Impacts of Hardwater on Public Health

Ahn Min Kyung
Ewha Girls High School, 26 Jeongdong-gil, Jung-gu, Seoul, South Korea.

Choon Han
Chemical Engineering Department, Kwangwoon University, Nowon-gu, Seoul.

Thenepalli Thriveni*
Climate Change Mitigation and Sustainability Division, Korea Institute of Geosciences and Mineral Resources (KIGAM), 124 Gwahagno, Yuseong gu, Daejeon 34132, Korea.

Abstract: Globally, in 2012, 89% of the people had access to water suitable for drinking. Nearly 4 billion had access to tap water while another 2.3 billion had access to wells or public taps. 1.8 billion people still use an unsafe drinking water source which may be the presence of excess minerals such as calcium carbonates, magnesium carbonates, and dolomite. Many International organizations such as United States Environmental Protection Agency (USEPA), World Health Organization (WHO), and European Union (EU) have played a key role in developing regulations for many metal species found in drinking water. The hardness water causes many public health safety issues especially on children's and new born babies. Water hardness causes to the risk of atopic dermatitis among children's and other kind of skin diseases are existed. In this paper, we reported the public health safety issues from water hardness.

Index Terms: water hardness, ground water quality, public health.

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I. Introduction

As we know, water hardness is due to the excess of minerals such as calcium, magnesium, sulfates, and carbonates presented in the water. Water hardness leads to the atopic eczema in children's. Recently is that it seems simply bathing in tap water can be enough to trigger eczema in hard water area. Bathing and washing our clothes in hard water can lead to increased skin irritation. The water in washing machines is typically no different from that in showers; it too can leave detergent residue in our clothing and linens. Therefore, our skin can be in constant contact with this residue, causing chafing, rubbing and further skin irritation[1].

Hardness of water effects in different ways in our daily life and presented in Fig.1

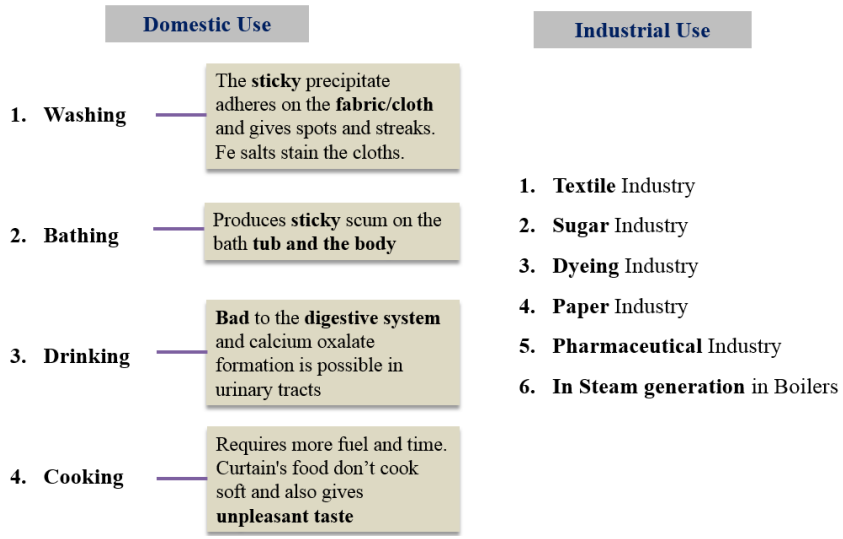

Fig.1 Hard Water Effect to the various sectors.

Tap water definitely causes an eczema because of scaling formation inside the pipe walls. Here we presented schematic mechanism of scale formation at pipe walls (Fig.2).

