

USEPA
Lead and Copper Rule Workshop 1: Simultaneous Compliance
Summary

May 11, 2004 – May 12, 2004
St. Louis Airport Marriott

Facilitated by R. Scott Summers, University of Colorado-Boulder

The facilitator, Scott Summers, began the meeting by welcoming the panel participants and observers. Scott Summers described the approach of the workshop as identifying as many issues as possible related to the simultaneous compliance of the Lead and Copper Rule (LCR) with other Rules, including the Total Coliform Rule (TCR), the Surface Water Treatment Rules (SWTR, IESWTR, LT2ESWTR), and the Disinfectant Byproduct Rules (Stage 1 DBPR, Stage 2 DBPR). Participants were informed that, for the identified issues, the goal is to propose solutions (both demonstrated and potential) and identify information gaps.

Cynthia Dougherty, Director of EPA's Office of Groundwater and Drinking Water (OGWDW) thanked the panel participants and observers for their participation. She explained that EPA is attempting to review the national implementation of the LCR with respect to regulatory, legal, and guidance issues. The purpose of the workshop is to gather information from the panel on the technical issues at a national level.

After introductions (see Attachment A for the attendance list), Eric Burneson of EPA's OGWDW elaborated on the context of the meeting. This workshop and future planned workshops are part of a broader review of the LCR. The main purpose of this workshop is to exchange information on the challenges facing systems in achieving simultaneous compliance with the LCR and other Rules. The expected outputs of this workshop (i.e., information on simultaneous compliance, problems and solutions) will assist EPA in determining further actions, including suggestions for additional guidance, identification of rule provisions that help or hinder simultaneous compliance, and data gaps. Eric Burneson emphasized that the goal of the workshop is not to reach consensus, but rather to exchange information on national problems.

Jeff Kempic of EPA's OGWDW provided an overview of the provisions of the LCR and potential issues associated with simultaneous compliance. The first portion of the presentation described the procedures for water systems to identify an optimal corrosion control treatment under the 1991 Final Rule. The presentation also described some of the minor revisions that were made to the rule in 2000. One key revision is that systems under reduced monitoring are required to notify the State when making a treatment change. The State can require additional monitoring or additional study to evaluate the impact of the treatment change. The Stage 1 Disinfection By-Products Rule was finalized in 1998. Many systems have made treatment changes in recent years while operating under reduced monitoring. Many of these treatment changes can impact corrosion control processes. Systems may also make treatment changes that can affect optimal corrosion control once proposed regulations are finalized.

EPA identified key issues on simultaneous compliance for discussion. The first issue dealt with nitrification in systems using chloramines for secondary disinfection. EPA requested input on additional control techniques and monitoring procedures that can be recommended for systems switching from chlorine to chloramines. The second issue examined the Minor Revisions Rule requirement that systems notify the State after making a treatment change. EPA requested input on whether States would like additional guidance on monitoring or treatment evaluations that could be required after a treatment change. EPA also requested input on the need for additional guidance for systems to evaluate the potential impact of treatment changes. EPA also requested input on the format for guidance related to treatment changes. The final issue dealt with phosphate inhibitors and their impact on microbial regrowth in the distribution system. More recent data indicates that phosphate inhibitors may help control biofilms and coliforms rather than contributing to regrowth. EPA requested additional input from the panel on this issue.

The agenda then provided time for panel discussion, and the following issues were identified:

- There are many gaps in understanding interactions of rule requirements under various circumstances. For example, what are the impacts of changes in source water quality, particularly on a seasonal basis? Are groundwater/surface water interactions important?
- We also don't know the effect of aluminum or iron on lead scales.
- From the State perspective, treatment and source changes do not just prompt notification, there is an evaluation process associated with the changes. Major changes prompt an approval process with conditions, including additional monitoring to determine impact on lead.
- Some States, such as OH, emphasize the need to conduct studies beforehand to reduce turnaround time because these studies can take years to complete.
- Should States wait for the results of evaluations/studies before giving approval for treatment changes?
- In the experience of some States, such as MN, the notification/approval process is more of a problem with smaller systems. Often smaller systems don't have the understanding to realize that a seemingly minor treatment change (such as a change in coagulant used) can have corrosion control impacts. There may be a need for modifications to operator certification or exams to increase the understanding of the potential impacts of using different chemicals. Turnover of personnel can also be a problem with small systems.
- Achieving corrosion control optimization has gotten quite complicated because of simultaneous compliance with a number of rules. There is now a need to optimize each parameter for each rule. What is optimization? Given constraints posed by other rules, optimum corrosion control may not be achievable.
- One potential consequence of corrosion control under the LCR is the increase in discharge of phosphates to wastewater when PO₄-based inhibitors are used.
- A problem identified with the current structure of the LCR is its specification of corrosion inhibition as the primary approach for reducing lead. Some systems, such as Madison, WI, have gone directly to lead service line replacement as a means to reduce lead. Greater flexibility in developing lead control strategies is needed.

