

#5

**LITERATURE SEARCH CONCERNING ON THE USE OF PEX
AS POTABLE WATER PIPE
(November 2003)**

Various suggested contamination issues and mass-product failures were raised to the Department by Mr. Thomas Reid, a consultant for the California Pipe Trades Council on the use of Cross-linked Polyethylene (PEX) potable water tubing. Mr. Reid did not provide the Department with any supporting documentation or citations to scientific health base studies to support the suggested contamination issues and mass-product failures. The Department has performed a follow-up literature search for the existence of any scientific studies or reports supporting the suggested contamination issues and mass-product failures on the use of PEX potable water tubing. The following is a summary of the finding following this literature search.

A. MECHANICAL FAILURES USING THE PRODUCT PEX

1. PEX is not a similar plastic as PB as suggested by Thomas Reid.

The literature shows that the chemical composition between PB and PEX is quite different and the two materials cannot be assumed to be the same. PB is a semicrystalline thermoplastic formed by polymerization of 1-butene, PEX, is a family of thermoplastic resins obtained by polymerizing ethylene.

2. PEX is not subject to attack by chlorine in water as suggested by Thomas Reid.

The literature indicates that PEX piping is not subject to attack by chlorine, because the pipe has been certified to resist attack by chlorine used as oxidizers in the water supply.

3. PEX law suit 19 units of a 57 unit Condominium in Seattle.

The California Pipe Trades Union suggested that a class action lawsuit exists against the makers of PEX used for massive failures of hydronic (in-floor) heating systems in Seattle.¹ A February 2003 statement by the law firm representing PEX manufacture was that there was no class-action lawsuit. A February 2003 Plasco Manufacturing letter stated that evidence suggest that their PEX tubing was not properly handled and installed and there was not a product problem. A November 2003 email from the law firm for the plaintiffs stated that the suit settled and the record establish that the defendants essentially admitted the tube was defective. Mr. Casey also stated "The class action is or rather was in a bit of a holding pattern until conclusion of my litigation." According to a copy of the complaint HCD has, only 19 of the 57 units experience water damage do to the PEX.

The literature shows that copper tubing was once extensive used for radiant floors, but its tendency to expand and contract cause premature failure and is no

¹ Blueberry HOA v. Plasco MFG, et al, Kings County Superior court, Cause No. 01-2-35783-2 KNT.

longer used.² Nearly all floor-heating systems installed in North America (over two billion feet of PEX) are made from PEX and PEX-AL-PEX.

The literature does not supported the existence of wide spread mechanical failures of PEX radiant heating pipe. With billions of feet of PEX installed in North America since 1977 and no reports of wide spread failures, common sense supports that the PEX piping failure within 19 units of the 57 unit condominium complex at Blueberry Place appears to be due to handling and installation of the PEX and not an inherent structural problem with the product itself.

B. POTENTIAL ADVERSE HEALTH ISSUES USING PEX POTABLE WATER PIPE.

1. PEX was not a subject of the Department's 1998 EIR for CPVC as suggested by Thomas Reid.

A review of the Department 1999 EIR for CPVC indicates that PEX was not part of the analysis of these documents and that much of the document was centered on issues related to glues and solvents (not applicable to mechanical fittings for PEX piping).

2. PEX literature does not support Mr. Reid's suggestion that the additives used in the formation of PEX and CPVC are similar, and in fact there appears to be very little additives used during the formation of PEX.³

3. PEX installation does not have same worker safety issues as CPVC as suggested by Thomas Reid.

A literature search finds that unlike CPVC installation that included solvents and glues for joining sections, PEX tubing is installed with mechanical fittings. The Department has not found any literature suggesting issues of worker safety or other health hazards associated with exposures similar to other permeable water pipes: (1) glues and solvents required to install CPVC and other approved plastic pipe materials, or (2) with fumes generated from the soldered connections for copper pipe installation.

4. PEX meets U.S. EPA, Health Canada, California Department of Health Services, and NSF's International peer-review drinking water criteria. If HCD were to have a health base study performed for PEX, the most extensive and best scientific review process would be through the US EPA and CA Department of Health Services approved NSF/ANSI 61 standard for "Drinking Water System Components-Health Effects."