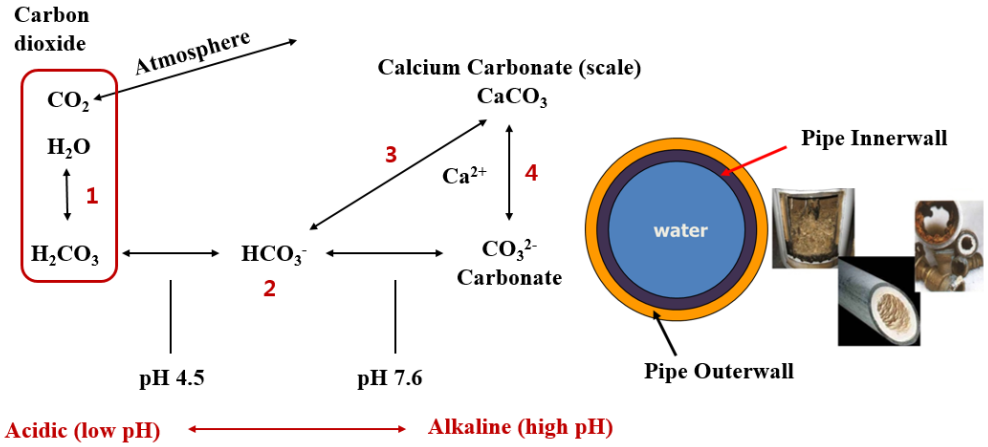

Fig.2. Scale formation mechanism in pipes

Carbon dioxide reacts with water to form carbonic acid (1) which at ordinary environmental pH exists mostly as bicarbonate ion (2). Microscopic marine organisms take this up as carbonate (4) to form calcite skeletons which, over millions of years, have built up extensive limestone deposits. Ground waters, made slightly acidic by CO_2 (both that absorbed from the air and from the respiration of soil bacteria) dissolve the limestone (3), thereby acquiring calcium and bicarbonate ions and becoming hard. Calcium, magnesium carbonates tend to precipitate out as adherent solids on the surfaces of pipes[2].

In an eczema study published in the Journal of Allergy and Clinical Immunology 33% of eczema sufferers said their work/school/home life is affected by being scratching. Studies have indicated that the incidence of eczema can be related to water hardness, with one study in Nottingham indicating that primary school children living in hard water areas are almost 50% to have eczema. Similar mapping studies carried out in Spain and in Japan have found higher incidence of eczema in areas of the country which are supplied with hard water. Hard water is identified as an environmental trigger in the Nice (2007) Guidelines on Atopic Eczema in children 12 years and under. Hard water areas are common with more than 60% of households in England and Wales affected[3].

Atopic dermatitis (or eczema) is an inflammatory, chronically relapsing, non-contagious and pruritic skin disorder. The environment plays an important part in the etiology of atopic eczema. The prevalence of symptoms of atopic eczema among Japanese, Nottinghamshire and Spanish children is the most. Water hardness may increase the risk of atopic dermatitis among elementary-school children in Japan, as well as in the United Kingdom[4].

Hard water linked to infant eczema- Infants living in areas with a high calcium carbonate concentration in the water supply. The calcium carbonate concentration of 285 mg/L or more in the domestic water supply leads significantly increased risk of eczema at 3 months of age in a large study conducted across England and Wales[5] (Fig.2).

Fig.2 Childrens with Atopic Eczema

2. Tap water causes Eczema

Recently, it seems simply bathing in tap water can be enough to trigger eczema in hard water area. Bathing and washing our clothes in hard water can lead to increased skin irritation. The water in washing machines is typically no different from that in showers; it too can leave detergent residue in our clothing and linens. Therefore, our skin can be in constant contact with this residue, causing chafing, rubbing and further skin irritation[6].

Scientists are investigated the benefits of a water softener in terms of alleviating eczema symptoms in young children, reports the team at green water technologies. In a study by the U.S. Department of H ealth, researchers seek to understand the differing effects of soft and hard water on a person's skin. Fin ally they found eczema existed at hard water areas consistently. Generally, eczema occurs on the face, a nkles, neck, elbows and knees. Sometimes patches or rashes appeared on various parts of the body such as scalp, forehead, legs, cheeks, neck and forearms. According to the American Academy of Dermatolog y (AAD) reports that, 1out of 5 children's in the United States suffered by eczema[7].

There is evidence to suggest that environmental and lifestyle factors play an important part in the et iology of atopic eczema, in common with other atopic diseases. One factor that may be particularly relev ant, and which has not been investigated in epidemiological studies, is the domestic water supply. Hard water levels in Southern Nottinghamshire[8] showed in the Fig.3.

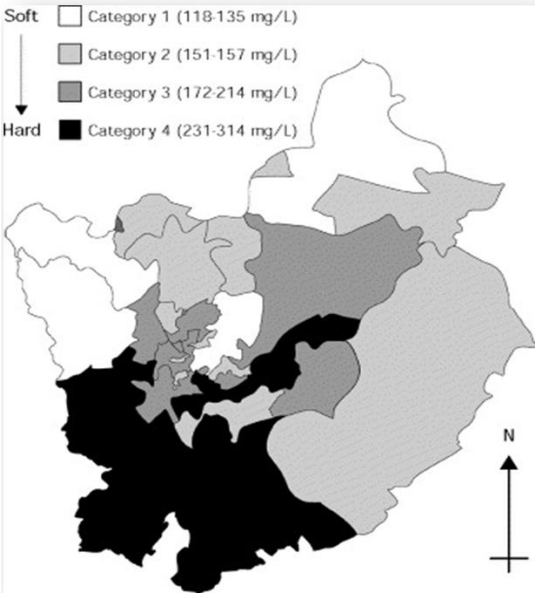

Fig.3. Water-hardness categories in districts of southern Nottinghamshire (adopted from ref.7).

