American Water Works Association

The Authoritative Resource on Safe Water [SM]

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U.S. Environmental Protection Agency
Water Docket (2822T)
1200 Pennsylvania Ave NW
Washington, DC 20460

RE: Announcement of the Results of EPA's Review of Existing Drinking Water Standards--Docket EPA-HQ-OW-2008-0747

Dear Docket:

The American Water Works Association (AWWA) is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 57,000-plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes more than 4,200 utilities that supply roughly 80 percent of the nation's drinking water. AWWA and its member utilities are dedicated to safe water. Regulations to ensure safe water must be developed through a transparent process, be based on good science, and provide meaningful risk reduction in an affordable manner.

AWWA appreciates the opportunity to comment on the second six-year review of existing drinking water standards. This cover letter summarizes our comments, and we have enclosed more detailed comments on the specific issues that EPA asked for comments on in the *Federal Register* notice. AWWA commends EPA for its work in reviewing 71 existing drinking water standards and supports EPA's decisions on the four contaminants for potential regulatory revisions. AWWA notes that this *Federal Register* notice summarizes the results of the analysis for the review of these 71 standards and that proposed revised standards for these four contaminants will follow at a later date.

EPA needs to ensure that any potential revisions to the acrylamide and epichlorohydrin treatment techniques do not impair any utility's drinking water treatment objectives—it is not just an issue of current manufacturing techniques. More research is needed to better understand the potential treatment implications of any additional monomer restrictions. AWWA looks forward to working with the agency as it evaluates the current acrylamide and epichlorohydrin treatment technique requirements. AWWA recommends EPA work with the drinking water community to collect information and to evaluate the following issues:

1. Monomer data to assure that the active dose of each charge density type polymer, especially the acrylamide-based anionic and non-ionic polymers, will be reduced below currently allowed levels by proposed changes to the treatment technique requirements;
2. Procedures to report allowed polymer doses on an active polymer basis; and
3. Balance between safety factors into NSF-60 and the treatment technique requirements and consider short-term variances to the allowed dose in usual treatment situations.

For trichloroethylene (TCE) and tetrachloroethylene (PCE), EPA needs to assess contaminant occurrence by "system" rather than "source." Future analyses will need to consider source-specific levels as system level data obscures the methods used by water systems to manage levels of TCE and PCE such as blending. Additionally, treatment effectiveness will need to be evaluated in the context of a lower MCL.

AWWA believes EPA did a robust analysis to identify the potential viability of quantifying TCE and PCE, but more work is needed to collect information and to evaluate the following issues:

1. Viability of available analytical methods in a compliance monitoring laboratory setting for monitoring TCE and PCE at a lower MRL, including a multi-laboratory analysis of LCMRLs for TCE and PCE;
2. Occurrence of TCE and PCE in source water at levels between the current and proposed MRL of 0.5 µg/L and the current MCL of 5.0 µg/L to support the agency's economic analysis for the proposed rule change; and
3. Co-occurrence of TCE and PCE with other carcinogenic volatile organic compounds with an eye toward better estimating risk reduction achieved through managing TCE and PCE at a lower MRL;
4. Practical treatment alternatives associated with the lower MCL taking into account both improvements in technology and relationship between removal and treatment cost as the concentration targeted in finished water is lowered; and
5. Inventory of existing TCE/PCE treatment plants and evaluate the impact of treatment modifications required to meet a lower MCL.

If you have any questions about these comments, please feel to call Alan Roberson or me in our Washington Office at 202-628-8303.

Yours Sincerely,

Thomas W. Curtis
Deputy Executive Director

cc: Cynthia Dougherty—OGWDW
Pam Barr—OGWDW
Eric Burneson—OGWDW

Comments by the American Water Works Association on the Announcement of the Results of EPA's Review of Existing Drinking Water Standards—FR 75:59:15500

The American Water Works Association (AWWA) is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 57,000-plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes more than 4,200 utilities that supply roughly 80 percent of the nation's drinking water.

AWWA and its member utilities are dedicated to safe water and we appreciate the opportunity to comment on the second six-year review of existing drinking water standards. AWWA has been an active participant in the regulatory development process since the initial 1974 Safe Drinking Water Act (SDWA), as its members are ultimately responsible for implementing the SDWA regulations. AWWA believes that the regulatory process should be transparent and this process should include impacted stakeholders such as AWWA. These regulations should be based on good science and should provide meaningful risk reduction that can be explained to utilities' customers.

AWWA commends EPA for its work in reviewing 71 existing drinking water standards and supports EPA's decisions on four contaminants for potential regulatory revisions. AWWA notes that this *Federal Register* notice summarizes the results of the analysis for the review of these 71 standards and that proposed revised standards for these four contaminants will follow at a later date.

Additional, but not unexpected, analyses remain prior to revising the standards for these four contaminants. EPA will have to meet its usual obligations to conduct the analyses required by the SDWA for any national primary drinking water standard. The risk assessments for tetrachloroethylene and trichloroethylene are currently being revised. The agency must consider how critical the new risk assessments are to understanding the health benefits, as part of the Administrator's assessment of whether the benefits will be justified by the costs of the revised standards. Treatment technologies for tetrachloroethylene and trichloroethylene will also need to be assessed to determine whether treatment feasibility will be the determining factor in the revised standards as opposed to analytical technique feasibility.