The U.S. EPA contracted with a consortium of organizations to develop a consensus standard to replace existing U.S. EPA Additives Advisory Program for

² John Siegenthaler, P.E., author of *Modern Hydronic Heating* (Delmar Publishers, 1995), a consulting engineer and associate professor of engineering technology at Mohawk Valley Community college in Utica NY.

³ See CIBA Specialty Chemical Plastic Additives home page @ www.cibase.com/construction/and/pipes.

drinking water system components⁴. All standards approved through the NSF Joint Committee on Drinking Water Additives must obtain final approval through the NSF Council on Public Health Consultants.⁵ The NSF/ANSI 61 standard for "Drinking Water System Components-Health Effects" has insured that PEX for potable water systems have met the acceptable health based concentration limits of the U.S. EPA, Health Canada, California Department of Health Services, and NSF's International peer-review drinking water criteria. The water analysis methods requires the use of U.S. EPA methods when available⁶. When there is no EPA method available, NSF/ANSI 61 requires that the analysis be performed in accordance with "Standard Methods for the Examination of Water and Wastewater" which is published jointly by the American Public Health Association, AWWA and the Water Environmental Federation.

U.S. Department of Labor's OSHA recognizes NSF International under its National Recognized Testing Laboratory Program to enforce its programs.

All chemicals, contaminants or impurities in the product that come in contact with the water must be studied using U.S. EPA and CA Department of Health Services approved toxicological review and risk assessments.

For a PEX product to be eligible for Certification to NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects, contaminant concentrations must not exceed the total allowable concentrations set by the standard. The total allowable concentrations set by the standards consists of existing health based standards and concentrations of leached materials that result in acceptable toxicological levels and risk assessments results.

4. Leaching of material harmful to health from the use of PEX.

a. Thomas Reid stated that there is a lawsuit in Scottsdale, Arizona suggesting that PEX pipe has leached MTBE contamination into the water and poisoned the family in concentrations of 15, 17, and 22 PPB—which is 3-4 times the 5 ppb taste and odor threshold and near or above the 20 ppb action level. Also that WIRSBO Manufacturing has disclosed that PEX does have chemical leaching problems. Thomas Reid also stated that "Tests by NSF confirmed this problem" and found MTBE in the water flushed through the PEX plumbing.

b. WIRSBO Manufacturing responded to Reid statements on Sept 2003 that the complaint involved taste and odor and not poisoning. They also stated that the source of the complaints was never identified, but that published records from the City of Scottsdale regarding its water supply shows presents of MTBE in

⁴ The consortium consisted of NSF International, the American Water Works Association Research Foundation, the Association of State Drinking Water Administrators (CA Department of Health Services is a member), the Conference of State Health and Environmental Managers, and the American Water Works Association.

⁵ The Council is comprised exclusively of public health representatives and its membership includes representatives from the U.S. EPA, Health Canada, U.S. Public Health Services, the Food and Drug Administration, regional U.S. EPA Offices, various state agencies and local health departments.

⁶ 40 CFR Part 141 and Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020.

the wells serving Scottsdale. An independent lab certified that the drinking water meets all state and federal guidelines for safe drinking water.

c. NSF International responded to Reid statements on Sept. 2003 stating that the EPA's action level is based on taste and odor and is not a health based effect level. USEPA does not have a health based level for MTBE. He also stated that NSF/ANSI current health based level for MTBE is 50 ppb. And all PEX approved products are below this level.

d. No leachable product were found in two separate studies (using PEX piping) by Army Corps. of Engineers two studies Sampling Trace-Level Organics with Polymeric tubing Louise V. Parker and Thomas A. Ranney (October 1996)—Dynamic Studies January 1997. One purpose of these studies was to determine the best type of tubing to extract contaminated groundwater w/o the pipe leaching contaminants into the sampling water.

e. The Material Safety Data Sheet for polyethylene states that there are no established limits for health hazards. Polyethylene dust is just treated as a nuisance particulate.

5. Permeability of contaminants through PEX.

a. The same house discussed above in the City of Scottsdale complained of pesticide contamination.

