

EPOXIES: DRINKING WATER APPLICATIONS

EPOXY RESIN COMMITTEE



Epoxy is a material with outstanding properties that is used in many important applications where for instance strength, chemical resistance, moisture protection and strong adhesion are key requirements.

They are being used in an increasing number of composite pipes and tanks as well as in coatings for traditional steel and concrete products. Thanks to their durability, processing flexibility, resistance to chlorine, microbes and other threats, epoxy resins represent a viable alternative for delivering drinking water.

During the post WWII times, the economy boomed and millions of new homes were built. With an expected life time of a water pipe of ca. 50-100 years, more and more of these pipes are suffering corrosion and subsequently are leaking or are releasing metal and other contaminants into the drinking water.¹

The first use of epoxy resins in drinking water applications was in the UK in the 1970s as the commonly used materials of cement mortar and bitumen linings had shown to be ineffective when used under aggressive waters². In addition to the problems arising due to water chemistry, the long times needed to repair pipes with these materials, and the unavailability of water during these periods of several days, also lead to the search for alternative materials.

A pipe liner or epoxy coating, applied in-situ without having to dig up the pipe from the ground or open walls to replace the pipe, is a time and cost saving alternative to previously used replacement of drinking water pipes.

In addition to the obvious benefits of time and cost, epoxy coatings inside an old pipe also stop pipes from leaking as well as contaminants getting into drinking water from the outside. This in return decreases future deterioration due to oxidation. Also, no galvanic corrosion due to the contact of two different metals can occur. Besides better water quality, also flow and pressure of the water are improved by the smooth surface provided by cured epoxy systems.

Corrosion

Factors like chemical composition, pH or temperature of water as well as delivery pressure are factors that can contribute to the corrosion of water pipes.

This corrosion can lead to leaching of metals, for instance lead or copper, or other substances from corroded pipes or the environment.

Relining creates a barrier between the pipe and the water, thereby preventing these negative interactions and also eliminating galvanic corrosion that results from the joining of dissimilar metals.

¹ Service line analysis of water main epoxy lining, Arun K. Deb, Jerry K. Snyder, John O. Hammell Jr, American Water Works Association Research Foundation (AWWARF) 2006.

² Ibid.

A classical material for this kind of relining is cement mortar. Unfortunately analysis has shown that many of these cement mortar linings have failed and cause deterioration in water quality³. Epoxy linings provide an excellent barrier against contamination, i.e. they prevent that substances from the pipe enter the water. The German UBA (Umwelt Bundesamt) states that pipes (any material) are supposed to have a life time of 50-100 years. The use of epoxy resins for pipe line coatings has only started in the 1970s. US field research has demonstrated that epoxy was a safe and durable material with an estimated life up to 60 years.⁴

Economy

As clean, safe drinking water is one of the world's most important and valued assets, billions are spent each year in order to repair the damage to water pipes that occurs due to corrosion over time.

Because pipes are buried within the walls and floors of a building, or in the case of exterior pipes, beneath streets and sidewalks, it can be less costly to re-line these already existing pipes than it is to tear them out, install new pipes and repair the damage done to their surrounding by this repairwork. Especially interrupting traffic in heavily populated areas leads to additional costs due to loss of work time and delayed deliveries. This can easily be avoided by using epoxy repair systems.

In addition, the smooth surface of polymeric linings result in a better flow capacity and thus lower energy cost for water transport.

Health

The releases of substances from corroded pipes sometimes can exceed the concentration limits set by the regulators but even if they do not exceed the legislative limits, they will likely affect the odor, taste and visual appearance of the water and thus render it unsuitable for consumption in the eyes of the consumer.

The smoother surface of epoxy linings also generally results in less ability for biofilm growth to occur.

Sometimes epoxy resins are reported in the press to release substances into drinking water. In the cases where these allegations could be verified, the reason for the poor performance was either improper installation of the product or an incorrect use of the epoxy system. Epoxy resins are a high performance, specialist material that should only be applied by experts who ensure that the polymer can function at its peak performance.

[Assessments](#) from the European Food Safety Authority concluded there is no health risk from current uses of BPA, including in food and other applications. Any regulatory action substituting epoxies with substances whose effects on human health and the environment have been subject to less research than epoxies would be driven by reasons other than scientific research and higher food and consumer safety.

What does a safety margin of 100 mean? To hold a Labrador Retriever with 30kg on your lap might feel quite heavy but if you reduce this weight by a safety factor of 100 you would have a 2 weeks old kitten on your knees.



³ Deb et al., 2006; Oram, 2004

⁴ Deb et al., 2006

Legislation

In order to be considered safe for drinking water applications, every material used in this application has to undergo thorough tests and evaluations from authorities. A maximum limit of each substance potentially leaching from this material into the water will be set, using a huge safety margin which often results in these limits being a hundred fold or more below any potential minimum level of effect.

A significant number of epoxy resin systems/coatings have been tested and approved for drinking water contact by the European authorities and local authorities in the Netherlands, Spain, France and Germany. Epoxies are included in the list of authorised substances under the European regulations, as well as French⁵ and German⁶ guidelines, after being tested according to the strictest migration limits.

Environment

To apply the epoxy coating, pipes are usually heated to be completely dried and left without humidity. The pipe surface is shot-blasted to remove scale and rust, and the epoxy primer is then applied to the pipe surface. After applying the primer, the pipe is dried and cooled.

Relining a pipe in this way keeps the old material, including the material that pipe is surrounded with like the concrete of walls or asphalt of streets, out of a landfill. Likewise, labor and material resources are saved.

Did you know? Fixing damaged pipes costs 50% to 60% less than applying new pipes. Epoxy resins help repair holes and cracks in existing pipes, thus avoiding the need for pipe substitution or reconstruction (when pipes need to be recovered and reassembled far away from where they are being used). Fixing existing pipes also prevents inconveniences caused to householders and public transport passengers, drivers and motorists during major repair works.⁷

⁵ Arrêté du 2 janvier 2003 relatif aux matériaux et objets en matière plastique mis ou destinés à être mis au contact des denrées, produits et boissons alimentaires, Legifrance.gouv.fr

⁶ Drinking water distribution: Guidelines and Evaluation Criteria, Umweltbundesamt.de

⁷ 'The Socio-economic Value of Epoxy Resins', 2015.