NSF Reviews of Studies on PEX

PEX tubing has been one of the most commonly used materials for residential plumbing in the USA and Canada since the 1990's. All of the model plumbing codes in the USA and the National Plumbing Code of Canada require PEX plumbing products to be tested and certified to a variety of product standards including NSF/ANSI 61: Drinking Water System Components- Health Effects. For more: http://www.nsf.org/newsroom_pdf/overview_nsf_ansi_61.pdf

NSF/ANSI 61 contains a test procedure for evaluating the concentration of any chemical contaminant that a material may contribute to drinking water. It also requires a toxicological assessment of the daily dose of that contaminant which a person may safely consume where no adverse health effects would occur. Only products that are tested and shown to meet this stringent standard are allowed to bear the "NSF-61" or "NSF-pw" mark for potable water safety. For more on NSF/ANSI 61 and PEX: http://www.nsf.org/newsroom_pdf/water_PEX_fact_sheet.pdf

Dr. Andrew J. Whelton of Purdue University has published several papers on studies that he and his students have conducted on the leaching of chemical contaminants from cross-linked polyethylene (PEX) tubing used in domestic plumbing systems. NSF welcomes research into this area, but believes the conclusions and data in some of Whelton's studies have been misunderstood and have contributed to misinformation and confusion about these products.

NSF Review of *"Release of drinking water contaminants and odor impacts caused by green building cross-linked polyethylene (PEX) plumbing systems"* as published in IWA Water Research 67 (2014) 19-32. Authors: Keven M. Kelley, Alexandra C. Stenson, Rajarashi Dey, Andrew J. Whelton.

This study presented field and lab studies on leaching of chemicals from PEX as well as taste and odor testing. NSF identified several limitations with this study including:

- Non-standard methods of testing pipe were utilized.
- Test samples were exposed to conditions that do not reflect any real life conditions.
- Quantification of chemical extractants were not reported.
- Assessment of potential health effects attributable to reported chemical extractants was not performed.
- Controls or reference materials when measuring the loss of chlorine residue were not reported.
- A US EPA taste and odor method was used in a manner for which it was never intended.
- The source water control was not analyzed for samples taken in a building.

The laboratory extraction testing performed in this study consisted of successive 72 hour exposures. These do not provide a reasonable representation of typical water usage needed to establish potential consumer consumption. While a 72 hour exposure may represent water in a building that has been

unoccupied for a weekend, it is unrealistic and inappropriate to assume that all drinking water that is consumed is always stagnant in a pipe for 72 hours prior to consumption.

NSF/ANSI 61 requires exposures to be conducted on piping products for 17 days. This includes two 72 hour weekend stagnation periods. Water that is analyzed for contaminants is collected after a 16 hour overnight stagnation period on day 17. The concentration of contaminants in this sample are compared to acceptable levels established based on a lifetime of daily exposure.

The study identified several chemical contaminants leaching from PEX products. Many of these have been detected by NSF labs in the past using the NSF/ANSI 61 protocol. However the findings in this study did not include the quantification of chemical contaminant concentrations. No conclusions about the public health safety of the products can be determined without quantifying the results and comparing these to the safe thresholds established for these chemicals based on a lifetime of daily exposure.

NSF Review of *"PEX and PP Water Pipes: Assimilable Carbon, Chemicals, and Odors"* as published in Journal of the American Water Works Association (JAWWA) April 2016. Authors: Matthew Connell, Alexandra Stenson, Lauren Weinrich, Mark LeChevallier, Shelby L. Boyd, Raaj R. Ghosal, Rajarshi Dey, Andrew J. Whelton.

The April 2016 hard copy edition of the JAWWA contained a summary of a study conducted on PEX tubing, where the complete study was found on the AWWA website. We found the expanded summary of ***PEX and PP Water Pipes: Assimilable Carbon, Chemicals, and Odors, (Whelton et al)*** that was published in the April 2016 Journal to be rather misleading when compared to the content of the complete manuscript that appeared on the AWWA website.

The paper contains some pretty strong allegations including: "… Certified products are causing homeowners to refuse to use their drinking water out of safety concerns…."

The summary states that data showed PEX pipes were the source of drinking water odor, yet the full paper reports that two of three systems tested in the field exhibited Threshold Odor Numbers (TON) that were : "… not statistically different from TON values of the tap water before it entered the PEX system…."

A third system that caused a detectable odor may be cause for further investigation, however it is not stated whether there were other products in the plumbing system of this house that could be causing the odor issue. Also there is no indication that this specific PEX product had undergone any controlled lab testing to see why it varied from the other two systems. In any case it seems a reach that this one

instance of odor problems warrants the statement that these products are causing homeowners to stop using tap water.

The results and discussion in the full paper reported (on page 13-14) that "…toluene, total xylenes and ETBE were the only contaminants that were detected that were listed on the NSFI Standard 61 screening protocol…." It is important to note that at the time of this publication more than 1600 chemical contaminants were listed in NSF/ANSI 61. Also the full paper goes on to say that: "…These contaminants were present at an order of magnitude lower concentration than their NSFI Standard 61 allowable limits…" Meaning that they are not an issue for human health at the levels detected. However this important fact was not included in the summary that appeared in the JAWWA print edition.

The water contaminant results were based on exposure studies that consisted of 10 sequential 72 hour stagnation periods. While one 72 hour stagnation period might represent a long weekend of inactivity in a plumbing system, it is unrealistic to assume that consumers would be exposed to water on a daily basis that had stagnated for 3 days. The fact that contaminant levels were magnitudes below the NSF/ANSI 61 safe thresholds even after 10 x 72 hour exposure periods make chemical leaching concerns even more insignificant.

NSF Review of *"Metal Accumulation in Representative Plastic Drinking Water Plumbing Systems"* as published in Journal of the American Water Works Association (JAWWA) November 2017. Authors: Maryam Salehi, Xianzhen Li, Andrew J. Whelton.

This study concluded that metal contaminants contributed from service lines or brass fixtures in a plumbing system can deposit and collect on PEX tubing. However, one of the big draw backs of this paper is that it doesn't establish any relevance of the information presented for water utilities. It's not surprising that some scale is seen on the interior wall of <u>any</u> pipe if for no other reason than water utilities purposefully add chemicals to the water that promote scaling to control for metal release from the metallic materials in the plumbing system.

To understand the relevance of this work, the authors should have contrasted their findings on plastic pipes with scale finding of other materials. Is the Plastics scaling more, less, or on par with other materials? If it's less or on par with other plumbing material types, what's the value in reporting on plastics versus the potential issues with other material types?

Another drawback of the paper is that is that it doesn't do a sufficient job of characterizing of what captured by the reporting of total metal on the interior surfaces. Are the g/m3 reporting's limited to particular deposit areas of the pipe or is it an estimation of the total loading of metals in the entire system.

The issue of metal accumulation on non-metallic materials does underscore the difficulty investigators can have in trying to identify the lead contributing products in old plumbing systems. If lead bearing scale is uniformly distributed over old galvanized pipe, high leaded brass parts as well as non-lead bearing products such as plastic pipe, the analyses of sequential water samples drawn from the tap may not readily identify the actual source of lead.

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