C. KNOWN ADVERSE HEALTH AND ENVIRONMENTAL AFFECTS WILL BE CONTINUE FROM TOXIC COPPER LEACHING INTO DRINKING WATER FROM COPPER PIPE IF PEX IS NOT ADOPTING TO MITIGATE THESE KNOWN HEALTH PROBLEMS.

1. At the direction of Congress, U.S. EPA asked the National Research Council (NRC) to review independently the scientific and technical basis for U.S. EPA's health level for copper in drinking water. The Committee members were from the fields of toxicology, epidemiology, pathology, pharmacology, genetics, physiology, medicine, public health, exposure assessment, nutrition, chemistry, biostatistics, and risk assessment. The Committee reviewed available toxicological, epidemiological, and exposure data and made the following evaluations in their 2000 published report titled "Copper in Drinking Water," Committee on Copper in Drinking Water, Board of Environmental Studies and Toxicology, Commission on Life Sciences, National Research Council:

- a. The current health level established by U.S. EPA for copper is based on acute exposure to copper and is not suitable for establishing a MCLG (maximum contaminant level goal). A chronic exposure level is necessary for the MCLG.
- b. Metallic copper is basically unstable and subject to corrosion and leaching and therefore a mistake to consider copper metal or any of its alloys as impervious to environmental conditions.

- c. Several states (such as Nebraska and Delaware) have measured copper concentrations in drinking water from copper pipes that exceeds U.S. EPA MCLG levels.
 - d. The average absorption of copper by the body is controlled by the liver function and is 30% to 40% and is influenced by age and genetic background.
 - e. Chronic exposure to excess copper is liver toxicity and a number of chronic cases of liver toxicity have been reported.
 - f. In sensitive human populations, the majority target of chronic copper toxicity is the liver and neurological toxicity with those with Wilson disease.
 - g. The reproductive and development effects of excess copper is not well known other than small amounts of copper from intrauterine devices can prevent embryogenesis by blocking implantation and blastocyst development. The committee commended that copper exposure during the early postnatal period requires additional study to determine teratogenicity during pregnancy.
 - h. Infants fed formula with tap water are much more sensitive to elevated copper in water because they have a higher absorption rate and reduced capacity to excrete copper as those of an older age.
 - i. The liver and brain are targets of copper toxicity in patients with Wilson disease.
 - j. Evidence suggests that when the body ability to regulate copper is surpassed, a large amount of copper is released into the bloodstream damaging red blood cells and causing acute hemolytic anemia.
 - k. The committee concluded that increased in the ingestion of copper should be cautioned against until the hepatic susceptibility is clearly identified.
 - l. The Committee recommended that studies be conducted to characterize the potential role of genetics that underlie infant and childhood copper toxicosis.
 - m. The Committee recommended genetic animal models be used to determine the associations between liver toxicity and copper in sensitive population (Wilson Disease-2% of population).
 - n. The Committee recommended that epidemiological studies of population who have been chronically exposed to elevated copper should also be carried out to determine the nature and frequency of chronic effects, especially in sensitive populations.
 - o. Given the potential risk for liver toxicity in quantification of copper toxicity should be undertaken and the MCLG for copper be re-evaluated.
2. The National Academy of Science that excess digestion of copper in drinking water can cause nausea, diarrhea, vomiting, and

intestinal cramps. Severe cases of copper poisoning have led to anemia and to the disruption of liver and kidney functions. Individuals with Wilson's and Menke's disease) genetic disorders resulting in abnormal copper absorption and metabolism) are at a higher risk from copper exposure than the general public and can have serious health problems.