These potentially revised standards also represent the first opportunity to implement the Administrator's new drinking water strategy. Tetrachloroethylene and trichloroethylene represent the first opportunity to examine contaminants by groups, and to better understand the challenges in potentially regulating by groups. The treatment technologies typically used to manage tetrachloroethylene and trichloroethylene also remove a number of other organic chemicals. Advancing these revisions provides an opportunity to qualitatively, or perhaps quantitatively, evaluate the risk reduction associated with co-occurring contaminants. Much can be learned through the lessons learned from applying the "contaminant group" concept to these two revised standards.

AWWA would like to point out the following issues that should be addressed as part of the analyses for the potentially revised standards:

- How feasible is it to modify existing treatment to comply with lower Maximum Contaminant Levels (MCLs)?
- How many systems would no longer be able to rely on blending to comply with lower MCLs?
- How many systems and how many wells would need to install additional treatment to comply with lower MCLs?
- What are the implications for utilities with the revised standards where the Superfund program is setting remediation objectives for responsible parties at clean-up sites?
- What are the implications for simultaneous compliance with all of the other drinking water regulations from revised standards?

Specific Requests for Comments by EPA

Acrylamide and Epichlorohydrin

AWWA supports reducing the level of acrylamide and epichlorohydrin monomers in finished water to the extent possible with available technology while maintaining effective treatment. Acrylamide and epichlorohydrin monomer are used to create polymers utilized in drinking water treatment. The manufacture of those polymers results in a product that not only contains an active polymer beneficial to drinking water treatment but also residual monomer levels. If the treatment technique is revised to minimize the presence of residual levels of acrylamide and epichlorohydrin monomer, it is important that the effective polymer doses possible using currently available polymer products are not reduced. Most of our comments below pertain to the polyacrylamide polymers as their current allowed dose is much closer to the dose required in water treatment than are the polymers that contain epichlorohydrin.

Acrylamide -based polymers can either be produced as a dry powder or as an emulsion. Both types of polymer products contain "active polymer" and "residual monomer." Active polymer refers to the actual content of polymer useful for water treatment. Emulsions contain varying percentages of active polymer with the remaining weight not contributing to effective water treatment. Emulsions can contain 10 to 65 percent active polymer; most commonly the range is 10 to 40 percent. Dry polymer products typically contain a much higher percentage active polymer, typically over 95 percent and, in calculations, are often treated as 100 percent active polymer. Also, different types of polymer products are selected based on their chemical characteristics. The acrylamide-based polymers can have a charge density that is cationic, anionic or non-ionic. The acrylamide-based polymers are the only available anionic and non-ionic polymers. AWWA recommends that currently allowed active doses of polyacrylamide anionic and non-ionic polymer continue to be available to utilities trying to optimize their water treatment process if the treatment technique is lowered.

It may be possible to reduce residual acrylamide and epichlorohydrin monomer levels without reducing the maximum allowed dosage of active polymer below currently approved levels. The supplied NSF data are encouraging in this regard. In addition, acrylamide- and epichlorohydrin-based polymers are often produced to meet European standards, and consequently, both monomers are generally present at levels below the maximum levels allowed in the U.S in drinking water treatment polymers. With lower ratios of residual monomer to active polymer in their products, manufacturers could meet lower treatment technique requirements for residual monomer while utilities using the polymer would be allowed the same effective dose of active polymer as under present operations. Data provided by NSF concerning monomer levels in polymer products is encouraging but it does not address the question as to whether the lower levels of residual monomer reported were due to more refined manufacturing techniques or due to the fact that some polymer products contain lower levels of active polymer. In other words, was there less residual monomer because the product contained a lower amount of polymer albeit with high level of residual monomer contamination? In the later case, the active polymer dose might be reduced by revising the treatment technique. Furthermore, the available data are not classified by polymer charge sub-type, so it cannot be determined if a subset of currently available polymers would be disproportionally limited by revising the treatment technique requirements. AWWA recommends that the allowed active polymer dose for polyacrylamide anionic and non-ionic polymers not be reduced below the current level. For polymers containing epichlorohydrin, the potential TT reduction should be assessed in light of any reduction in the allowed active polymer dose and its impact on water plant uses. Therefore, EPA should consider:

1. Soliciting information gathered by states 40 CFR 141.111 annual certification requirements; and
2. An analysis of active polymer dose and charge density could be used to assess possible impacts on the allowed active dose. Such an analysis would be straightforward to undertake and could be accomplished in a timely fashion to support development of a proposed rule.

Current water treatment plant design and plant operations utilize the available active polymer levels under the current SDWA acrylamide and epichlorohydrin treatment technique requirements to meet multiple treatment objectives. In particular the acrylamide-based polymers are the only available anionic and non-ionic polymers and these functional group types are critical to treatment performance for some source water characteristics. Additional analysis prior to proposal will be necessary to assure that potential revisions to the acrylamide and epichlorohydrin treatment techniques do not impair utilities' ability to meet drinking water treatment objectives.

