Multi-Technique Analysis of Cleaning Products for Target Component

By Amy Porter, Ph.D.

About Impact Analytical

Impact Analytical is a contract analytical testing laboratory that provides testing for four main sectors: specialty chemicals including polymers and silicon materials, medical devices, pharmaceuticals, and agricultural products. Impact Analytical provides release testing, R&D support, method development and validation, extractable/leachable studies, stability studies, actives quantitation, raw materials testing, problem solving, and competitive analysis. Impact Analytical is ISO 9001:2015 certified, DEA licensed, FDA registered, cGMP and GLP compliant.

A customer submitted fifteen cleaning products to be analyzed for a variety of target compounds.

The products ranged from non-viscous multipurpose cleaners to extremely viscous laundry detergents; all submitted samples were scented. The samples were screened for bromodichloromethane (BrCCl2), acetaldehyde, methanol, acetone, methylene chloride, chloroform, 1,4,-dioxane, ethylene oxide, formaldehyde and bisphenol A (BPA) using gas chromatography (GC) with a combination of electron capture (ECD), flame ionization (FID), and mass spectral (MS) detection. Samples were injected by both headspace (HS) and liquid injection. Three analytes were screened for by liquid chromatography-mass spectrometry (LC-MS): sodium dodecyl sulfate (SDS), nitrilotriacetic acid (NTA) and 3-(dimethylamino)-1-propylamine (DMPA) and a full metal screen was performed on all of the samples using inductively coupled plasma-optical emission spectroscopy (ICP-OES).

The complexity of the samples required a variety of preparation techniques, particularly for the GC analyses. Liquid/liquid extraction, solid phase extraction and headspace analyses were utilized to minimize interferences and maximize sensitivity. Example GC-MS chromatograms obtained for a laundry detergent without sample clean-up and with sample clean-up are shown in Figures 1 (page 2) and 2 (page 3). The target analyte for these analyses was BPA; an expanded chromatogram showing the detection of a BPA peak is shown in Figure 3 (page 4). The method used in Figure 1 resulted in a complex chromatogram with interfering peaks; the sample preparation utilized for Figures 2 and 3 allowed for detection and quantitation of BPA.

The GC and LC-MS results are summarized in Table 1, below. Inorganics detected by ICP-OES analyses included aluminum, calcium, strontium, zinc, silicon, and sulfur.

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Table I. Summary of GC and LC-MS Results

Sample	$BrCCl_2$	Acetaldehyde	Methanol	Acetone	Methylene Chloride	Chloroform	1, 4-Dioxane	Ethylene Oxide	Formaldehyde	BPA	SLS	NTA	DMPA
Laundry Detergent	ND	20	1254	ND	ND	ND	ND	ND	ND	<1ppm	ND	ND	ND
Laundry Detergent	ND	59	1603	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dish Soap	<1ppm	3	1	4	ND	ND	ND	ND	3	<1ppm	>>1ppm	ND	ND
Dish Soap	<1ppm	5	5	7	ND	<1ppm	ND	ND	7	ND	>>1ppm	ND	ND
Hand Soap	<1ppm	4	47	5	ND	ND	<1ppm	ND	<LOD	ND	ND	ND	ND
Multi-Surface Cleaner	<1ppm	1	15	ND	<1ppm	ND	ND	ND	<LOD	<1ppm	ND	ND	ND
Multi-Surface Cleaner	<1ppm	4	18	ND	<1ppm	ND	ND	ND	<LOD	<1ppm	ND	ND	ND
Surface Cleaner	ND	14	35	ND	<1ppm	ND	ND	ND	ND	ND	ND	ND	ND
Hand Wash	<1ppm	8	76	ND	ND	ND	ND	ND	<LOD	ND	>>1ppm	ND	ND
Laundry Detergent	<1ppm	69	69	ND	<1ppm	1	ND	ND	ND	ND	>>1ppm	ND	ND
Dish Soap	<1ppm	18	10	ND	ND	ND	ND	ND	12	ND	>>1ppm	ND	ND
Hand Soap	<1ppm	1	ND	ND	ND	<1ppm	ND	ND	5	ND	>>1ppm	ND	ND
Laundry Detergent	<1ppm	3	1	ND	ND	ND	ND	ND	ND	ND	>>1ppm	ND	ND
All-Purpose Cleaner	ND	<1ppm	<1ppm	ND	ND	ND	ND	ND	ND	<1ppm	ND	ND	ND
Hand Wash	<1ppm	11	<1ppm	ND	ND	ND	<1ppm	ND	<LOD	<1ppm	>>1ppm	ND	ND