3. Dr Lewis Mehl-Madrona, M.D., Ph.D, Program Director, Center for Health and Healing, Beth Israel Hospital/Albert Einstein School of Medicine reported that environmental factors associated with ADHD from studies have found correlations between certain toxic agents such as copper and learning disabilities such as Attention-Deficit/Hyperactivity Disorder (ADHA)
4. Dr. William Walsh, Ph.D., Co-Founder and Senior Scientist for "The Health Institute and Pfeiffer Treatment Center" discussed the potential correlation for Autism Disorder and copper poisoning that could impair neuronal development, especially in the first 30 months of life, which could result in incomplete maturation of the G.I. track and brain.
5. Research is being carried out by Ashley Bush, Harvard Medical School and the University of Melbourne and the PRANA Biotech School Melbourne that studies the a link of copper accumulation in the brain that causes a buildup of hydrogen peroxide which induces amyloid plaques in the brain i.e., Alzheimer's disease.
6. In 1992 a 6 week old girl was diagnosed with methemoglobinemia induced by simultaneous exposures of copper at levels close to the federal drinking water standards. The study stated that drinking water that stands overnight in copper pipes may often contain copper levels that exceed federal drinking water standards and that the water should be flushed prior to drinking water that stands overnight in copper pipes according to the investigation by the Wisconsin Department of Health and Social Service's Division of Health.
7. Two Material Safety Data Sheet states that copper may cause anemia and other blood cell abnormalities and copper accumulates in various tissues and may result in liver, kidney, and brain damage. It has also been reported that copper poisoning has led to hemolytic anemia and accelerates arteriosclerosis.
8. U.S. EPA's "safewater" web site states that all water is corrosive toward copper to some degree, even water termed non-corrosive or water treated to make it less corrosive which corroborates the findings by the NRC study.
9. A 1975 AWWA Journal reported that corrosion of household copper plumbing contributed to the metal content of drinking water and was a major source of copper metal contamination in U.S. drinking water supplies.

10. February 1997, the Office of Drinking Water for the U.S. EPA Environmental Criteria and Assessment Office reported that a majority of copper present in drinking water appeared to come from copper pipes and they were unable to estimate the number of individuals who regularly consume water that exceed safe MCL (Maximum Contaminant Level) levels for copper.
11. The Agency for Toxic Substances and Disease Registry (ATSDR)⁷ created the "Public Health Statement for Copper" which states that you may be exposed to high levels of soluble copper in your drinking water, especially if your water is corrosive and you have copper plumbing and brass water fixtures. The average concentration of copper in tap water ranges from 20 to 75 parts copper per billion parts water (ppb). However, many households have copper concentrations of over 1,000 ppb (near the upper limit of U.S. EPA's Maximum Contaminant Level. That is more than 1 milligram per liter of water. This is because copper is picked up from copper pipes and brass faucets when the water sits in the pipes overnight. After the water is allowed to run for 15-30 seconds, the concentration of copper in the water decreases.
12. The Medical Toxicology Unit from Guy's and St. Thomas' Hospital stated that "Chronic poisoning with copper leads to gross hepatic copper overload with severe liver disease in young children. Indian childhood cirrhosis have reports of poisoning in young children as a result of high copper content in well water
12. Water softeners using ion exchange are likely to have increase copper contamination levels.
13. Washington State Department of Health stated that most copper in drinking water comes from household plumbing and that copper contamination can accumulate overnight and recommends that households flush their water before use for the first 30 to 45 seconds. Health studies have found that copper in drinking water can add 4 to 45 percent more copper to a person's diet than what is in food sources.
14. Known Copper pollution in the Town of Discovery Bay, in Danville, CA that has a California Regional Water Quality Control Board NPDES permit with a requirement for a Pollution Prevention Plan to remove copper from the water supply. The recommendation will be to replace the copper pipe for new homes with alternative plastic pipe.
15. A Copper Action Plan for the NPDES permit for Palo Alto whose receiving waters are the San Francisco Bay estimated in 2002 that corrosion accounts for 60% of the estimated copper sources.

⁷ ATSDR is an agency of the U.S. Department of Health and Human Services whose purpose is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and disease related to toxic substances.

16. An article published in a recent issue of the Wisconsin Medical Journal detailed two separate cases in Wisconsin reported that ingestion of copper-contaminated drinking water resulted in numerous reports of nausea, vomiting and abdominal discomfort because of new copper piping systems. Samples analyzed showed copper levels exceeding Federal MCL levels. In the following weeks, 251 families submitted first drawn water samples (after sitting overnight) and 48 had copper levels that exceeded federal limits. The homes were built in the past 10 years and had the highest copper levels in the water.