- The focus of guidance has been on the simultaneous compliance with LCR, LT2ESWTR, and Stage 2. The focus should be broader than just LT2 and Stage 2.
- The current guidance on simultaneous compliance seems to have an implied hierarchy of compliance, with LCR compliance at the bottom. The tradeoffs/implications of this implied hierarchy should be evaluated. Also, clarifying the hierarchy would be helpful if LCR problems arise. The relative risk levels of multiple health impacts should be articulated and communicated to customers.
- Treatment changes can lead to an increase in dissolved oxygen, leading to new systems at copper action level.
- The best long-term direction to reducing lead in drinking water is to “Get the Lead Out” of contact with water. It is not clear if this approach will work for copper because of the lack of available substitutes. If the regulation were being written from scratch today, this approach may be better than the existing treatment technology approach.

After this initial discussion, three utilities presented case studies to the panel.

Case Study #1: Indiana American Water Co., Presented by Jeff Robinson

Jeff Robinson of Indiana American Water Co. presented the first case study. American Water provides corrosion control in 85 water facilities, most using zinc orthophosphate, while some use alkalinity and pH adjustment. He focused on the experience of one system, a groundwater system with serious copper corrosion problems. The copper level at the 90th percentile was 3.37, with two thirds of the samples exceeding the copper action level. The system has very low lead levels. The system conducted a desktop study and determined that the application of zinc would be the best approach to control copper corrosion. The system added zinc orthophosphate (1:3) to control corrosion. After the system achieved passivation, the copper samples were down to 1.1 mg/L, at the 90th percentile meeting the LCR requirements. The system was concerned about two potential simultaneous compliance issues associated with the use of zinc orthophosphate. They were concerned with biofilm regrowth (TCR) and the effects of adding phosphate. Also, the system was concerned about additional phosphate levels in wastewater and zinc loading during the land application of sludges. The system uses an aggressive flushing program to control biofilm regrowth. Neither the phosphate nor zinc contributed significant loading to wastewater effluent or wastewater sludge.

The system also took a very slow approach to optimizing the zinc orthophosphate treatment. They received State approval and then implemented a process to methodically reduce zinc while maintaining orthophosphate levels. After each incremental change, monitoring was used to assess and evaluate the impacts of the change. This process allowed the system to eliminate use of zinc, improving cost efficiency and reducing environmental impacts.

The panel discussed the case study.

- The panel questioned whether zinc was needed in the formula for corrosion control. Zinc orthophosphate is the prescribed treatment because it is used by other systems and it usually works. Zinc orthophosphate is a good starting point, but zinc may not be needed from the start. The panel identified a need for additional information on zinc and its

usefulness. Water quality characteristics may be important in determining whether to use zinc. The IN case study is example of how to start with zinc and then slowly determine next steps.

- Optimizing corrosion for lead and copper does not necessarily optimize corrosion control for other materials.
- Minimization of standing water metals concentrations does not necessarily imply minimization of corrosion rates.
- The case study system did not experience any red water issues with zinc orthophosphate.
- Some systems may be reluctant to optimize.
- During optimization, systems need to maintain passivation with sufficient residuals throughout the system.
- What are the impacts of flushing program on optimization?
- Predictions of corrosion control from pipe loop studies using fresh materials do not recognize the interaction of such strategies with existing scales and deposits. The time to establish steady-state conditions in the distribution system and the consequences during the interim are poorly understood.

