

**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT**

**RATIONALE FOR THE DEVELOPMENT OF
AMBIENT WATER QUALITY CRITERIA**

RESORCINOL & SULFONIC ACID COMPOUNDS

(Revised February 2012)

(Revised February 2013)

Introduction:

Beazer East, Inc. (Beazer) implemented environmental investigations and remediation at sites in Butler and Armstrong Counties, Pennsylvania in cooperation with the Department of Environmental Protection (Department) and United States Environmental Protection Agency (U.S. EPA). These sites are located within an area approximately 60 square miles in size that has been designated by the Department under the Hazardous Sites Cleanup Act (HSCA) as the “Bear Creek Area Chemical Site” (BCACS). The Department has determined that environmental media (i.e. soil and groundwater) within the BCACS have been impacted by sulfonate (sulfonic acid) compounds and resorcinol and other hazardous substances. The sulfonic acid compounds include meta-benzene disulfonic acid (m-BDSA), benzene monosulfonic acid (BSA), p-phenol sulfonic acid (p-PSA).

Currently, with respect to surface water, there are no ambient water quality criteria for the sulfonic acids or resorcinol, which are needed to evaluate the environmental clean-up objectives and progress within the BCACS.

EPA and Department Review Aquatic Life Water Quality Criteria Developed by AMEC:

Because water quality criteria had not been developed for the sulfonic acids or resorcinol by either the Department or the U.S. EPA, AMEC Earth & Environmental (AMEC) used U.S. EPA's national guidelines to develop aquatic life water quality criteria (Stephan, et al., 1985) in accordance with 25 Pa. Code § 16.22. (AMEC. April 2008). The AMEC studies included a comprehensive review of relevant literature and existing toxicity data. These studies also required that a series of acute and chronic toxicity tests be conducted since there was insufficient existing toxicity data available to meet U.S. EPA's established minimum data requirements for aquatic life criteria development. AMEC used a variety of U.S. EPA and/or ASTM approved methods and protocols for conducting the different series of biotoxicity tests, depending on what was determined to be appropriate for the particular species being tested.

The Department reviewed the documentation developed by AMEC. U.S. EPA performed an informal review of this documentation, and the process used by AMEC. Based on comments

forwarded to the Department from the U.S. EPA's Health and Ecological Criteria Division in the EPA Office of Science and Technology, it was determined that AMEC followed the U.S. EPA National Guidelines on toxicity testing and criteria development. However, based on a more thorough review of the calculations and data tables, U.S. EPA provided additional recommendations to correct errors found in some reported values. AMEC revised its ambient water quality report at the request of Beazer, and updated the report titled "Development of Ambient Water Quality Criteria for Benzene Metadisulfonic Acid, Benzene Monosulfonic Acid, p-Phenol Sulfonic Acid and Resorcinol" (AMEC. 2008). This updated report, dated April 3, 2008, incorporates revisions based on recommendations provided by the U.S. EPA and Department.

Based on the results of the studies presented by AMEC on behalf of Beazer, and the U.S. EPA and Department's review and recommended revisions, the Department proposed the following site-specific ambient water quality criteria for sulfonic acids and resorcinol. These criteria were used to calculate effluent limits for permitted facilities within the BCACS located within Bear Creek basin (§93.9s), in Armstrong and Butler Counties:

Compound	CAS Number	Acute AWQC Criterion Maximum Concentration (ug/l)	Chronic AWQC Criterion Continuous Concentration (ug/l)	Human Health Criteria (ug/L)	Health Effect
Benzene Metadisulfonic Acid	00098486	2592000	1620000	N/A	H
Benzene Monosulfonic Acid	00098113	1956000	1151000	N/A	H
p-Phenol Sulfonic Acid	00098679	3476000	1363000	N/A	H
Resorcinol	01084603	28000	7180		H

Analytical Test Method Requirements:

Because there are no EPA approved analytical methods for benzene metadisulfonic acid, benzene monosulfonic acid and p-phenol sulfonic acid (sulfonates), the Department published a request in the Pennsylvania Bulletin on May 23, 2009 (39 PaB 2594) seeking analytical test methods, data and pertinent scientific information concerning these sulfonic acid compounds.

The Department's Bureau of Laboratories (BOL) reviewed the responses to the May 2009 Pa Bulletin notice "Request for Scientific Information; Resorcinol and Sulfonates." Two responses were received. One is from the law firm that represents Beazer. This respondent provided the analytical method development pathway used by Beazer (and its subcontractors) since 1990. The other response was from Test America, the laboratory that is currently providing testing

services to Beazer, and also included a brief summary of the analytical methodology currently in use by them for these compounds.

In the absence of an EPA approved analytical test method for the sulfonic acids and resorcinol, the Department is requiring that analytical laboratories apply for and obtain accreditation in accordance with 25 Pa Code Chapter 252 prior to accepting and analyzing samples for these compounds, if required to do so as a permit requirement. Currently, the Department's Laboratory Accreditation Program has approved the Test America Method OR357A - DETERMINATION OF RESORCINOL and BENZENESULFONIC ACIDS BY LIQUID CHROMATOGRAPHY-TANDEM MASS SPECTROMETRY (LCMS/MS) USING MULTIPLE REACTION MONITORING (MRM).