Water hardness has been associated with atopic eczema (AE) prevalence in two epidemiologic studies carried out on schoolchildren in England and Japan. The atopic eczema symptoms are existed in Japanese children aged 6-7 years especially higher in highest water hardness areas. Numerous studies are published and discussed about the severity of water hardness and public health safety issues[9-14]. According to the investigations of European Environment and Health Information System (EUROHEIS) research project, it provides statistical evidence of the relationship between mortality from cardiovascular diseases and hardness of drinking water. The relationship between cerebrovascular disease, heart diseases, strongly pronounced for women than for men, and is more significant with magnesium than with calcium concentration levels[15,16].

3. Conclusions

Based on the different publications and international organization reports, it is clearly evident that excess of calcium and magnesium concentration levels in tap water and drinking water hardness causes not only atopic eczema, cardio vascular diseases and also cerebrovascular diseases particularly in children's aged from infant to 12 years. From this we can understand the severity of water hardness is very important issue to solve. Water hardness effects food, chemicals, refined petroleum, paper, coal power plants and primary metals. Hence it is important to know effects of water hardness to the

industry. Finally we concluded that, currently, there are several technologies and softeners were available for water hardness.

References

1. Hard water effects on babies, Littlegreen blog news, 2012.
2. Andrew Jay, Ocean acidification and Oyster shells ability to offset, 2013.
3. A water softening approach to eczema, web article, 2015.
4. P. Sengupta, Potential health impacts of Hard Water, Int. J. Prev. Med, 4, 2014, 866-875.
5. Bruce Jancin, Hardwater linked to infant eczema, Pediatric news digital network, October 17, 2014.
6. Green, Could you tap water be causing eczema? Littlegreen blog news, 2012.
7. Erik Jonathan Bernal, green water technologies on the connection between eczema and un conditioned water, green water technologies blog news, October 15, 2014.
8. N.J.M. Mcnally, H.C. Williams, D.R. Philips, M. Smallman Raynor, S.Lewis, A. Venn, J. Britton, Atopic eczema and domestic water hardness, The LANCET, 352, 1998, 527.
9. Yoshihiro Miyake, Tetsuji Yokoyama, Akiko Yura, Masayuki Iki, Tadahiko Shimizu, Ecological association of water hardness with prevalence of childhood atopic dermatitis in a Japanese urban area, Environmental Research, 94 (2004) 33–37.
10. Alberto Arnedo-Pena, Juan Bellido-Blasco, Joan Puig-Barbera, Adrián Artero-Civera, Joan Baptista Campos-Cruañes, M Rosario Pac-Sa, Jose Luis Villamarín-Vázquez, Carlos Felis-Dauder, Salud Publica Mex 49 (4), 295-301.
11. G Nardi, F. Donato, S. Monarca, U.Gelatti, Drinking water hardness and chronic degenerative diseases. I. Analysis of epidemiological research, Ann Ig 15 (1), 2003, 35-40.
12. S. Monarca, I. Zerbini , C. Simonati, U. Gelatti, Drinking water hardness and chronic degenerative diseases. II. Cardiovascular diseases, Ann Ig 15 (1), 2003, 41-46.
13. F. Donato, S. Monarca, S. Premi, U. Gelatti, Drinking water hardness and chronic degenerative diseases.III.Tumors, Urolithiasis, fetal malformations, deterioration of the cognitive function the aged and atopic eczema, Ann Ig 15 (1), 2003, 57-70.
14. Silvano Monarca, Francesco Donato, Ilaria Zerbini, Rebecca L Calderon, Gunther F Craun, Review of epidemiological studies on drinking water hardness and cardiovascular diseases, Eur.

J. Cardiovasc Prev Rehabil. 13 (4), 2006, 495-506.

15. I. R. Lake, L. Swift, L. A. Catling, I. Abubakar, C. E. Sabel, P. R. Hunter, Effect of water hardness on cardiovascular mortality: an ecological time series approach, J. Public Health, 32 (4), 2009, 479-487.
16. Juan Ferrandiz, Juan J Abellan, Virgilio Gomez-Rubio, Antonio Lopez-Quilez, Pilar Sanmartin, Carlos Abellan, Miguel A Martinez-Beneito, Inmaculada Melchor, Hermelinda Vanaclocha, Oscar Zurriaga, Ferran Ballester, Jose M Gil, Santiago Perez-Hoyos, Ricardo Ocana, Spatial analysis of the relationship between mortality from cardiovascular and cerebrovascular disease and drinking water hardness, Environ Health Perspect 112 (9), 2004,1037-1044.