Case Study #2: Greater Cincinnati Water Works Presented by Jack DeMarco

The second case study was presented by Jack DeMarco of Greater Cincinnati Water Works (GCWW). GCWW serves a population of about 800,000 using a combination of surface and ground water. Three examples of operational practices required to maintain simultaneous compliance were briefly described

In terms of lead compliance monitoring, GCWW meets the 90th percentile action limit. The system has about 30,000 (13%) lead service lines. GCWW conducted desktop studies required by the USEPA that were developed by consultants for GCWW and approved by OEPA. The studies indicated that pH control was the preferred method of lead and copper control for our specific site conditions. When the concentration for an individual sample exceeds the lead action limit, GCWW has a procedure entailing an immediate call to the customer; providing lead and health information; discussing mitigation methods; offering free follow-up analysis including a flush sample and offering to replace the utility part of service line at our cost if the customer is willing to replace their part of the service line at their cost.

Although GCWW's action level has never exceeded the Federal requirements, GCWW saw an unacceptable increase in the lead action level compliance data. At that time the pH was increased to a distribution system concentration of about pH 8.8. This very effectively decreased the lead levels. However, CaCO₃ scale formation in the distribution system increased when pH concentrations of 8.8 were maintained. This carbonate deposition problem became critical during a recent electrical outage. Cone valves were frozen open due to the scaling, jeopardizing water delivery to about 30% of the system. Return of electrical service and comprehensive actions by GCWW distribution system personnel avoided the crisis condition. The current practice of maintaining a distribution system pH level of about 8.6 and feeding sodium hexametaphosphate to sequester carbonate appears to be maintaining a reasonable balance between corrosion by-product concerns and the operational necessity of maintaining delivery of water. A monitoring program has been enacted to provide early warnings of any problems of the

type faced in balancing lead dissolution and carbonate deposition. GCWW is fortunate that disinfection by products have been fairly low because of site specific treatment and conditions. This has allowed the use of pH in dealing with lead and copper rule compliance.

Higher pH levels also mean higher CT requirements. During a cold weather period with main breaks, the margin of safety for CT was undesirably low. The actual CT was 77 and the required CT was 70. GCWW generally prefers maintaining a CT at about twice the required level. Coping with normal, uncontrollable operational difficulties such as the simple one outlined is a vital part of insuring that regulations will not be violated.

GCWW expects that the upcoming provision of the Stage 2 DBPR will pose additional simultaneous compliance problems. The calculation of compliance with DBP limits using a location running annual average (LRAA) at the worst location in the distribution system is a de facto more stringent standard (compared to the past trihalomethane compliance method of using a running annual average from multiple locations). For many areas, the greatest impact will be felt by wholesale users because of the longer times that the water takes to travel to consumers. In systems that sell water to wholesale customers there is the danger of providing them water that will not meet the trihalomethane or haloacetic acid requirements of 80 ug/l and 60 ug/l respectively. Willingness to sell water to consecutive systems may be curtailed. At GCWW we evaluated the difference between the new sample location running annual average compliance requirement and the old running annual average compliance requirement calculations. One full year of results showed that the location running average would cause our compliance concentration to rise from the current level of about 20 ug/l to a level of about 45ug/l. Although the relative differences between the concentrations that were reported under the running annual average method as compared to the new location running annual average may vary depending on site specific conditions, the compliance numbers will surely be higher. That may mean that more systems may fail the DBP regulation and also may place severe limits on which systems a wholesaler can sell water to.

GCWW profiled lead in the water from customers' taps over time following full and partial lead service branch replacement. Lead service branches that were not replaced were also monitored at homes in the same manner for an added comparison. Since there were only 5 or 6 lead service branches for each of the three conditions used in this study, this was not a statistically significant sampling. However, it did serve the purpose of aiding GCWW in developing a policy on how to deal with lead service branch replacement. The data from this study along with previous studies on lead presented GCWW with a source of data to use when trying to determine the best course of action for our system.

During partial lead service branch replacement, GCWW used methods, such as use of a cutting tool rather than a hack saw, to cut lines to minimize the disruption of scale from the surface of lead, which leads to lead-containing particles in tap water. The results were mixed. Initial lead levels increased immediately after partial replacement. In addition, longer term lead levels remained relatively high with partial branch replacement. After a year, the lead levels were the same in the partial replacement homes and the homes where no lead branch removal work was performed. Thus, partial replacement of lead service branches provided no benefit to lower lead values when compared to the service branches where no work was performed.