EPA's *Federal Register* notice notes that Australia, the European Union, and United Kingdom have more stringent requirements for acrylamide monomer in drinking water than the current U.S. treatment technique. However, we also note that resulting allowed active polymer dose is sometimes also much lower. For example, the UK allowed average dose for acrylamide polymers is 0.25 mg/L compared to 1 mg/L in the U.S. This observation should be coupled with recognition that none of these regulatory frameworks include a regulatory requirement for the removal of total organic carbon (TOC). In the U.S., under the Stage 1 Disinfectants and Disinfection By-Product (DBP) Rule, Subpart H systems (as defined by EPA) must remove a certain percentage of TOC based on pH and alkalinity of the source water. This broadly framed requirement is imposed in order to reduce DBPs, which are suspected carcinogens, including DBPs that cannot be easily identified by currently available compliance monitoring analytical methods. This U.S. TOC removal requirement is particularly relevant because the capacity to add effective levels of anionic and non-ionic polymers (e.g., acrylamide-based polymers) plays an important role in cost-effective compliance with this TOC-removal requirement in parts of the U.S. because of the nature of the natural organic matter and alkalinity of the source water.[1] In some regions of the US, the polymer is critical to assisting settling of the metal floc under enhanced coagulation conditions.

Effective acrylamide polymer doses are also important in other ways that are central to meeting drinking water treatment objectives. Research by Knappe et al. identifies anionic polymers as a key tool in algae removal during flocculation / sedimentation.[2] Effective removal of algae is a key aspect of complying with the Surface Water Treatment Rule (SWTR) Interim Enhanced Surface Water Treatment Rule (IESWTR), Long-Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), as well as a means of reducing future concerns regarding algal toxins included on EPA's Contaminant Candidate List (CCL3).

Revision of the current treatment technique presents an opportunity to clarify the reporting requirements in the current rule and alleviate confusion experienced in practice presently. Currently, the treatment technique requirement to report maximum dose is based on neat polymer added during drinking water treatment. AWWA recommends that EPA evaluate basing the allowed maximum dose on the active polymer dose added. Such an approach will make it easier to quickly determine the active polymer that can be fed. This change would have the additional benefit of simplifying comparison of polymer products. Reporting active polymer in combination with refining the allowable level of residual monomer in the applied polymer will not only control acrylamide and epichlorohydrin levels it will also facilitate clearer communication between water systems and primacy agencies..

In summary, AWWA supports the goal of reducing residual acrylamide and epichlorohydrin levels in polymers used for drinking water treatment. In pursuing this revision, EPA needs to both look at the observed levels of monomer in NSF approved products, and to clarify the treatment technique requirement. The additional analysis recommended here can be accomplished quickly and will be critical to identifying what are appropriate revisions to the current standard. Such analysis is needed to clearly understand the potential treatment implications so that any revisions to the current requirements are technically sound and do not create any simultaneous compliance

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[1] 2010, Environmental Engineering and Technology, Engineering Memorandum (copy attached).
[2] Knappe et al., 2003, Algae Detection and Removal Strategies for Drinking Water Treatment Plants, Water Research Foundation.

issues. AWWA looks forward to working with the agency as it moves forward to evaluate the current acrylamide and epichlorohydrin treatment technique requirements. AWWA recommends EPA work with the drinking water community to collect information and evaluate the:

1. Monomer data to assure that the active dose of each charge density type polymer, especially the acrylamide–based anionic and non-ionic polymers, will not be reduced below currently allowed levels by proposed changes to the treatment technique requirements;
2. Procedures to report allowed polymer doses on an active polymer basis; and
3. Balance between safety factors incorporated into NSF-60 and the treatment technique requirements and consider short-term variances to the allowed dose in unusual treatment situations.

As the agency prepares the proposed rule, AWWA requests that EPA work with the drinking water community to review the educational material available on the proper evaluation and application of polymers in the drinking water treatment. The drinking water community has already developed considerable technical guidance, and the publication of the proposed revised standards would be an appropriate time to ensure that guidance is effectively presented to drinking water community.

The 60-day comment period provided limited time for detailed analyses of the multiple issues surrounding polymer manufacturing and use in treatment. But, given that time constraint, AWWA contracted with Environmental Engineering and Technology (EE&T) to conduct a brief assessment of the state of polymer manufacturing and potential implications of changes in treatment techniques for drinking water treatment. A copy of EE&T's Engineering Memorandum No. 1 is included as Attachment No. 1.

Tetrachloroethylene (PCE) and Trichloroethylene (TCE)
EPA's *Federal Register* notice notes that the practical quantitation limit (PQL) for PCE and TCE is the same as the MCL (0.005 mg/L). AWWA agrees with EPA that analytical methods have improved since these regulations were promulgated in the late '80s and that the compliance data submitted to EPA by the state primacy agencies illustrates that many samples are currently being reported as being below a reporting limit of 0.5 µg/L.

Documentation supporting the notice indicates the agency Minimum Reporting Level (MRL) analysis is based on 138,348 MRL values for PCE and 138,439 MRL values for TCE.[3] It is not completely clear which values from the Six-Year Dataset were used for this analysis. For example, the dataset for TCE provided on EPA's website, includes a total of 403,609 records, 374,052 of which were non-detects (i.e., at or below MRL). The available documentation is not clear on how the 138,439 values used in EPA's analysis align with the values provided to the public as a part of this rulemaking.

