



Small-Diameter Pipe Wipe Sampling for PCBs: Technology Review and Status of EPA Approval

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ABSTRACT

The Toxic Substances Control Act (TSCA) regulations governing management of polychlorinated biphenyls (PCBs) in the electric and gas industry include a series of options for abandoning pipe in place and managing pipe removed for disposal. The management options available to owners are different and, in some respects, more stringent for pipe that is less than or equal to 4 inches in diameter. The differentiation comes about because, in U.S. Environmental Protection Agency's (EPA) view, it is not possible to strictly apply their wipe sampling protocol due to size constraints. Many gas companies would like to have the option of sampling small pipe in order to take advantage of the potential reduction in recordkeeping, management, and storage and disposal costs that can come with knowing the PCB concentration.

This paper reviews the current options available for small-pipe sampling and the progress that has been made in expanding the options available. Atlanta Gas Light Company (AGLC) applied for and received a limited approval from EPA in 1999 to use a modified gun-cleaning kit to wipe the inside of their pipe for purposes of characterizing the pipe for abandonment. The method was limited to qualitative (pass/fail) testing. This paper describes subsequent work, performed earlier this year between EPA, Roy F. Weston, Inc. (Weston), and a consortium of gas companies to successfully expand the AGLC permit to allow for quantitative use of the testing method. This paper also outlines the process for gaining approval of an alternate sampling procedure from your respective EPA regions and identifies other methods that could be used for this purpose.

BACKGROUND

Atlanta Gas Light Company (AGLC) used a PCB-containing lubricating oil in a compressor in the early 1970s. This use resulted in the introduction of PCBs

into the gas distribution system in a portion of metropolitan Atlanta. The compressor has long been removed from service, but the PCB contamination has since migrated to the medium- and low-pressure portions of the system where it resides today.

With the promulgation of EPA's 1998 PCB Disposal Amendments, AGLC was forced to address the abandonment of gas lines in the affected part of their system. Working with a local grouting contractor, AGLC began abandoning small-diameter lines by defaulting to the grouting option available in the new rule. This was accomplished through a local grouting contractor that coordinated with abandonment crews around the city. Given AGLC's plans to abandon over 1,600 miles of pipe over the ensuing 10 years and the cost associated with grouting, an effective and economical alternative to their abandonment method was sought.

In 1999, AGLC applied to EPA for approval of a sampling procedure for small-diameter gas pipe. If successful, the test was expected to help eliminate the need for grouting most of the small pipe in the system by showing the actual PCB concentration was below regulated levels in many locations. This paper provides information on the test method, the experimental protocol used to confirm its effectiveness, and the process of working with EPA Region 4 and Headquarters to gain approval in September 2001.

REGULATORY PERSPECTIVE

The 1998 PCB Disposal Amendments under the Toxic Substances Control Act (TSCA), also known as the Mega Rule, made a series of changes in the regulations that affected gas distribution companies. For companies with PCBs in pipeline liquids exceeding 50 parts per million (ppm), the continued "use" (presence) of the PCBs is permitted provided the companies conduct annual PCB monitoring in pipeline liquids. Also, as long as PCB levels remain above 50 ppm, companies are required to abandon pipe in place using one of several options (capping, grouting, or decontamination). For gas pipe greater than 4 inches in diameter, the choice of options can be based on the internal surface concentration of the pipe based on a wipe sample.

For pipe that is 4 inches in diameter or less, however, there is no protocol in the regulations for wipe sampling, and the abandonment options are limited, less practical, and/or more expensive than for larger pipe. So-called "small-diameter pipe" can only be abandoned by (a) grouting at least 50% of its volume or (b) capping the pipe and entering it on the company's one-call system. In addition, the storage, manifesting, and record keeping requirements for PCB-contaminated pipe ($< 100 \text{ ug}/100 \text{ cm}^2$) are much less imposing than for pipe with an unknown concentration that must be presumed to be a PCB article. Furthermore, the reuse or distribution of abandoned pipe in commerce requires that the PCB concentration be known, not assumed. The incentive for sampling

pipe in order to know the PCB concentration is significant for many gas companies because it involves major potential cost and administrative savings.