Locations with full lead service branch replacement showed lower lead levels than the other two test conditions. However, even with full lead branch replacement, it took some time for lead levels to decrease and levels were still present at the end of the study. The study lasted a little over one year. Although the data collected was very useful in Cincinnati, partial lead service branch replacements needs to be further evaluated at other locations. GCWW now has a policy of doing partial replacements only if there is another reason to do so.

A question was also raised from the first flush data related to the contribution of the household faucets and the rest of the home plumbing. It is generally believed that a one liter, first flush sample will measure what has been dormant within the home plumbing. Our experience is that it normally takes 2 to 4 liters to obtain a service branch sample. If so, we need to know what the relative contribution of the household plumbing is to the concentrations reported as first flush samples. Likewise, the relative contribution of the service branch to the first flush sample concentration as well as to any specialized samples needs to be determined.

GCWW practice is to try to encourage our customers to replace their portion of the service branch when we replace ours. We offer that if the customer will replace their portion, we will coordinate and replace our portion at the same time. We estimate that it is \$2,000 to \$3,000 for them to do their portion. We get almost zero participation in this offer. We were unsuccessful in attempting to secure loan money to assist in this effort. If we really want to improve the number of full service lead service branch replacements there needs to be other incentives offered to homeowners. We have continued to provide public education.

In preparation for this meeting, GCWW performed a quick review of our past research regarding lead and have distributed a brief summary of the work that we have done. Also, GCWW has distributed the results of a half hour brainstorming session that shows some of the simultaneous compliance issues we have experienced as well as some that others may experience. In the handout, GCWW experiences are in bold type.

Madison, WI also completed lead service line replacements. In this case, the higher lead levels were particulate lead. Dissolved lead levels were about 5 ppb. The particulates flushed out over time, about 3-8 years.

Case Study #3: East Bay MUD Presented by Ron Hunsinger

The final case study was presented by Ron Hunsinger of East Bay MUD (EBMUD), a utility serving a population of 1.3 million in the San Francisco Bay area. EBMUD has high quality source water coming from snow melt in the Sierras with very low TOC and local reservoirs with moderate quality water. The distribution system, however, is complex and covers 325 square miles with no booster chlorination. The corrosion control strategy involves feeding lime at all plants to maintain a pH of 8.7 at the plant, 8.5 in the distribution systems.

The system has a lead reduction strategy that changed all known lead service line connections by 1995. Meters and connection fittings are lead free. In 1998 the system switched to chloramines. Red water problems were anticipated because of unlined cast iron pipes, but no red water problems occurred. The system did detect the DBP NDMA, but it is not known if this was connected to the switch to chloramines. There has been nitrification in 10% of the distribution system reservoirs, which has been controlled through flushing, mixing, optimizing pumping schedules, and washing tanks with chlorine. They do not anticipate switching to free chlorine.

Maintaining simultaneous compliance is difficult with a dynamic system. To meet SWTR and TCR goals, at first additional chlorine was used, with higher DBPs. These high levels of free chlorine resulted in an aesthetic deterioration in water quality. Hence the switch to chloramines. NDMA has now been detected and there are potential impacts whenever chloraminated water is discharged to the environment. Nitrification may cause TCR violations in future. EBMUD has not seen changes in metal release with chloramination. They have seen no impact on carrying capacity or scaling. EBMUD is facing large potential costs to clean up MTBE. NDMA and other emerging contaminants may become an issue. CA has a low lead fittings program. SF has a program that gives a \$10 rebate for lead free faucets. The new 0.2% lead brass fittings are easy to work with and have not caused problems.

At this point, the Scott Summers informed the panel that Marc Edwards had requested time to give a presentation. The panel was given the option of hearing the presentation and the other panel members were asked if they also had a presentation. The panel agreed to hear the Edwards presentation and none of the other panel members had a presentation.