[3] USEPA, 2009, Exhibit 3-1, Development of Estimated Quantitation Levels for the Second Six-Year Review of National Primary Drinking Water Regulations, p. 4-12 and 4-15.

AWWA applauds the use of multiple datasets to evaluate existing method performance. Using the approach described in for determining the Estimated Quantitation Levels (EQLs) provides a useful structure for identifying improved analytical method performance for regulated contaminants.[4] AWWA agrees with EPA's findings that the current agency analysis raises the question of what additional information is needed to resolve expectations for PCE and TCE analytical method performance.

Over the last six-years, EPA has shifted its appraisal of analytical method performance from Method Detection Limits (MDLs) and MRLs to Lowest Concentration Minimum Reporting Level (LCMRL). The methodology continues to evolve but is described in detail on EPA's website at (http://www.epa.gov/safewater/methods/analyticalmethods_ogwdw.html).[5]

The New Jersey PQL Study reported by EPA in the Six-Year Review notice, as well as a more recent analysis, place the PQL at 1.0 µg/L in a state where there the MCL is set at 1.0 µg/L. Based on our informal preliminary inquiries with practicing SDWA compliance laboratories, these individual laboratories have demonstrated LCMRLs near 0.13-0.14 µg/L. As EPA continues to refine its LCMRL protocol, EPA should both validate the LCMRL approach and conduct a multi-laboratory evaluation of TCE or PCE LCMRLs. Such an analysis would allow the agency to confirm that quantification is reliable as suggested in the Six-Year notice at 0.5 µg/L. As part of its ongoing implementation of all of the regulations, AWWA recommends that the agency identify a sound expectation for ongoing compliance monitoring by commercial laboratories as it is not completely clear at this time what the expectation is.

EPA's analysis also includes an assessment of TCE and PCE occurrence. The assessment summarizes contaminant occurrence by "system" rather than "source." This distinction is an important consideration for future analyses to support any regulatory action, as any potential revision to these standards needs to consider the number of wells impacted for each system. As an example, the California Department of Public Health (DPH) has identified 75 water systems that have detected TCE and PCE in active wells are above 0.001 mg/l but lower than the MCL. In theses 75 water systems, 119 active sources have these detections.

Future analyses will need to consider source-specific levels as system level data obscures the methods used by water systems to manage levels of TCE and PCE such as blending. The current analysis is a useful range finding exercise but it likely underestimates the number of water systems and the number of wells impacted by a lower MCL. The current analysis suggests that of 50,432 systems, less than 500 water systems would be

[4] USEPA, 2009, Exhibit 3-1, Development of Estimated Quantitation Levels for the Second Six-Year Review of National Primary Drinking Water Regulations, p. 3-1.
[5] USEPA, 2004, Statistical Protocol for the Determination of the Single-Laboratory Lowest Concentration Minimum Reporting Level (LCMRL) and Validation of Laboratory Performance at or Below the Minimum Reporting Level (MRL), # 815-R-05-006.

affected by a lower TCE or PCE MCL.[6] Water systems are already taking steps to manage TCE and PCE levels below the current MCL. Consequently, compliance data presented underestimates the number of water systems with sources at levels that will require treatment under a lower MCL as well as the number of systems that will have to make significant changes to current water treatment systems.

Additionally, treatment effectiveness will need to be evaluated in the context of a lower MCL. In some cases, a larger blower can be installed to increase the removal at an aeration tower, but even that addition has a limit on treatment effectiveness. Granular Activated Carbon (GAC) has similar issues with limits on treatment effectiveness. Additional and/or modified treatment, whether for new treatment plants or expanding existing plants, could also impact the ability to get or keep air quality emission permits.

Utility experience and operational records in New Jersey complying with the states' 1.0 µg/L MCL provides an opportunity to evaluate what treatment technologies can achieve greater removal, and what conditions are likely to lead to a need for new or additional treatment. New Jersey's experience also illustrates that the transition period to a lower standard will likely be challenging but a lower standards is not unachievable. In New Jersey, non-compliance rates doubled before subsequently declining.

In summary, AWWA believes the agency did a robust analysis to identify the potential viability of quantifying TCE and PCE at lower levels and looks forward to working with the agency as it moves forward. AWWA recommends EPA work with the drinking water community to collect information and evaluate the:

1. Viability of available analytical methods in a compliance monitoring laboratory setting for monitoring TCE and PCE at a lower MRL, including a multi-laboratory analysis of LCMRLs for TCE and PCE;
2. Occurrence of TCE and PCE in source water at levels between the current and proposed MRL of 0.5 µg/L and the current MCL of 5.0 µg/L to support the agency's economic analysis for the proposed rule change; and
3. Co-occurrence of TCE and PCE with other carcinogenic volatile organic compounds with an eye toward better estimating risk reduction achieved through managing TCE and PCE at a lower MRL;
4. Practical treatment alternatives associated with the lower MCL taking into account both improvements in technology and relationship between removal and treatment cost as the concentration targeted in finished water is lowered; and
5. Inventory existing TCE/PCE treatment plants and evaluate the impact of treatment modifications required to meet a lower MCL.