EPA admits that using the standard wipe sampling protocol for pipe 4 inches in diameter and smaller is not practical due to size constraints. Still, the regulations do allow companies to apply for alternative sampling method approvals for either disposal/abandonment (761.61(c)) or for decontamination and disposal/reuse (761.79(h)(3)). Both of these applications need to include information on the intended application as well as experimental justification that the method is equivalent to the standard wipe sampling approach. Although Subpart Q of the regulations provides some clues when comparing analytical (versus sampling) method, no formal guidance is provided regarding the experimental design required to provide sufficient justification.

To date, AGLC is the only company to have applied for a small-diameter-pipe wipe test approval. Many other companies are expected to follow in the coming years due to the potential savings. There is no indication from EPA that alternatives to the standard wipe test will be approved on a national level.

THE AGLC WIPE TEST METHOD

The AGLC wipe test method (the method) involves wiping the bottom of a gas pipe with a hexane-moistened swab attached to a rod. The swab is then removed and sent to the laboratory for analysis.

An outside contractor (Safety Kleen PCB Services) prepares test kits in advance. The test kits consist of a rod approximately 21 inches long with a screw-on wool swab at the end. The rod is marked with two pieces of tape:

- The first piece of tape (red) is located 6 inches from the tip of the rod, in accordance with the requirement (761.247©(2)) that the sample be taken at least 6 inches into the pipe from the (hot) cut end.
- The second piece of tape (blue) is located 7.4 inches from the leading edge of the red tape. The distance is calculated to be the equivalent of 100 cm² when used on a 2-inch-diameter pipe. Sampling of larger or smaller pipe requires conversion factors to adjust for the resulting surface area and proper sample result; these conversions are included in the sampling instructions.

The moistened swab is then inserted into the pipe up to the leading edge of the first tape. It is then used to wipe the bottom third of the pipe in a side-to-side and slow, forward motion until the leading edge of the second tape is reached. The swab is then turned over and the same side-to-side motion repeated as the swab is backed out of the pipe. The swab is then removed and sent to the lab for extraction and analysis.

VALIDATION OF THE METHOD

The experimental design for the EPA validation study involved collecting clean pipe samples of different diameters and cutting them lengthwise for ease of PCB addition. Pipe sizes included 2-inch and 1/4-inch plastic pipe and 2-inch, 1 1/4-inch and 3/4-inch steel pipe. Control samples consisted of 6-inch plastic pipe and 2-inch steel pipes wiped with the standard EPA wipe sampling protocol. QA/QC samples were also collected, as were high (10x) and low (1/10x) concentration spiked samples from 2-inch plastic and 1 1/4-inch steel pipe.

Below, Table 1 is a summary of the test results. The table shows that almost all of the test results showed better recovery of PCB from the pipe surface than the EPA protocol. Keeping in mind that wipe sampling is known to be imperfect (i.e., that some residual PCB will remain on the wiped surface), these results show that the AGLC method is an even more conservative approach than EPA's protocol.

Table 1. Summary of Comparison Test Results

Pipe Type and Size	Spike Amount (ug)	Average Recovery (ug)	Average Recovery %
Plastic Pipe Control Samples	100	49.6	49.6
1/2-inch plastic pipe	100	38.7	38.7
2-inch plastic pipe	100	69.7	69.7
2-inch plastic pipe (low level)	10	9.3	93.5
2-inch plastic pipe (high level)	500	272.5	54.5
Steel Pipe Control Samples	100	60.5	60.5
3/4-inch steel pipe	100	69.7	69.7
1 1/2-inch steel pipe (low level)	10	8.4	84.2
1 1/2-inch steel pipe (high level)	500	309	61.8

On the basis of these results, EPA granted AGLC an approval to use the method but only on a pass/fail basis. Failure was any concentration above the laboratory detection limit. The approval was granted 15 August 2000.

Quantitative approval of the testing method was dependant upon a more rigorous statistical review of the data submitted. Specifically, a minimum of the following statistical tests were requested:

- Distribution of test data
- Box and whiskers plots
- Histograms
- Linear regression plots
- Scatter plots
- Outlier tests

Additional information about the method, the location of the experiment, and copies of the lab reports and QA/QC data were also requested and provided.

Two rounds of statistical analyses were eventually performed, the second as a response to EPA's request for additional information.