Presentation on Chemistry of Chlorine and Chloramines

Marc Edwards, of Virginia Tech, next gave a presentation to review new information on the chemistry involving metals and chlorine/chloramines. In short, Dr. Edwards reported that chlorine can inhibit copper and lead leaching. In some cases, when chlorine is dosed to “blue water” caused from high concentrations of copper, the blue water suddenly disappears. This has always been presumed to be evidence that microbes were the cause; however, recent tests have revealed a direct abiotic reaction between chlorine and blue $\text{Cu}(\text{OH})_2$ scale that can instantly convert the solid into brown tenorite. Though the causes for this are not understood, it is clearly a chemical reaction that occurs without microbial involvement. Dr. Edwards and other researchers have also recently shown that the effect of chlorine on lead is similar, although not quite as rapid. Chloramine does not cause the same transformation of lead to less soluble red-brown solids as did chlorine. Samples were passed around that illustrated that chlorine dramatically reduced lead solubility even at pH 5.5, whereas in the presence of chloramines lead remained completely soluble.

In addition, Dr. Edwards reported that his research shows that chloramine can attack brass fittings, and in the worst cases can cause an order of magnitude increase in leaching from brass. But in some waters no difference was observed and different types of brass respond even qualitatively differently to chloramines than other types.

After numerous tests, a recipe of aggressive water was found that caused pitting corrosion and resulting in pinholes leaks in copper piping. The recipe that is believed to reproduce one type of pitting observed in practice has a pH about 9.0, relatively high disinfectant residuals, and aluminum in the water. The higher pH and aluminum in water were once believed to protect pipe from corrosion, and they have now been shown to increase the likelihood of pitting.

Dr. Edwards also discussed the NSF testing methods for inline devices (NSF 61). The test uses a test water that has been discovered to be much less aggressive than typical tap water (because it includes orthophosphate as a buffer). As a result, even small pure lead devices can pass the leaching part of the test. Dr. Edwards argued that we have little assurance these devices will not leach excessive lead to drinking water in practice and that a much more rigorous standard is needed.

Open Floor Discussion

The facilitator then opened the floor to comments from the non-panel meeting observers. Kevin Dickson of Black & Veatch, based on experience with NJ AMWATER, offered the opinion that systems will have issues with simultaneous compliance and the Stage 1 DBPR. Some measures, such as flushing programs, distribution system maintenance, and replacing plumbing fixtures within households, can be effective. Kevin Dickson advised that the validity of monitoring results for the LCR can be questionable when samples are collected by customers. For example, it is not possible to confirm that the required 6 to 8 hours stagnation period occurred before the sample was taken. Mr. Dickson offered the opinion that, in light of the well known and frightening health effects associated with lead, spending dollars on perceived risk of DBPs instead of the known risk of lead may not be appropriate.

Issues

The facilitator next solicited specific comments from the panel. Attachment B contains the list of comments. The comments were then sorted by into four issue groups for further discussion.

- Disinfectant conversion
- Coagulation changes
- Inhibitor issues
- Distribution System and home plumbing issues

Some comments were outside of the scope of this meeting and were deferred for future consideration. Some cross-cutting issues were be considered for all of the issue groups, including the following:

- Effects on lead
- Effects on copper
- Small systems
- Consecutive systems
- Information gaps

- Guidance
- Rule review
- Matrix of consequences

The panel was broken up into four workgroups, with workgroup discussing one issue.

Reports from Issue Breakout Groups

After discussing and considering the issues, each panel group summarized their topic for the full panel.

Coagulation Impacts on Corrosion Control

- The purpose of the coagulation process is to reduce NOM.
- Coagulation reduces the amount of NOM, but can also change the composition of the remaining NOM. Coagulation can also effect inorganics and polymer residuals.
- These in turn can have impacts on corrosion, resulting in economic, health, environmental consequences (both positive and negative).
- The impacts of coagulation on inorganics (including aluminum, iron, pH, alkalinity, and chlorine) include changes in ion ratio, complexes-scales, and precipitation.
- The impacts of coagulation on NOM include changes in residual stability, DBPs, colloidal mobilization, complexes-scales, and sorption.
- The impacts of coagulation on polymer residuals are less well known and could include changes in NDMA and complexes-scales.
- Issues associated with lead impacts include the following.
- Information Gaps: understanding the impacts of seasonal variations, source changes, and upstream processes
- Guidance: existing guidance on simultaneous compliance specifically with regards to coagulation needs enhancement. Guidance could be improved by adding consequence matrix, decision trees, and a host of case studies to help avoid conflicts. Guidance should also be small system friendly
- States and other agencies should be involved in developing guidance.
- Consider re-organizing the guidance to be a mirror image: instead of primary guidance look at LCR and reverse, secondary instead of primary rule.
- Regulatory: The rule could be revised to clarify whether changes to coagulant and coagulant practices trigger state notification.
- As an alternative to revising the rule, EPA and States could develop rules of thumb on what constitutes a significant change and what constitutes a non-significant change. A non-significant change would not require review. A significant change might trigger additional monitoring, testing, or desktop analysis.
- Copper issues are similar to lead issues.
- Information Gaps: understanding pitting corrosion, chloride, and sulfates, as well as the human health effects of copper.
- The rule could be revised to consider impacts on receiving water and limitations for residuals handling.