[6] USEPA, 2009, Table VI–24, National Primary Drinking Water Regulations; Announcement of the Results of EPA's Review of Existing Drinking Water Standards and Request for Public Comment and/or Information on Related Issues; Notice, 79 Federal Register 15499, p.15558.

Location of nitrate and nitrite monitoring
AWWA recommends that monitoring remain at the entry point to the distribution system. Nitrate/nitrite concentrations in delivered water are primarily attributable to the nitrite and nitrate present at the entry point plus any additional nitrite and nitrate formed in the distribution system due to microbial activity where available ammonia is converted to nitrite and nitrate. While concentrations of nitrate and nitrite may be higher in the far reaches of the distribution system compared to the entry point, the only significant contributing processes, nitrification, is incapable of generating significant increases in nitrite or nitrate unless influent ammonia levels are uncontrolled. For example, the use of ammonia to generate a secondary monochloramine residual will not significantly increase (<1.5 mg/L) levels of nitrite or nitrate formation.[7] As recognized in existing EPA guidance, nitrate/nitrite when monitored at selected locations in distribution systems can be a useful operational control parameter. As a distribution system water quality parameter, the utility of nitrate/nitrate monitoring lies in large part in the recognition of system specific trends (e.g., the identification of system-specific monitoring strategies and trend analysis to find triggers for modifying water management strategies, evaluating treatment performance, and/or initiating maintenance activities.

Monitoring frequency of groundwater systems with low nitrate/nitrite
AWWA recommends that no change be made to the current monitoring frequency of groundwater systems with low nitrate and nitrite concentrations. Long term trends in the overall increases in nitrate and nitrite levels in ground water aquifers illustrate the need for much more aggressive efforts to reform agricultural nutrient management practices. The available health effects and occurrence data do not demonstrate that public health or oversight of water systems would benefit from either increases or decreases in monitoring frequency but more research is needed. In evaluating potential changes in monitoring, the agency should also consider that monitoring data is not the only information available to either the water system or the state primacy agency (e.g., sanitary survey, designs and specifications for well construction, source water protection programs, etc.).

Monitoring requirements for non-community water systems
AWWA recommends that no change by made to the current monitoring frequency for non-community water systems. The current monitoring requirements adequately protect public health. See our previous comments regarding monitoring frequency of groundwater systems with low nitrate/nitrite concentrations.

New health assessment for chromium
In 2007, the National Toxicology Program completed a very extensive and expensive two-year toxicology study for hexavalent chromium, with a goal of this study to inform future risk assessments.[8] Unfortunately, many experts are legitimately concerned that the doses in the NTP study were so large as to lead to health effects that cannot be

[7] AWWA, 2002, Table 3-1, Theoretical Nitrite/Nitrate Production Based on Chloramine Decay Stoichiometry, Distribution System White Paper, Nitrification, p. 6
[8] 2007, National Institutes of Health, Public Health Service, U.S. Department of Health and Human Services, NTP Technical Report on the Toxicity Studies of Sodium Dichromate Dihydrate (CAS No. 7789-12-0) Administered in Drinking Water to Male and Female F344/N Rats and B6C3F1 Mice and Male BALB/c and am3-C57BL/6 Mice.

extrapolated to low-dose exposures in drinking water for a risk assessment that would be used in setting a drinking water standard. At least one group of expert toxicologists has developed a research framework for overcoming existing data limitations and provided those research needs to EPA scientific peer review process.[9] AWWA recommends that EPA incorporate this research framework into its risk assessment for chromium.

New health assessment for nitrate/nitrite, selenium, and 1,2,4-trichlorobenzene
AWWA does not have any new health effects data that will assist EPA in its decision of whether to initiate a new health assessment for nitrate/nitrite, selenium, or 1,2,4-trichlorobenzene. AWWA would note that nitrate/nitrite is currently managed as an acute chemical risk, and is a risk management endpoint of potential concern at tens of thousands of drinking water systems. Non-compliance with the standards set in the early '90s has remained in the range of 1,000 systems annually. Consequently, any potential changes to this standard will have significant national implications. A new health risk assessment for nitrate/nitrite warrants a robust, scientifically sound analysis and deserves considerable attention by the Office of Water, and AWWA recommends that EPA complete a new risk assessment for nitrate/nitrite as soon as possible.

Climate change impacts on occurrence
Key impacts will vary by region of the country, from hydrologic change (drought to more intensive storm events), to changing temperatures, changing snowmelt, and a rise in sea levels. Both the quality and quantity of water resources are expected to change and abrupt changes in climate can significantly impact water quality. For example, sudden decreases in snow pack lead to a reduction in the amount of natural fresh water storage and an increase the duration and frequency of flood flows during the winter months. These flooding events result in degraded water quality and can provide treatment challenges if a utility does not have a robust treatment process.

Drought conditions reduce the amount of surface water in both rivers and reservoirs, and the resulting impacts on water quality can be significant. Warmer and potentially drier summer seasons with more extreme droughts and heat waves can result in changes in vegetation of watershed and aquifer recharge areas. This would lead to changes in quantity and quality (e.g., TOC, alkalinity) of runoff into surface waters as well as altered recharge of groundwater aquifers. The amount of total dissolved solids in the surface water supplies can also increase as can the salinity in surface waters that are tidal influenced. Additionally, as the water levels in reservoirs decrease due to prolonged drought periods, the likelihood for increased algae growths and also warmer water temperatures will occur.