ND = Not Detected

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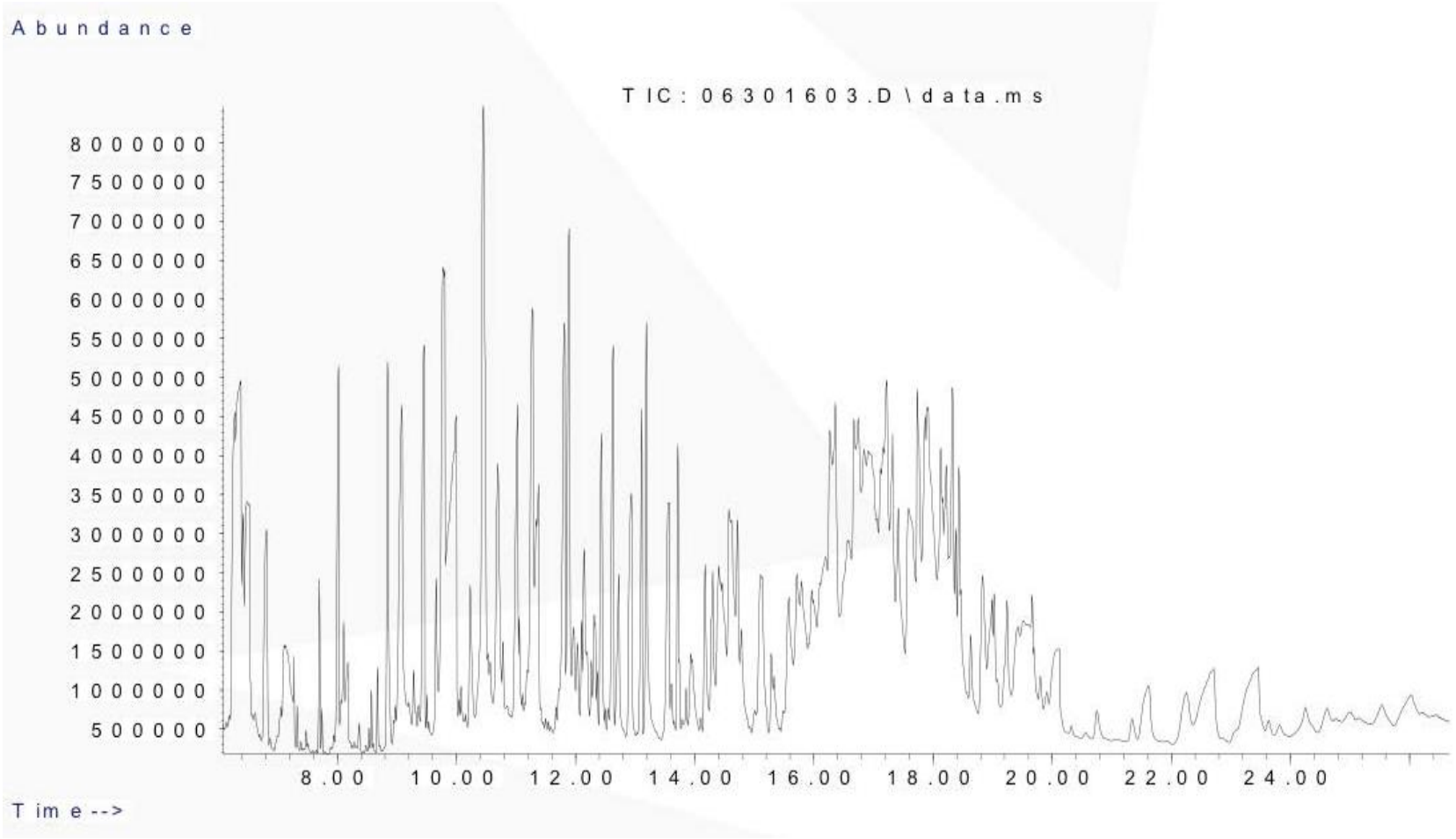