- There is a need to investigate coagulation's role in pitting. Iron corrosion may interact with downstream materials and form iron particles. Iron particles may increase particulate deposition and the growth of biofilms.
- Small systems have basically the same problems. There is not a lot of research funding so that efforts should be focused on developing concise predictive guidance.
- The Rules could be clarified with respect to timelines and administrative orders, etc. There is also a need for better prioritization among the rules.
- The existing tools that can be used to ease the burden on small systems (such as administrative orders, variances, and exemptions) are difficult to use and time consuming. There is a need to streamline these processes/tools.
- Consecutive systems pose a particular problem because they have minimum control on coagulant treatment process, but they are still subject to the effects, perhaps magnified, in pH, disinfectant residual, uptake, and sediments.
- There is a need for guidance for just consecutive systems to consolidate information in a manual or training. The role of distribution system management, including flushing, should be explained.
- The provisions for consecutive systems must balance the risks, while still encouraging regionalization.
- Some panel members are concerned about the impacts of pH changes on concrete (aluminum). Also, iron pipe may release iron downstream into plastic pipes.
- To promote regionalization, EPA or agencies should allow flexibility for consecutive systems to prioritize rules. The difficulty is deciding which rule should be flexible and whether the flexibility should be shown with the retailer or consecutive system. There is no easy answer.
- More information is needed on the impacts of metal salt coagulants on soluble aluminum, solids, nature of coagulants, and biofilm formation.
- Research gaps include speciation of left over organic matter (what organic matter gets through is important), scales, biofilm, and the nature of NOM post- coagulation (not just TOC).

Impacts of Disinfectant Changes on Corrosion Control

- The changes in primary disinfection that are expected from upcoming rules including the change from chlorine to ozone, chloramines, or uv. Groundwater systems may also be changing from no disinfectant to chlorine, ozone, chloramines, or uv. Secondary disinfectant may change from chlorine to chloramines.
- These changes will be necessary to reduce DBPs and maintain persistent residuals.
- The key issue for these changes with respect to lead is that there is not enough understanding of basic chemical interactions, including the redox chemistry and nitrogen chemistry, particularly with respect to variables such as pH and NOM.
- Copper pitting raises the same questions.
- Guidance for small systems needs to be clear and concise. These are more complex technologies than free chlorine and operators must be equipped to look for nitrification,

and other issues. These issues should be included in operator training or licensing. Is the disinfectant residual a good enough indicator of distribution system problems?

- An appropriate treatment option should be defined for small systems.
- The rules should harmonize how consecutive systems are defined and treated. The effects for consecutive systems are different for small and large systems.
- Information Gaps: understanding change in redox chemistry; nitrification; N-chemistry; creation of new DBPs; corrosion scale transformation rates; and impacts on different materials.
- Guidance should be developed for optimization/re-optimization that explains what to do or look for before, during, and after changes in corrosion treatment. A matrix of possible consequences would be useful.
- EPA should define a “list” that would be followed nationally as to what constitutes a significant change under the LCR.
- An interim step should be added in the implementation timeline for Stage 2 to assess the impact of changing to chloramines on chemistry or infrastructure. There is a concern with going ahead with the rule when the potential impacts are not fully understood. The use of chloramines is expected to increase significantly. This change may have unanticipated consequences. However, many systems have converted to chloramines for Stage 1 without developing lead or copper problems.
- There is a need to understand fundamentals before we can predict problems. For example, what is impact on older pipes over time? Also, localized pH changes could be important, when copper is connected to lead, or when waters are mixed, localized pH changes are critical.