Increases in water temperature may lead to increased evaporation and eutrophication in surface sources. The warmer water will support a different set of bacteria and other microorganisms than is found in colder waters. The possibility that pathogens that thrive in warmer waters that historically have not been present may be detected in the drought

[9] 2009, The Hamner Institutes for Health Sciences, Research Framework for Evaluating the Potential Mode(s) of Action Underlying the Carcinogenicity of Hexavalent Chromium Following Exposure in Drinking Water

impacted supplies. Water treatment and distribution challenges in the areas of disinfection, byproducts, and regrowth may arise as a result of the changes in water quality.

Variability of occurrence and treatment impacts on variability

Although water utility operations may be sustainable under the relatively short historic record of existing climate conditions, any change to these recorded conditions must be evaluated to determine whether utility operations will continue to be sustainable under the wider variability predicted by current downscaled global climate models. Some degree of variability is inherent in any norm or statistical average. Water utilities typically account for this variability in their planning, allowing them to develop the systems needed to provide for reliable water service. However, projected changes in climate indicate that there will be significant deviations from the historical norm and statistical variability. In other words, future climate conditions are predicted to deviate significantly from recent historical climate conditions, rendering obsolete the analysis of recent historical climate data as a planning tool for water utilities.

Climate change impacts to specific water resources are not completely clear at this time as the general trends are region-specific, i.e., some regions will see increases in precipitation, some regions will see decreases, and some regions will not change. Regions with decreases in total precipitation will likely see more negative water quality impacts from wastewater treatment plants.

Even in regions with no change in the total precipitation, the variability in precipitation events will likely increase, i.e., more intense rainfall events will occur on a more frequent basis. Limited research has been conducted on the relationship between intensity and duration of rainfall events and the resultant impacts on water quality. Generally, more intense rainfall events will create more of a "flush" of humic and fulvic acids, oil and grease, and other surface constituents.

However, water treatment plants are designed to treat variable source water quality and it is not clear whether this potential change in variability is going to be outside of normal design variability (or not). Treatment plants are designed to treat a range of turbidity, Total Organic Carbon (TOC), etc., and future variability may (or may not) be handled by current engineering practices. More research is needed on:

- The relationships between rainfall events and source water quality;
- The significance of the predicted deviations in water quantity and water quality due to climate change as opposed to historical norm and variability: and
- The ability of treatment to handle variability in source water quality.

Attachment No. 1
Environmental Engineering & Technology
Engineering Memorandum No. 1

EE&T, Inc.

ENVIRONMENTAL ENGINEERING & TECHNOLOGY, INC.

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May 17, 2010

AWWA Government Affairs
Engineering Memorandum No. 1
Review of Treatment Techniques for Acrylamide and Epichlorohydrin
EE&T Project No. 5319

Subject: **Review of Treatment Techniques for Acrylamide and Epichlorohydrin**

INTRODUCTION

Polymers are utilized in drinking water treatment to destabilize and aggregate particles, which can enhance the effectiveness of many treatment processes including clarification, floatation, filtration, thickening, and dewatering. There is a substantial literature describing the mechanisms by which polymers function in water treatment (Levine *et al.*, 2004; Dentel et al, 1989; Bolto and Gregory, 2007). Drinking water utility surveys by Levine et al (2004) and MacPhee et al. (2002) indicate that roughly two out of every three utilities report using at least one polymer at some point in their treatment process.

In general, there are three classes of polymers used in drinking water treatment (Henderson *et al.*, 2009):

- Epi-DMA polyamines (epichlorohydrin/dimethlyamine polymers)
- PolyDADMACs (poly(diallyldimethyl ammonium chlorides))
- PAMs (polyacrylamides)

Of these three classes, both the Epi-DMA polyamines and PAMs may contain residual impurities in the form of unreacted monomers (epichlorohydrin and acrylamide, respectively) for which the USEPA has in place treatment technique (TT) requirements for residual monomer levels. This memo will describe the use of these polymers in water treatment and provide the feedback received from polymer and high-rate treatment process manufacturers regarding potential changes to USEPA TT requirements for these chemicals.

POLYMER USAGE DURING DRINKING WATER TREATMENT

How Polymers Function During Drinking Water Treatment

Both Epi-DMA polyamines and PolyDADMACs are cationic polyelectrolytes that generally are characterized as having a low to medium molecular weight (MW) and a high charge density (CD). As such, these polymers typically target particle destabilization via charge neutralization or electrostatic charge patch destabilization, and thus these polymers are most typically used for coagulation or flocculation. In some applications, Epi-DMA polyamines and PolyDADMACs from multiple manufacturers perform equivalently, once selected with laboratory testing and plant trials (Henderson *et al.*, 2009). As such, it may be possible that, should certain Epi-DMA polyamine products become unavailable due to USEPA TT requirements, utilities using these products could switch to a PolyDADMAC product. Furthermore, since epi-DMA and polyDADMAC polymers function similarly to metal salt coagulants (e.g., alum or ferric sulfate), these polymers are used to lower metal salt coagulant doses in order to reduce costs and consequent residuals production. If polymers like epi-DMA become unavailable, a utility could always go back to higher metal salt coagulant doses (though this would mean higher cost and greater residuals production).

