

Characterization of Cyanides at MGP Sites & Development of Analytical Tools for their Detection

Description: To determine the chemical composition and concentration levels of cyanide compounds present at MGP sites and developed improved analytical tools for their detection.

Status: Study completed.

BENEFITS

Cyanides are commonly found at Manufactured Gas Plant (MGP) sites. The NYSEARCH study established the chemical species and concentrations of cyanide at various MGP sites across New York State. A new, previously unknown, cyanide complex was detected and identified. An existing analytical method for measuring free cyanide was further refined and submitted for formal approval. Also, a more accurate method for the measurement of Weak Acid Dissociable (WAD) was

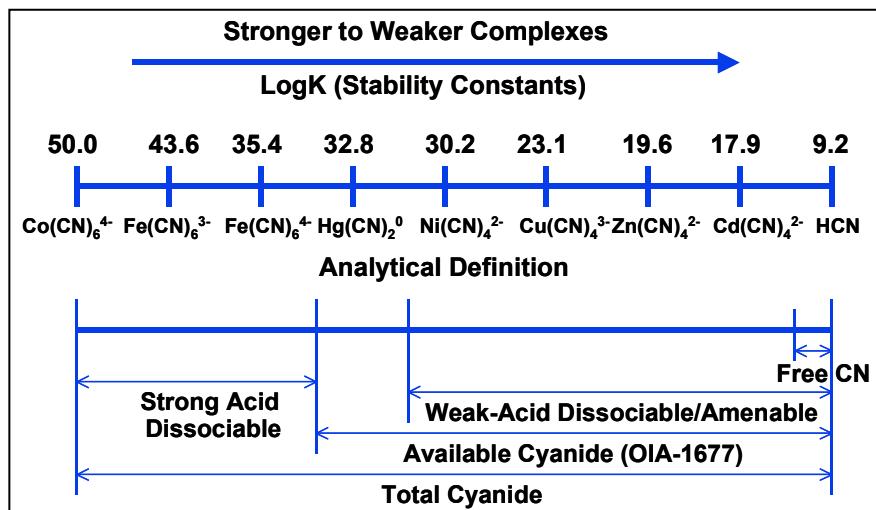
developed. Finally, a systematic review of the literature was conducted that established the low toxicity of iron-complexed cyanides as compared to that of free cyanide.

The results of the cyanide characterization and WAD method refinement studies have been published in a peer-reviewed scientific journal, Environmental Engineering Science. These articles present a new body of knowledge that can be used to more accurately characterize MGP sites and, as a

result, support the development of remediation strategies that are based on solid scientific evidence, rather than on over-conservative models. Substantial benefits to utility rate payers are expected to materialize as a result of these improved strategies.

BACKGROUND

Cyanide is one of the potentially toxic substances encountered in MGP sites. It is found either as “free cyanide” or as iron-complexed cyanide. The former is the most toxic form of cyanide known while the latter is rather non-toxic. However, USEPA approved analytical methods can only detect the total cyanide present in a sample and cannot distinguish between free, iron-complexed or other forms of cyanide. As a result total cyanide levels are used to meet present environmental standards developed for free cyanide, resulting in overly conservative management practices for



cyanide residuals at MGP sites.

TECHNICAL APPROACH

NYSEARCH, the Research, Development, and Demonstration organization within the Northeast Gas Association retained Ish Inc., ENSR (formerly the RETEC Group, Inc.), the University of Illinois at Chicago, and Purdue University to: (i) characterize the content of cyanides in MGP sites in New York State, (ii) refine and secure EPA approval for the micro-diffusion method for measuring free cyanide in water and soil leachates, (iii) correct the deficiencies of the ASTM and Standard Methods approved weak acid dissociable (WAD) cyanide analytical method for appropriate quantification of weak metal cyanide complexes, (iv) determine the chemical composition of an unknown cyanide compound that some earlier studies have found to dominate groundwater cyanides in MGP sites, and (v) conduct a human health toxicological literature review for cyanide compounds.

The micro-diffusion method is the only method capable of measuring free cyanide species. While the American Society for Testing of Materials (ASTM) has approved this method, the USEPA has not. As part of this project, the micro-diffusion method was optimized for application to groundwater samples and soil leachates using "real world" solid and groundwater samples, and will be submitted to USEPA-OSWER for approval and inclusion in SW-846.

During the course of the study certain shortcomings were identified in the WAD cyanide analytical method, when applied to water samples dominated by strong (iron) cyanide complexes. These shortcomings have resulted in concentrations that were higher than the true WAD cyanide concentrations. The WAD method was refined as part of this project and is being submitted for peer reviewed publication (and ultimate approval).

Analysis of solid wastes and impacted waters at manufactured gas plant sites revealed the presence of trace amounts of free cyanide and a few metal-cyanide complexes, which comprise the majority (>99%) of the cyanide found in the MGP site groundwater. An iron-cyanide species (FeCN-X) not previously detected was identified in groundwater samples and in soil leachates at many MGP sites. As part of this project, a preliminary identification of the structure and properties of the FeCN-X complex was accomplished through the application of a series of chemical analysis methods. The complex has been identified to be an iron pentacyano methylamine specie, with its toxicological properties expected to be similar to iron-complexed cyanides (i.e. low toxicity).

Finally, a comprehensive review of the toxicological literature for human health was performed for Prussian Blue cyanide compounds to provide additional technical support for the risk-

based management of cyanide at MGP sites.

PROJECT STATUS

NYSEARCH, in collaboration with other interested parties, conducted a one-day technical workshop that included the presentation of these research results to an audience that included several New York State environmental regulators. The workshop, which took place on September 14, 2004, was designed to inform the regulators of these new scientific developments.

Data generated from this project were incorporated into a cyanide textbook, Cyanide in Water and Soil – Chemistry, Risk, and Management [David A. Dzombak, Rajat S. Ghosh, and George Wong-Chong, Editors, @2006 by CRC Press (Taylor and Francis Group, LLC), Boca Raton, FL 33487-2742, 2006].

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