Figure 1. GC-MS chromatogram obtained for a laundry detergent with no sample clean-up step

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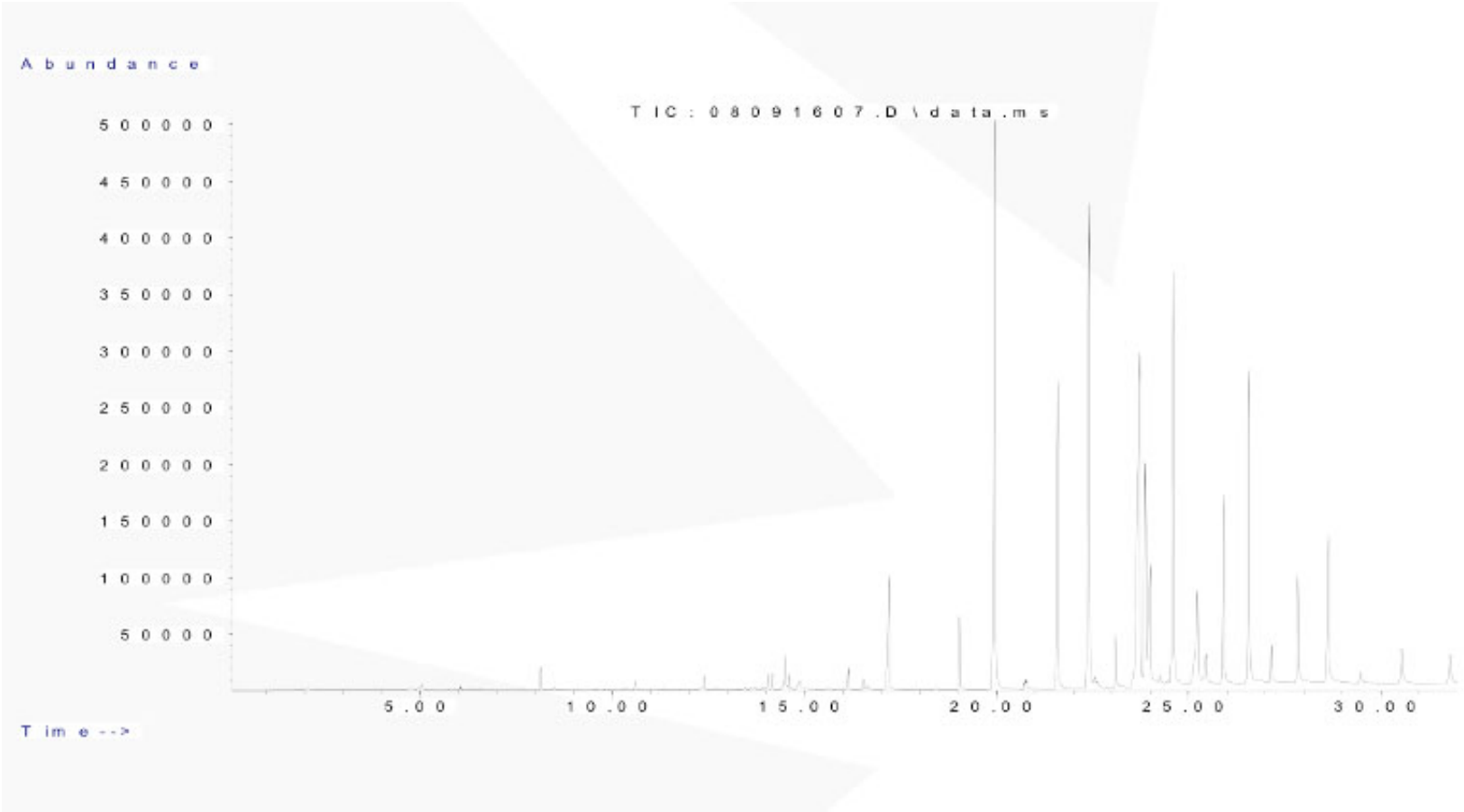