Unlike Epi-DMA polyamines and PolyDADMACs, PAMs are capable of being manufactured with cationic, anionic, or non-ionic CDs. Compared to the other polymer types, PAM CDs are typically lower, although PAMs generally have MWs that are orders of magnitude higher than can be achieved with Epi-DMA polyamines or PolyDADMACs. Due to their high MW, PAMs enhance particle aggregation of previously destabilized particles via inter-particle bridging. PAMs may be used to aid coagulation, flocculation, or filtration, but are also commonly used to enhance thickening and dewatering of water treatment plant residuals. PAMs used in residuals treatment tend to be non-ionic or anionic in charge. Currently there are no alternative non-ionic or anionic polymers used in water treatment that could replace the use of PAMs. It is possible that other cationic polymers such as Epi-DMA polyamines or PolyDADMACs could be used in place of cationic PAMs, but the MW of these alternative polymers are much lower than those in the cationic PAM products. However, these other polymers would not produce the bridging mechanism of the PAM (including cationic PAM). Consequently, the only real replacement for a PAM, whether cationic, non-ionic, or anionic, is another PAM.

Polymer Application Points Utilized During Drinking Water Treatment

Polymers are applied in the following portions of drinking water treatment processes:

- Coagulation
- Flocculation
- Filter aid
- SFBW treatment prior to recycle
- Thickening
- Dewatering
- High-rate treatment (including some of the above applications)

The polymers are added to improve particulate removal (e.g., turbidity) without adding the cost and mass of solids associated with higher metal salt coagulant doses. Furthermore, the bridging function of the PAM products promotes additional particle aggregation and densification functions that the metal salt coagulants and non-PAM polymer products do not provide. In particular, where optimization of DBP precursor removal is a key objective (e.g., US drinking water utilities responding to requirements of the Stage 1 and 2 DBPR), metal salt coagulant doses and coagulation pH conditions are typically optimized to remove as much TOC and other DBP precursors as possible. The conditions suitable for optimal DBP precursor removal are frequently not optimal for turbidity removal. Therefore, since both turbidity and DBP precursor removal are required, many utilities will optimize metals salt coagulant dose and pH for DBP precursor removal, which often results in a floc high in metal hydroxide that does not settle well. Anionic or non-ionic polymer addition is necessary to settle the floc. Consequently, though polymers do not directly impact DBP precursor removal (except via improvement in removal of DBP precursors associated with particulate material), the improvement in turbidity removal associated with polymer use is an important tool for many utilities in US struggling to maintain simultaneous compliance with DBP precursor and particulate removal requirements of USEPA and the States. Other regions of the world with more restrictions on polymer use also are not faced with the same DBP precursor removal requirements as in US.

Polymers added in coagulation, flocculation, SFBW treatment prior to recycle, and use of filter aid polymers all are employing the polymer to improve separation of particulate from water. High-rate treatment processes promoted by some manufacturers, including solids contact processes with internal and external solids recycle, include solids contact for particle agglomeration (analogous to flocculation in non-solids contact process) as well as thickening. The use of polymers in these processes is important because it allows the sludge to be denser which helps in thickening and helps in control of the solids recycle throughout the process.

FEEDBACK FROM POLYMER MANUFACTURERS

Henderson *et al.* (2009) identified the following as major manufacturers of Epi-DMA polyamines and PAMs:

- Ciba (BASF)
- SNF
- Nalco
- Kemira
- Ashland Hercules (emulsion/dispersion form PAMs only)

Representatives from several of these companies were contacted to discuss the potential impacts that changing the USEPA TT requirements could have on their current operations. All of the manufacturers that were contacted were confident that they possessed the manufacturing capabilities required to produce polymers with lower residual monomer levels. Several noted that, as they are owned by and market to companies located outside of the US, their current manufacturing processes are sufficient to meet the more stringent European and overseas regulations. None of the manufacturers that were contacted were concerned that they would need to change the formulation of any products currently marketed to the water industry if the USEPA implemented stricter standards; one manufacturer instead said explicitly that they would focus on refining manufacturing techniques to meet stricter standards rather than altering product formulations or concentrations.

One individual on the AWWA Polyelectrolytes Standards Committee who was contacted for feedback noted that because the US currently has more relaxed standards than overseas markets, polymers with relatively high (but still allowable) levels of residual monomers may be directed to the US market to sell product that does not meet the stricter European standards. It may be expected that products that do not meet specifications required in more strictly regulated countries will continue to be directed to the US market as long as the USEPA allows for higher levels of residual monomers in products used in the US.

It was noted that, due to complexity of manufacturing PAMs, there were likely to be more small manufacturers of Epi-DMA polyamines than of PAMs. Of the two types of polymers, it may also be more difficult to reduce the residual monomer levels in Epi-DMA polyamines because residual DMA levels are also a concern. Historically, in order to reduce residual epichlorohydrin levels, manufacturers could add excess DMA; now that option is not feasible because residual DMA levels must also be controlled (potential NDMA precursor). In order to determine if small manufacturers could be disproportionally impacted by potential changes to epichlorohydrin TT requirements, we contacted a small manufacturer ($2.5 to $5 million annual revenues) in the US that produces Epi-DMA polyamines. According to this manufacturer, they had recently refined their manufacturing process to improve processing speed and reduce impurities and they are now producing Epi-DMA polyamines with residual epichlorohydrin levels that are well below current USEPA TT requirements. It appears that it is feasible for smaller manufacturers of Epi-DMA polyamines to produce product capable of meeting more stringent residual monomer limits.

