

don't let the plumber "just do it to code" or you'll be watching cold water run out of the hot water tap for a long time before you hop in that shower.

Gary has evolved greatly in the time since these articles were written and has gotten involved in the development of the Metlund D'mand recirculating hot water system (good) and Navien's demand water heater (not a fan). I warn people about the flow rate related pressure drop problem with the Navien water heaters which is an issue for those of us who build luxury green homes and is why many of us have chosen to stick with the Rinnai and Quietside condensing demand water heaters.

But mostly I think we've stepped past one of the most elegant solutions which is to have a central solar/ demand water heater solution with small under counter or closet located electric hot water tanks in the remote bath rooms that just receive hot water from the central water heater and keep it from cooling down for no wait usage in that bathroom. It's an in-expensive and effective solution. So long as you are able to provide the 1,500 watts those units draw from time to time to keep the water from cooling down.

Interesting anecdote about that though, I built a house a while back that was very spread out and the client called a year or so after moving in to say that the water heater wasn't getting hot water to the primary bath for some reason. I stopped by to check it out and discovered that the 110 volt water heater had been wired to a 220 breaker and had most likely burned up the element the first time it was used but, because it was constantly being refreshed with hot water so long as people were living there, it never got cold until they went on vacation and they lived there for a year without knowing the auxiliary water heater was broken and had fast hot water all that time. I fixed it, but my point is that it probably doesn't use much electricity if it works well when the breaker is popped ANSWERED BY MICHAEL CHANDLER, GBA ADVISOR Posted Wed, 02/17/2010 - 19:43

2. As with most building materials today, it's not easy to determine the Helpful? relative merits of copper and PEX for domestic water supply. There are Sign in to significant benefits and liabilities, including deleterious health impacts of both. The following is a summary of the issues. My best advice at this point is to use copper for chlorinated water supplies and PEX for private wells, particularly with acidic water, or with ionic water softeners.

Copper is a naturally-occurring mineral with associated mining impacts, but it's easily recyclable (and often contains a high recycled content), while cross-linked polyethylene is not.

Copper domestic water piping must be soldered with "lead-free" solder (no more than 0.2% lead) and fittings, except in CA and VT under new rules can contain up to 8% lead. Soldering flux is also toxic as well as corrosive to the copper. For this reason and because of galvanic and chemical reactions, copper is vulnerable to corrosion and pin-hole leaks. It is highly vulnerable to frost-breakage. Over time, copper pipes build up a layer of mineral deposits from hard water which constricts water flow and, along with internal burrs and irregularities, creates turbulence and noise. Water turbulence in pipes, often exacerbated by too-small diameter piping, causes increased dissolution of heavy metals such as lead and copper, particularly when water pH is less than 6.5 (acidic, as most water is today). Noise and water-hammer is exacerbated by rigid tubing, angular direction changes and high velocities due to narrow pipe.

Not only is dissolved lead a problem in domestic water systems, though largely mitigated since the lead ban in 1998, but dissolved copper has become increasingly recognized as a threat to both human health and the environment, limited by the EPA to 1.3 parts per million in domestic water supplies.

Copper dissolution occurs in new piping, and in piping carrying acidic water, soft water (low dissolved solids), or water with high dissolved oxygen. It is recommended that water sitting in copper supply pipes for more than 6 hours be flushed for 30 to 60 seconds before using for drinking or cooking, that hot water (more dissolved metal) never be used for drinking, cooking or (especially) baby formula

Cross-linked polyethylene (PEX) piping, on the other hand, is flexible, smoother, does not scale or corrode, is resistant to acids, and is relatively resistant to frostbreakage. Because it comes in long spools, it has far fewer fittings (usually just one at each end) to leak or cause turbulence, and requires no solder or torch fuels. Because it is far simpler to install, it can typically be done less expensively, even with the now-common "home run" system in which each hot and cold fixture

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gets supplied by a separate pipe, allowing the use of smaller-diameter tubing, eliminating the pressure-drop common in most homes and allowing a centrallylocated "switch panel" to isolate each fixture.

PEX has been used in Europe since the 60's and in the US since the 80's. It's made from a petrochemical plastic and, while it has 46% more embodied energy per pound than copper, because it is so much less dense (lighter) it has 85% less embodied energy per unit volume.