Corrosion Inhibitor

- The LCR has been in effect for a decade. We should summarize and evaluate what we have learned in that time, including constraints and experience using ortho and poly phosphates.
- Lead and copper should be analyzed separately.
- Revised guidance is needed, particularly for small systems, including compatibility with existing practices, materials, and sources. Additional money is needed for training and technical support.
- The challenge for consecutive systems is maintaining residual throughout the distribution system. Systems need to work together to look at inhibitors, and to maintain residuals under different materials and different set of conditions in parts of distribution systems.
- Information gaps include understanding the role of zinc in corrosion inhibition: effectiveness, data, and site specifics.
- Information on the processes for reduction in doses and evaluation of alternatives is also needed. How long should pipe studies be, what different metals or different water qualities should be studied? How long to reach steady state?
- With respect to phosphates, what is the impact on biofilms, regrowth, and the environment?

- A separate matrix of consequences for each technology or technology change would be useful. Topics could include the use of ozone; chlorine to chloramines; process control and monitoring; interactions; and impact on large customers.
- Guidance focused on the needs of small and consecutive systems would be useful.
- There needs to be a more continuous revision structure.
- Guidance on the sequence of decisions that will indicate the least cost alternatives to minimize lead is needed.
- With respect to potential changes to the current LCR, the rule currently specifies the use of a treatment technique. This limits the ability to tailor options for local situations. For example, it may be advantageous in some systems to go directly to replacement of lead service lines.
- Optimization should look across all treatment goals.
- With regards to the impact of phosphates on waste water, if a WWTP is already doing nutrient removal, the additional phosphate will probably not be a problem. If the WWTP is not doing nutrient removal, the additional phosphate could trip the need to do removal.
- We need to understand more about galvanically driven corrosion.
- Guidance could be provided on methodological issue of pipe studies, such as the age and configuration, for different types of pipes.
- We need to do a better job of collecting existing information. (Know what we know.) Behind the scenes, utilities have knowledge. We need to figure out how to extract this information and then use it to prioritize. Also, there are reports that could be pulled together and summarized. It may be hard, however, to use case histories to tease out specific impacts because of the lack of control.
- We still need to act in the face of data gaps. We will not have complete understanding by the next rule. We may need to focus on the most important issues. We may not know all nuances, but research can help point us in the right direction.
- Developing a clearinghouse with existing information and experience was suggested. Information is not synthesized well. There is a danger of drawing inappropriate conclusions. If we don't really understand a situation, we could have false sense of security because we don't know nuances.
- Guidance on the formulations of commercial products would be useful. Some manufacturers consider the formulations proprietary. Guidance should include procurement strategies that differentiate products, place future in hands of chemical suppliers.
- We also need to evaluate the synergistic, positive side effects of using corrosion inhibitors.
- Guidance on simultaneous compliance should be technology based, cross cutting at least two dimensions.

Distribution System Management

- Although the long term solution should be to remove all lead service lines, there are many instances in which it seems that the lead service lines are not contributing to undue lead exposure as long as water quality conditions remain the same.

- Can passivation permanently control corrosion? There is a need to define systems and chemistry where passivation does the job.
- Should the goal be no lead service lines?
- Information Gap: More research is needed on galvanic corrosion, particularly on leaded brasses and solders. What is the basic chemistry? How does galvanic corrosion act under real world situations?
- Research into online monitoring may allow the assessment of water quality changes. For example, there could be a simultaneous compliance benefit for online particle counting, TCR, corrosion, and particle release.
- Distribution system best management practices could describe the appropriate use of flushing as a distribution system management tool.
- What is the role of POU devices? What are the best practices for installation, maintenance, and public education? What is the utility's continuing responsibility? POU devices could also help with the compliance with other rules, such as arsenic.
- Plumbing codes need to be changed to provide true "lead free" fixtures, when needed. Also, are there incentives (such as loans or rebates) that can be offered to homeowners to change fixtures?
- There is a need for guidance manual to encourage homeowners to change out their portion of the lead line.
- AWWARF has conducted research on the long term performance of lead free fixtures. Each situation has new water chemistry, but the institutional knowledge may still be relevant.
- Materials specification is very important, especially for small systems. For example, avoid copper pipe in certain waters. Galvanized pipe can be appropriate
- Materials specifications and codes need to be encouraged in a regulatory framework. These are not easy to implement at a local level.
- NSF 61 is not very good at evaluating the performance of lead free fixtures.
- Research needs to be done on the chemistry of lead facing. Also, are there different processes that could make lead less leachable?
- Encouraging public education is important.
- What is the impact of home water softeners? We need more information on interactions and what happens if the equipment is not operating properly. There may be some data available.
- Since water cannot be made noncorrosive, strategies that encourage homeowners to replace lead lines and fixtures could be effective. For example, HUD or the VA could set lead service line standards in homes.
- Schools are a special case because of pipe age and water quality. The schools guidance is old and not definitive. Schools are a special case, and the school regulations need to be updated.