When asked about feedback received from utilities regarding polymer dosages, the manufacturers noted that they very rarely receive feedback from utilities that feel constrained by the current 1 ppm maximum dosage requirement for PAMs. If utilities need more than 1 ppm to achieve effective treatment, the manufacturers will often work with the utilities to select an alternative product that is more effective for their source and treatment requirements. The few times that utilities indicated they felt constrained by the 1 ppm limit tended to be in response to short-lived runoff or algal bloom events. Although these circumstances are rare, unfortunately occasional higher doses of PAMs could be a critical part of maintaining treatment.

EVALUATION OF NSF DATA

A common issue noted by several of the manufacturers and one that confuses utilities is that the current regulations or standards are unclear when it comes to maximum allowed polymer dosage. It is not clear if the maximum dosage limits described in the allowed dose levels refer to ppm as product, or ppm as active chemical. Recent calculations provided by NSF suggest that the dose calculations are done as product.

The data provided by NSF shows the monomer levels for dry and emulsion type polymers. As an example, for acrylamide polymer in dry emulsions, the mean content in tested products was 99 with a std dev of 106. So if the TT were lowered to 250 essentially all the dry emulsion polymers somewhat over one std dev above the mean would have a lowered allowed dose. For emulsion polymers, more of the tested polymers would meet a lowered TT. Dry polymers are essentially all active polymer, while emulsions can vary from 10 to 40 percent active polymer. A concern is that by lowering the TT, the allowed dose of active polymer could be lowered; in other words the emulsions are passing at a lower TT because they have lower polymer concentrations. Since utilities rely on the active polymer they would be impacted if the rule resulted in a decrease in allowed active polymer dose. In order to evaluate this further, EPA would need to evaluate the NSF data in terms of active polymer such that the allowed dose of active polymer could be assessed before and after a possible TT change.

In addition, the data should be provided for PAM polymers separated into cationic, anionic and non-ionic functional groups. There are no alternative polymers to the PAM non-ionic and anionic polymers so it is important to evaluate if they would be disproportionally impacted by a TT change.

In any event, the current TT requirement review process would represent an opportunity to eliminate this reporting ambiguity and the associated confusion experienced in practice. Several individuals that were contacted stated that they felt that the requirement should be based on the active polymer dose, not on the dose as neat product. We agree with this approach and reporting as active polymer would make it much clearer to utilities. This approach is consistent with the fact that residual monomer levels are correlated with the mass of polymer in the product, not with the total product volume.

We cannot comment as to whether lowering the TT will have the affect of lowering the allowed active polymer dose without further data.

FEEDBACK FROM HIGH-RATE TREATMENT DEVICE MANUFACTURERS

Compared to conventional water treatment processes, high-rate clarification processes tend to be relatively polymer-intensive. The manufacturers of several high-rate processes such as dissolved air floatation (DAF) and solids contact clarification were contacted to determine if reductions in the maximum allowable polymer dosages would impact their products. These products almost universally utilize high-MW PAMs, which cannot typically be replaced with an alternative polymer product.

In general, DAF manufacturers did not feel as if their products would be significantly impacted by polymer dose restrictions. However, there did appear to be a concern that solids contact clarification processes would be affected by any reduction in allowed polymer dosage levels. While this concern was expressed by several individuals, a representative for one well-established solids contact clarification process felt that their process would not be adversely impacted by a reduction in maximum polymer dosage, as their typical polymer requirements are in the range of 0.2 to 0.3 mg/L (as active product). Nonetheless, there does appear to be a concern among manufacturers that solids contact processes would be limited if the allowed active polymer dose was lowered by a TT change.

One high-rate manufacturer did note that US drinking water utilities tend to be conservative and like to use safety factors. Therefore, this manufacturer recommended that the maximum allowed dose for PAM, for example, not be dropped below the current levels. Utilities do not have a problem dosing at 0.2 to 0.3 mg/L, or even 0.5 mg/L, since that still gives them a safety factor of >2 for many of the polymers. However, if the maximum dose is lowered, to 0.5 mg/L for example, then utilities may be reluctant to add the polymer at doses above 0.2 to 0.25 mg/L.

RECOMMENDATIONS

Without further data we cannot assess the impact of lowering the TT on the allowed active polymer dose. We suggest the following to completely assess and improve the rule and to help provide clarity to utilities and manufacturers:

1. EPA should evaluate data on the monomer content of the tested polymers relative to the active polymer content so that an assessment can be made as to the impact of lowering the TT on the allowed active polymer dose can be made. The data should be analyzed by functional group charge.
2. Set the 1 mg/L dose level as "active polymer" and have each product's allowed dose established on that basis.
3. Consider a method where a utility could receive a short term waiver from the Primacy Agency to allow a higher dose during unusual raw water condition
4. EPA should conduct additional research into the detection of acrylamide and epichlorohydrin in treated water so that actual monomer concentrations in the water can be determined.