Figure 2. GC-MS chromatogram obtained for a laundry detergent with a sample clean-up step

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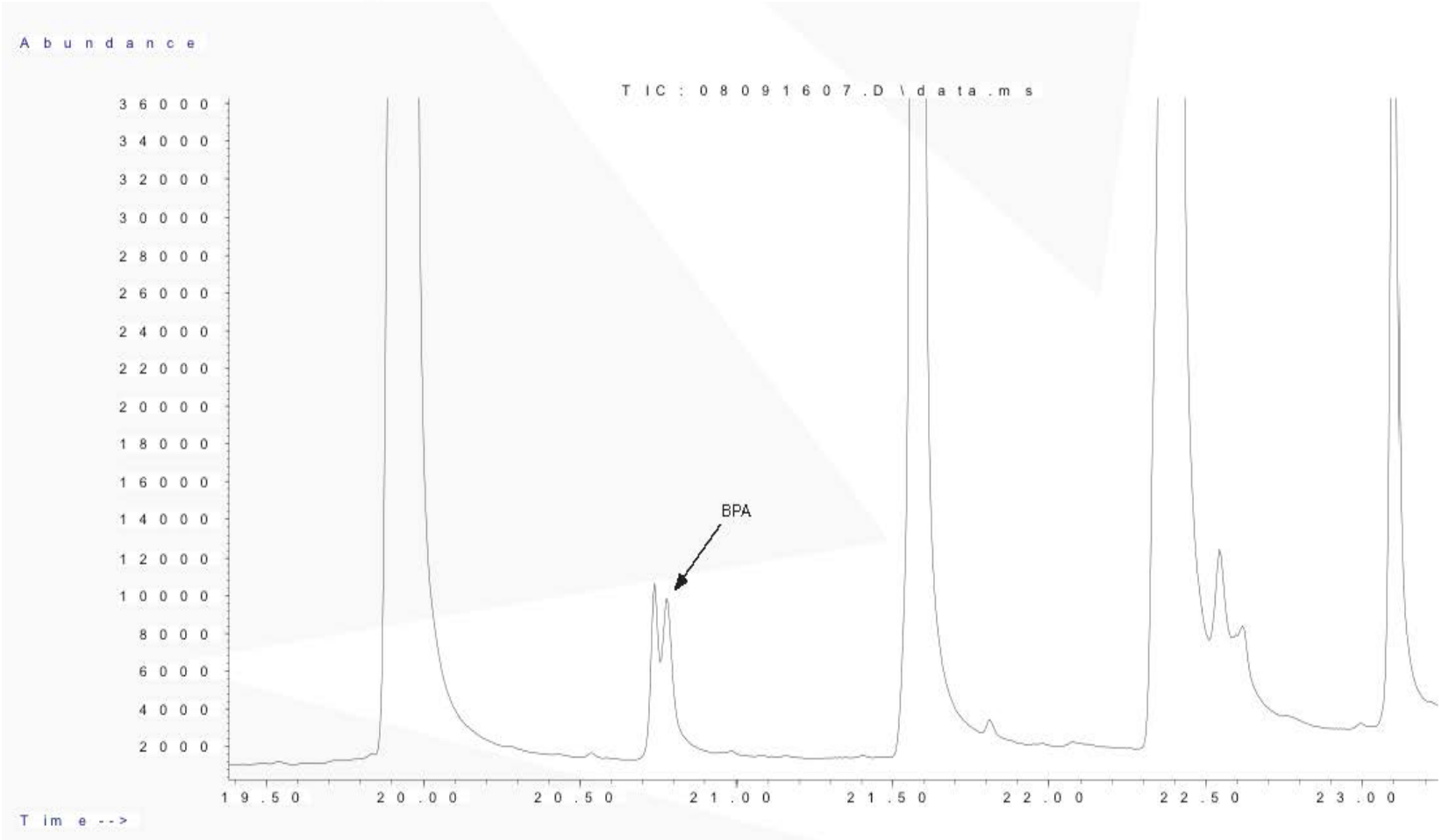

Figure 3. GC-MS expanded chromatogram obtained for a laundry detergent with a sample clean-up step, highlighting the detection of BPA.