In the first exchange (February 2000) regarding the experimental design itself, the AGLC approach, spiking 10 or more control samples (in this case representing conventional wipe sampling) and comparing the grouped results with the alternative sampling method on the same medium (plastic or steel) was deemed to be acceptable, as long as the results are analyzed using appropriate statistical tools and the complete analytical data package provided to EPA for review.

Regarding the AGLC experimental results, statistical analyses of the data looking first at the results assuming normal distribution, showed that all but the ¼inch pipe results compare favorably with the control samples. Looking at the data without assuming normality and instead interpreting the data based on the tools mentioned above, only the ½inch and 2-inch plastic pipes were shown to be abnormal. Several outliers were identified, with the greatest deviations being associated again with the ½inch plastic pipe. Nonparametric comparisons of the data sets were performed as another conservative check, and the results again found the steel samples to compare favorably with the control while the plastic pipe results did not.

As a summary of the first round of statistical analysis, the AGL test results show the alternate wipe sampling protocol to be a suitable replacement for conventional wipe sampling when applied to steel pipe. The plastic pipe test results were inconclusive although promising. However, these findings alone were not sufficient for EPA to amend the original approval to allow quantitative testing.

After several clarifying discussion with EPA, a second analysis of the data was performed (September 2000) focusing specifically on the following issues:

1. Do the test results differ significantly between different sizes of pipe at the same PCB surface concentration?
2. Do the results differ significantly between different materials of construction (in this case steel versus plastic) at the same PCB surface concentration?

Several additional conclusions were offered from the statistical analysis at that time. They are as follows:

- Comparison of the test data between metal and plastic pipe showed that there is a significant difference in the results, i.e., the material affects the relative result.
- Comparison of the standard wipe results with those of other pipe sizes and for the same material showed there was no significant difference, i.e., the pipe size does not affect the result as long as the material is the same.
- For the lower concentrations of PCBs, there was a significant difference between plastic and steel results. For higher concentrations of PCBs, there was no significant difference between the materials.

It was concluded from the above analysis that the AGLC method is at least as good at quantifying PCB levels on most small-diameter pipe surfaces as a standard wipe test is on a flat surface or large-diameter pipe. This conclusion is valid for all sizes of metal pipe tested, and for all except very small (1/2") sizes of plastic pipe. The conclusion is also valid for PCB concentrations around 10 ug/100cm² and above; however, this conclusion is not valid for extremely low concentrations (well below the typical action level defining the appropriate abandonment/disposal option).

It was then recommended that EPA consider modifying the approval to allow the AGLC method to be used on every type of small-diameter gas pipe, except <1-inch plastic pipe, for determining the PCB internal surface concentration. It was also recommended that EPA allow those results to be used for determining the regulated status of pipe for either abandonment in place or for removal with subsequent action.

STATUS AND PLANS FOR THE METHOD

Based on the statistical findings, EPA tentatively agreed to amend the approval to allow quantitative testing of small-diameter pipe using the AGLC method. The approval was granted 18 September 2001. The final preapproval review resulted in the approval scope being reduced to (1) only the range of pipe sizes tested successfully and (2) only testing at or above 10 ug/100 cm². It was argued (unsuccessfully) that the diminishment in the method's effectiveness would be expected as the pipe size was reduced and, therefore, that the approval should only limit the lower diameter of pipe. As a result, the pipe size limit of approval is 3/4-inch to 1 1/2-inches for steel (metal) and 2 inches for plastic. Note also that because the 3/4-inch plastic pipe failed, the only size plastic pipe that can be tested is 2-inch pipe. Expansion of the approval will require testing of 4-inch plastic and 4-inch steel pipe.

Effective January 2001, Georgia law governing pipe abandonment was amended to require that all abandoned pipe be logged and kept as part of the public service notification system (One Call System). AGLC has essentially ceased all grouting and testing of small-diameter pipe and adopted the Mega Rule, One Call System option for small-pipe abandonment.

The experience gained from developing the method, running the experiment, and performing the statistical analysis will be useful to others who wish either to obtain their own permit for the same method or to conduct their own testing on new methods. Users should be cautioned to make sure they test the full range of pipe sizes necessary, perform the full suite of statistical analyses and QA/QC testing EPA requests, and engage all parties at EPA (Region and HQ).

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