Copper smelting and production also creates environmental emissions which cause both human toxicity and environmental impacts. PEX has recently been approved, after an extensive Environmental Impact Study, by the plastic-phobic state of California for all water supply systems, concluding that it would be "an environmentally superior action with respect to public health and hazards, water quality and air quality." It is accepted by all North American plumbing codes. However, see the lawsuit below to overturn the California approval.

Copper ingestion is now associated with flu-like symptoms, kidney damage, Wilson's disease, learning deficiencies in adolescents, and Alzheimer's disease. It is not known whether it is carcinogenic.

Coalition of Environmental, Consumer, Public Health and Labor Organizations Have Filed Lawsuit to Overturn the Schwarzenegger Administration's Approval of PEX Pipe

On February 19, 2009, a coalition including: (1) the Consumer Federation of California; (2) Planning and Conservation League; (3) Center for Environmental Health; (4) Sierra Club California; (5) California Professional Firefighters; and (6) the California State Pipe Trades Council jointly filed a lawsuit to overturn the Commission's approval of PEX on the grounds that it was based upon a legally inadequate environmental impact report (EIR).

Potential Environmental, Health and Economic Risks Posed by PEX

Contamination of drinking water

The PEX EIR found that methyl tertiary-butyl ether (MTBE) and tert-Butyl alcohol can leach from PEX in amounts that exceed taste, odor and health guidelines set by the State of California for drinking water. The PEX EIR found that PEX pipes can initially leach as much as 290 ppb of MTBE. The California Department of Public Health and the California Office of Health Hazard Assessment have established a drinking water taste and odor standard of 5 ppb for MTBE and a drinking water public health goal and maximum contaminant level of 13 ppb.

The PEX EIR also found that PEX can leach ethyl tertiary butyl ether (ETBE), a chemical in the same family as MTBE, in amounts exceeding 100 ppb. An expert toxicologist report commissioned as part of the PEX EIR found that the leaching of ETBE from PEX pipe could contribute to taste and odor impacts, and could potentially lead to adverse health effects.

The PEX EIR found that PEX pipe is susceptible to permeation by outside contaminants such as pesticides, oil, gasoline, benzene and termiticides.

Numerous studies and articles submitted to the State of California comparing potable water pipe materials, including variants of PEX, polybutylene, polypropylene, CPVC, copper and steel, have found that PEX displayed the strongest biofilm formation and the strongest initial promotion of the growth of Legionella bacteria.

California's January 2009 approval of PEX relies upon the less-protective PEX chlorine resistance standard ASTM F2023, instead of the much superior NSF P171 standard. ASTM F2023 only assures an adjusted lifetime of 25 years, while the NSF P171 standard assures a 40 year adjusted lifetime. At least one reputable PEX manufacturer (Lubrizol Advanced Materials, Inc.) has questioned the adequacy of this standard since it only results in "an expected service life of 25 years, five years less than the traditional home loan."

Even short term exposure to sunlight can dramatically reduce the resistance of PEX to chlorine and result in premature rupture of the pipe. Studies show just a one-week exposure to sunlight may reduce the chlorine resistance lifetime of some PEX pipes by half; with a two week exposure completely depleting PEX of any chlorine resistance.

Lack of Recyclability

Because it is a thermoset plastic, PEX cannot be melted down and reused. A 2005 report by the San Francisco Department of the Environment found that PEX was the only type of plastic piping that no plastic recycler would accept. Copper pipe generally contains around 70% recycled material and has almost a 100% recycling rate.

Toxic Smoke

PEX produces toxic smoke when burned in building fires.

Testing and Certification

PEX-c is cross-linked in a cold process using electron beams rather than the heat and chemical based process for PEX-a or PEX-b, and is the cleanest of the three. PEX tubing meeting the health effects requirements of NSF/ANSI Standard 61 will bear either the NSF-61 mark or the NSF pw (potable water) mark on the print string. The NSF pw Mark indicates the product meets health requirements as well as performance, long term strength and quality control requirements.

Water exposed to PEX tubing and associated fitting systems are tested for the following contaminants as required by NSF/ANSI Standard 61: $\hfill \ensuremath{\square}$

VOCs (Volatile Organic Compounds)
Semi-volatile compounds

Phenolics

Regulated Metals including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, and thallium

🕅 Methanol

Tertiary butyl alcohol

MTBE (methyl tertiary butyl ether)

 ${\ensuremath{\mathbb H}}$ Any other potential contaminant identified during the formulation review.

These test methods are capable of detecting contaminants in water as low as 4 parts per billion.

ANSWERED BY RIVERSONG

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