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# FACTS ABOUT PLUMBO-SOLVENCY IN WATER SUPPLIES

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Lead is a common material of construction in the field of sanitary engineering. It is widely used to remove the polluted water from water closets, tubs, showers, lavatories and other plumbing fixtures. But it is also commonly employed to conduct clean, pure water to these fixtures, particularly for the underground water service pipe from the street main to the house, where its high resistance to corrosion by substances in the soil and its flexibility which prevents breakage by ground settlement are especially needed.

In the first instance, for the plumbing soil, waste and vent system it does not make any difference if the pipe material itself pollutes the water, since the water is not used, or at least is not intended to be used for human consumption. On the other hand, the water supplied to the fixtures must be free from pollution by the pipes or any other source.

It has long been recognized that excessive amounts of lead taken internally, either by inhalation of dust or fumes, or through the mouth may produce illness. However, lead taken through the mouth is much less apt to produce illness than inhaled lead. Nevertheless ever since lead was first used in water supply systems many years ago, some degree of care has had to be exercised to make certain that it is used under conditions in which excessive amounts will not be dissolved. Plumbo-solvency has been a subject of almost exhaustive research, and fortunately all this research and study has resulted in good knowledge of what may happen and how to meet the situation.

Of course, it may be said that the easiest method of avoiding lead intoxication is to do away with the use of lead services altogether. However, that can be compared to cutting off your nose to spite your face. Waters that are aggressive enough to attack lead sufficiently to cause a dangerous condition will also attack the other common metals. Substituting other metals for lead where aggressive waters are encountered may simply mean exchanging one set of problems for another. For instance,

such things as short service life, clogging, discoloration or amounts of dissolved metals higher than permissible limits will then, in all probability, have to be overcome. So, one answer to the entire problem is not that the use of lead pipe be discontinued because of the danger of plumbo-solvency but that aggressive waters be properly treated. In this connection we quote from a paper written by Robert Spurr Weston in 1925. He said, "Galvanizing protects iron for a while, but in many waters, the zinc dissolves rapidly, bringing 'red water' troubles in its wake. Waters which so affect zinc may be carried in pipes of yellow brass, red brass, copper and lead, but even these corrode in certain waters. The escape from corrosion by choice of pipe metals being barred, treatment with chemicals may be employed."

When we mention aggressive waters, we do not want to give the impression that this type of water in public water supplies is commonplace. As a matter of fact, New England is the only area in the United States in which this type of water predominates.

There are many thousands of feet of lead service pipe already in use throughout the country. Because it is used so extensively there must be economic reasons, as the answer again, cannot be in discontinuing its use. After all, no one would suggest that we go back to the horse and buggy days because there are so many automobile accidents.

In such cities as Denver, New Orleans, New York and right here in Chicago water is supplied through lead services to millions of people without ill effect. As a matter of fact, even in the soft water areas of New England the danger is not as great as supposed. A survey made by the Massachusetts State Board of Health many years ago before water treatment was generally employed found lead intoxication in only four of more than 300 municipalities.

Up to about 20 years ago, it was generally agreed that regardless of the amount of lead taken in by the body it accumulated until ultimately lead intoxication developed. This has been proved to be definitely wrong by such recognized authorities as Drs. Aub, Kehoe and Fairhall. Their work on this subject has shown without doubt that the body can and does dispose of small quantities of lead.

In one of Dr. Robert A. Kehoe's studies on this subject that appeared in the Journal of Industrial Hygiene, he reported the results of a test he made in a primitive Indian community in Mexico. He found that the Mexicans were steadily excreting quantities of lead with apparently no contact with it. Dr. Kehoe followed up this work in the United States among industrial workers, showing that exposure to varying

amounts of lead resulted in correspondingly varying rates of elimination. Kehoe thus proved that people are always exposed to some lead and that their elimination rate adjusts itself, at least within certain limits, to varying exposures.

This is the type of modern medical research that effectively dispels the idea that even small quantities of lead remain within the body until enough has accumulated to cause lead intoxication. After all, the earth's crust contains all of the minerals and it is only natural to assume that the human body has been able to adjust itself to the presence of small quantities of minerals that would be poisonous if allowed to accumulate within the body.

In experimenting with lead arsenate, a material far more toxic than lead, L. T. Fairhall and P. A. Neal of the United States Public Health Service have shown that lead arsenate can be ingested in amounts as large as 10 milligrams per day for 10 days and that 85% of it is eliminated from the human system within a few days. Further, the American Public Health Association has this to say and we quote, "Nevertheless, practical experience and systematic investigations have demonstrated that certain levels of OCCUPATIONAL lead exposure and absorption are compatible with normal healthy existance and activity . . . ." We might point out that this statement refers to occupational exposure which is far more severe than the type of exposure we are concerned with here.

The United States Treasury Department has placed a limit of 0.1 p.p.m. lead in water and all the research along with practical experience shows this to be a decidedly safe margin. The research further proves that a consumer can ingest a relatively large amount of lead at one time, without harmful effects, provided it is not repeated regularly.

We are fortunate in that there are only a few public water supplies that are aggressive enough to attack lead and make its use undesirable without some protective measures. Almost all of this type of water from public supplies will be found in New England. In other sections of the country there may be private water supplies where the use of lead is undesirable but, in general, we can safely say that there is very little if any danger of lead intoxication from public water supplies in the United States outside of New England.

Because of variables, there is no definite rule to go by as to the kind of waters that will dissolve dangerous amounts of lead. In a general way, we can say that with very soft waters sufficient lead may be dissolved to create a hazard unless protective measures are taken. However, we can't judge by pH value alone, as some waters with a very

low pH value are less corrosive than others with a higher pH because of different compositions. High oxygen and free $CO_2$ content and low hardness add to the corrosiveness of the water, and certain salts in the water are inhibitors. Likewise, stable organic matter in waters that might otherwise be corrosive may deposit on the lead pipe walls, forming an adherent protective coating that prevents solution of the lead by the water. On the other hand, soft waters from peaty moorland sources contain organic acids, in addition to carbonic acid, which increase the attack and do not form protective coatings.

Where we have waters with a low pH value, say, below 7, high oxygen and $CO_2$ content, and hardness below 50 or 100 p.p.m., lead services should be used with care. However, such waters in a public supply are rare and where they are encountered lead pipe lined with a substantial lining of block tin will prove most effective in combatting the corrosive properties present in the water. Another method and probably the best and most frequently used is proper treatment of the water with lime or sodium silicate. Normal amounts of chlorine used in water treatment do not appear to have any effect on lead.