

Analytical Method Criteria for the Determination of Bisphenol A in Various Matrices

Prepared by the Bisphenol A Analytical Research Task Group

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The following criteria are intended for an uncharacterized matrix/site and could be modified based on the known characteristics (history) of the matrix/site being sampled and the method quantitation limit needed. The main goal of these criteria is data integrity and is based on extensive experience within the Bisphenol A Analytical Research Task Group in determining bisphenol A (BPA) in biological, environmental, and polymer extract matrices.

Materials:

- 1) All materials (analyte & internal standard), solvents and reagents, including water, should be of high enough purity as to not limit the method capabilities, and be fully documented.

Sampling:

- 1) Each sampling site should include a minimum of duplicates (triplicates recommended) of the appropriate blanks, controls, fortified controls, samples, and site-fortified samples.
- 2) Sample containers should be selected to ensure sample integrity and large enough to allow reanalysis if deemed necessary.
- 3) Depending on the sample matrix and biological activity it may be necessary to treat the samples with a preservative/stabilizer. Concentrated HCl at ~1 mL/L is one treatment that has been used successfully as a preservative in previous surface water analyses.
- 4) All sampling, sample treatment and shipment/storage conditions should be documented using a detailed chain of custody form that travels with the samples.

Preparation & Analysis:

- 1) Multiple extractions should be performed to maximize the recovery of any BPA in the sample matrix.
- 2) As BPA is formed through an acid-catalyzed condensation reaction of phenol and acetone, a combination of these solvents should not be used.
- 3) A method that employs simultaneous quantitation and structural confirmation at the method quantitation limit, such as gas chromatography/mass spectrometry (GC/MS), is highly recommended. However, other (non GC/MS) methods that meet or exceed the performance criteria outlined in this document are acceptable.
- 4) The use of internal standard(s) greatly improves the method accuracy and precision. An internal standard (IS) should be chosen based on accepted IS selection criteria such as: a) the

IS should be stable and not interfere with the analyte, b) the IS should be as similar in structure to the analyte as possible, which ensures it will behave (extraction, concentration ...) like the analyte, c) the IS should not be present in the sample matrix. The above criteria have led to the use of stable isotope internal standards when MS techniques are employed. The use of D8-BPA as an IS is strongly recommended and has been used successfully in biological, environmental, and polymer matrices. The use of other commercially available stable isotope IS (e.g. D10-anthracene) may be used when acceptable accuracy and precision are demonstrated.

- 5) The method should be validated over the entire concentration range reported using a fortified control sample matrix.
- 6) Method validation should include a mass balance experiment to determine the absolute method recovery.
- 7) Elevated temperatures during sample extraction, concentration, chemical derivatization, or injection can increase the chance of BPA analogs to thermally degrade and produce false positives. If elevated temperatures are used in any portion of the method, the appropriate controls/experiments must be conducted to demonstrate data integrity. Derivatization reagents that can hydrolyze or transesterify BPA analogs should not be used. This in particular is the case for tetramethyl ammonium hydroxide (TMAH) and trimethyl sulfonium hydroxide (TMSH).
- 8) Matrix standards (minimum 3 point, recommended 5 point calibration) should be prepared with each sample set, encompass the full range of quantitation, and include the appropriate blanks, controls, and isotopic crossover samples.

Data Analysis & Report:

- 1) The final report should be detailed enough (methods, instrumentation, and parameters) to allow duplication of reported data by a qualified laboratory.
- 2) When MS with stable isotope internal standard techniques are used, appropriate isotopic crossover calculations must be applied following the method of Barbalas and Garland.
- 3) The relative method recovery (internal standard corrected) should be 80 % to 120 % and the precision should be ≤ 20 %. Blanks should not exceed more than 20 % of the value of concern (amount of BPA in the sample, lowest standard at calibration or method quantitation limit). The results should be corrected for the blank signal.
- 4) The method must include some form of confirmation of the BPA chromatographic peak. It is preferred that the confirmation be based on structural information such as accurate mass, daughter ions or ion ratio obtained from MS techniques. Using a GC/EI/MS methodology, the confirmation ratio for underivatized samples would be calculated using the molecular ion peak (M^+) with a mass-to-charge ratio (m/z) of 228, and the base peak (loss of a methyl group, $M-CH_3^+$) with m/z equal to 213. The formula is as follows: (abundance of 228/abundance of 213) x 100. The appropriate ions should be used for derivatized samples. The confirmation ion ratio precision should be (\leq / Less than or equal to) 20% between standards, fortified samples, and positive samples. Confirmation techniques other than MS, such as high performance liquid chromatography (HPLC) with fluorescence detection or diode array ultraviolet (UV) detection, or chromatographic multi-column separation, may be

adequate based on the method quantitation limit needed and the prior knowledge of the nature of the sample.

- 5) The method quantitation limit is set based on the lowest standard and fortified sample that meet the method performance criteria set in points 3 and 4 of this section. The linearity of the calibration must be checked.

Reference:

Barbalas, M.P. and Garland, W. A. (1991). *J. Pharm. Sci.*, **80**, 922-927.

These criteria were prepared by the Bisphenol A Analytical Research Task Group, a subgroup of the Bisphenol A Global Industry Group, which operates under the auspices of the American Plastics Council (APC), the Association of Plastics Manufacturers in Europe (APME), and the Japan Chemical Industry Association (JCIA).