precursors to specific DBPs is assessed by chlorinating feed and effluent samples to/from the advanced process under **simulated distribution system (SDS)** conditions and measuring the concentrations of DBPs formed under these conditions. Thus, careful attention to the SDS test is a key step towards ensuring that useful data is generated during the ICR Treatment Studies. The purpose of this fact sheet is to summarize important aspects of the procedure in order to assist utilities, labs and consultants in conducting SDS tests.

SDS Sample Collection: Both feed and effluent samples are collected for SDS testing. Feed samples are collected prior to the GAC or membrane process but after all pretreatment processes (e.g., prior to entering the first stage of a pilot-scale membrane system, but after the addition of acid and antiscalant and after cartridge filtration). Effluent samples are collected immediately after the GAC or membrane process. Samples should be collected in clean glass containers with Teflon lined caps. The volume collected for each SDS sample must be large enough to generate samples for TOX, THM4, HAA6(9), chlorine residual and pH measurement; and if a chlorine demand test will be conducted prior to the actual SDS test, the sample volume must include the volume necessary to perform the demand study.

SDS Sample Storage Prior to Dosing: During the course of a treatment study, it will likely be necessary to store the SDS samples for a short period of time prior to dosing the sample with chlorine and starting the actual SDS test. Storage may be necessary to allow time to conduct a chlorine demand study or to obtain TOC results. However, there is always the potential for sample degradation during storage due to microbial activity, light, etc. To minimize the change in sample characteristics due to degradation, the sample should be dosed as soon as possible after it is collected, and the sample should not be stored longer than **five working days**. In order to preserve sample integrity during storage, it should be placed in a 4°C refrigerator immediately after collection and kept there until the SDS test is performed. Prior to dosing the sample, it should be adjusted to a temperature close to the SDS incubation temperature. The sample should be left at ambient pH during storage.

SDS Test Parameters: Four parameters must be selected to perform a SDS test for the ICR Treatment Studies: incubation time, incubation temperature, sample pH prior to dosing, and the free chlorine residual at the end of incubation. These test parameters should be selected to represent the conditions at the average distribution system residence time at the time of the SDS test. (For quarterly studies, the SDS conditions should be based on the average conditions at the average distribution system residence time **during the quarter in which the SDS tests are being performed**). Note: It is important to chlorinate feed/effluent sample pairs under similar SDS conditions since direct comparisons will be made between the feed/effluent DBPs. Also, for quarterly studies, it is important to keep the SDS test conditions constant over the quarter to allow comparison among different sample sets.

- *The Incubation Time* used in the SDS test should be equivalent to the average residence time in distribution system during the quarter in which the SDS test is being conducted. Furthermore, the SDS aliquot should be incubated in a headspace free container in the dark.
- *The Incubation Temperature* used in the SDS test should be equivalent to the water temperature in

the distribution system (at a point representative of the average distribution system residence time) during the quarter in which the SDS test is being conducted.

- **The pH Prior to Dosing** used in the SDS test should be equivalent to the pH in the distribution system (at a point representative of the average distribution system residence time) during the quarter in which the SDS test is being conducted. In general, the pH prior to dosing and the pH at the end of incubation should be comparable in a buffered system. In some cases, it may be necessary to buffer the sample pH prior to dosing using a phosphate, borate or carbonate buffer system.
- **If free chlorine is used as the residual disinfectant in the distribution system**, then the *Free Chlorine Residual at the End of SDS Incubation* should be equivalent to the free chlorine residual in the distribution system (at a point representative of the average distribution system residence time) during the quarter in which the SDS test is being conducted. **If chloramines are used as the residual disinfectant in the distribution system**, then the *Free Chlorine Residual at the End of SDS Incubation* should be set at 0.5 to 1.0 mg/L. The residual at the end of incubation should never be less than 0.2 mg/L.

The actual value for each of the SDS test parameters (i.e., incubation time, pH, incubation temperature, and free chlorine residual at the end of incubation) must be measured and reported in the *ICR Treatment Study Data Collection Spreadsheets* (EPA 815-B-97-002). Do not report the target values in the spreadsheets.

Goals for Achieving the SDS Parameters: The purpose of using distribution system conditions to select the parameters for the SDS test is to evaluate DBP formation under realistic, site-specific conditions. Thus, an effort should be made to achieve these targets during the SDS test. This section lists tolerance goals for each of the SDS test parameters. Since these are only goals, failure to meet these tolerances does not constitute a failure for the SDS test.

- The tolerance goal for the SDS incubation time is $\pm 5\%$ (e.g., if the SDS incubation time is 20 hours, the tolerance goal would be ± 1 hour).
- The tolerance goal for the SDS incubation temperature is $\pm 2^{\circ}\text{C}$.
- The tolerance goal for the SDS pH prior to dosing is ± 0.4 pH units.
- The tolerance goal on the free chlorine residual at the end of SDS incubation is ± 0.4 mg/L.

Determine the SDS Chlorine Dose: Unless the chlorine demand of a specific water sample is known ahead of time, or can be estimated with accuracy, it will be necessary to conduct a chlorine demand test prior to dosing the SDS sample. In a chlorine demand test, several aliquots of water (typically three) are dosed at SDS pH, temperature and incubation time, but at different chlorine doses. At the end of the incubation period, the free chlorine residual is measured in each aliquot, and the SDS demand can be estimated from a linear plot of dose vs. residual.

Collecting DBP Samples from the SDS Aliquot: At the end of incubation, the SDS aliquot is immediately sampled for THM4, TOX and HAA6(9) (THMs and TOX should be sampled prior to HAAs since THM4 and TOX contain volatile compounds). Samples for DBP analysis should be poured into bottles containing the appropriate dechlorinating agents/preservatives, and care must be taken to not aerate the sample during this transfer. After the DBP samples are collected, the free chlorine residual and pH are measured. All parameters should be analyzed in accordance with the methods and QA/QC requirements listed in the *DBP/ICR Analytical Methods Manual* (EPA 814-B-96-002).