Department's Development of Human Health Criteria - Resorcinol:

In addition, the Department developed an ambient water quality criterion for the protection of human health for resorcinol since it was discovered during this evaluation of water quality criteria that human health is the most sensitive use and sufficient data is available for the development of such human health criteria.

Water quality criteria had not been developed for resorcinol by either the Department or the U.S. EPA. Under the Department's statement of policy, when no criteria have been developed for a substance identified or expected in a discharge, the Department will develop criteria following EPA's standard toxicological procedures outlined in the Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (EPA-822-B-00-004, October 2000) and the *National Recommended Water Quality Criteria* (EPA-822-H-04-001, 2004), as amended and updated or Exhibit 3-1 of the *Water Quality Standards Handbook, Second Edition, EPA 823-0-94-005A, August, 1994*, as amended and updated."

EPA's toxicological procedures have been updated as reflected in the *EPA Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health – 2000*. The Department therefore, calculated a threshold human health criterion using EPA's updated methods, and toxicity data from *Resorcinol – Concise International Chemical Assessment Document 71*, which was published in 2006 under the United Nations Environment Programme, the International Labour Organization, and the World Health Organization. The Department also used information from the *Data Analysis and Test Plan for Resorcinol*, INDSPEC Chemical Corporation, (May 2004).

The human health criterion for resorcinol (3400 ug/L) was developed using the following equation, variables, and sources of data:

AWQC (ug/L) = NOAEL/ UF x RSC x (BW/DI + (FI x BCF)) x 1000, where:

- **RfD Equivalent** for resorcinol – **NOAEL/UF** (0.5 mg/kg-day)
 - **NOAEL** – No Observed Adverse Effect Level (50 mg/kg-day) (*Concise International Chemical Assessment Document 71*, 2006)
 - **UF** – Uncertainty factor (100, 10 –intra species, 10 – inter species variations) (*Concise International Chemical Assessment Document 71*, 2006)

- **RSC** – Relative Source Contribution - .20 (Accounts for the non-water sources of exposure.) (EPA, 2000)
- **BCF** – Bioconcentration Factor – 3.162.0 L/kg (INDSPEC Chemical Corporation)
- **BW** – Body weight (70 kg) (25 Pa Code § 16.32(b))
- **DI** – Drinking Water Intake (2.0 Liter) (25 Pa Code § 16.32(b))
- **FI** – Fish consumption Rate (17.5 g-day) (EPA, 2000 & 25 Pa Code § 16.32(b))

The Department submitted its criteria development rationale, which includes the additional human health criterion that is based on the reference in question, *Resorcinol – Concise International Chemical Assessment Document 71* (WHO. 2006), and the *Data Analysis and Test Plan for Resorcinol*, INDSPEC Chemical Corporation, (May 2004) to U.S. EPA for approval of the study and the methodology used to calculate the human health criterion for resorcinol. Based on U.S. EPA’s review of this rationale and the *Resorcinol – Concise International Chemical Assessment Document 71* (WHO. 2006) document, U.S. EPA agreed that the Department used the appropriate methods and equation, but recommended using a NOAEL of 36 mg/kg-day based on the toxicity data, which calculates to an RfD of 0.4mg/kg-day. Therefore, the updated resorcinol criterion is **2700 ug/L**.

Summary of Criteria Development

Based on the results of the aquatic life studies presented by AMEC on behalf of Beazer, the Department’s development of human health criteria for resorcinol, using established U.S. EPA protocols and the most current scientific information and data, and an on-going cooperative review of the Department’s criteria development activities by U.S. EPA, the Department is proposing the following ambient water quality criteria for the sulfonic acids and resorcinol.

Compound	CAS Number	Acute AWQC Criterion Maximum Concentration (ug/l)	Chronic AWQC Criterion Continuous Concentration (ug/l)	Human Health Criteria (ug/L)	Health Effect
Benzene Metadisulfonic Acid	00098486	2600000	1600000	N/A	
Benzene Monosulfonic Acid	00098113	2000000	1200000	N/A	
p-Phenol Sulfonic Acid	00098679	3500000	1400000	N/A	
Resorcinol	01084603	28000	7200	2700	H

Upon approval these criteria will be placed in 25 Pa. Code Chapter 93, Table 5 (relating to water quality criteria for toxic substances).

References

25 Pa Code Chapter 16 Water Quality Toxics Management Strategy – Statement of Policy. Commonwealth of Pennsylvania.

AMEC Earth & Environmental 2008. Development of Ambient Water Quality Criteria for Benzene Metadisulfonic Acid, Benzene Monosulfonic Acid, p-Phenol Sulfonic Acid and Resorcinol (AMEC April 3, 2008).

INDSPEC Chemical Corporation (May 2004). *Data Analysis and Test Plan for Resorcinol*.

Stephen, Charles, et al. (1985). *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*.

United Nations Environment Programme, the International Labour Organization, and the World Health Organization (2006). *Resorcinol – Concise International Chemical Assessment Document 71*.

U.S. Environmental Protection Agency (2000). *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health – 2000*. EPA-822-B-00-004 October, 2000.