Eric Burneson of EPA concluded the workshop by once again thanking the panel for their participation. A draft summary of the workshop will be circulated to the panel for comments. The summary will then be made available to the public. EPA will continue to gather information on lead and copper issues, such as an assessment of compliance and detailed evaluations of systems that have had success in reducing lead levels. Future workshops are planned on such

issues as lead service line replacement, health effects, and public education requirements. In the longer term, EPA will make a determination if there are national problems with compliance or the rule itself, depending on information collected. EPA will also consider to what extent national problems should be addressed through modifications to guidance, training, regulations, research, NSF committees, or other means.

**Attachment A
Panel Participants**

USEPA Lead and Copper Rule Simultaneous Compliance Workshop Panel List St. Louis, MO; May 11-12		
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Attachment B
Issues Identified by the Simultaneous Compliance Panel

- Health impacts of lead service line replacement
- Treatment change/new sources, small system
- Copper pitting – biostability, ozone, chloramines
- Guidance on chloramines changes and nitrification
- LT2 and Stage 2 technologies – guidance on corrosion control to guide treatment changes
- Matrix of risk-health effects tradeoff vs treatment
- Operator training (pH control, inhibitor addition)
- Coagulant chemistry and compliance with DBPR and impact on lead/copper
- Protection of homeowner plumbing
- Goals of lead free system in 20 years
- Interaction of DBP/TCR/LCR
- Streamlining corrosion control change approval
- Definition of “lead free”
- Compliance with other standards in addition to lead
- Impact of quality, workmanship and materials
- Re-evaluate phosphorus as nutrient
- Simultaneous clearinghouse for simultaneous compliance
- Impact of simultaneous compliance on waste water
- More research into chemical addition options
- Consecutive system pH control
- Health effects/prioritization
- Getting the lead out – lead service line replacement
- Relative importance – health effects exposure and other data
- Reliable predictive method to monitor corrosion
- Health effects for copper – detach copper from lead rule
- Lead service line replacement efficacy
- Significance of minor sources of lead
- Cost benefit
- Fill knowledge gap regarding effects of ozone and chlorine, chloramines, and oxidants
- Address consecutive systems – all issues
- Investigate CT table accuracy and precision
- Involve states and small systems in development of guidance
- Role of NOM in corrosion
- User model to predict simultaneous compliance (treatment technologies)
- Address data gap of pitting
- Wastewater treatment and other phosphate discharge
- Time and prioritization of research before rules
- What will we replace lead with
- Consecutive systems – LCR and other rules deterrent to expansion
- Role for POU? Better guidance
- All water unique – site specific guidance

- Best practice manual for customer plumbing
- Re-equilibration phenomena
- Stage 2b and impact of chloramines on economics
- Matrix of consequences
- Phosphate chemistry data gaps
- Chlorine as corrosion inhibitor
- Separation of lead and copper
- Flushing data gaps
- Guidance and training for infrastructure design and operations
- Predictive value of corrosion assessment tools
- Coagulation aids impact on corrosion
- Chloramination optimization monitoring and control
- Chloramination and biofilm regrowth
- Alternative financing
- Iron vs. lead corrosion
- Seasonal/daily water quality variability
- Means to go back to free chlorine optimization
- Catalogue of large utility experience with simultaneous compliance
- Calcium carbonate deposition control
- Alternative/intermittent source protocol
- On-line monitoring tools