Technical University of Denmark



Moving from adequate to optimal drinking water quality. A reassessment of mineral composition

Rygaard, Martin

Publication date: 2018

Document Version Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA): Rygaard, M. (2018). Moving from adequate to optimal drinking water quality. A reassessment of mineral composition. Poster session presented at Nordic drinking water conference (NORDIWA 2018), Oslo, Norway.

DTU Library Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

DTU Environment Department of Environmental Engineering

Moving from adequate to optimal drinking water quality. A reassessment of mineral composition

Martin Rygaard, Associate Professor

Drinking water guidelines are designed to ensure the safety of the public against microbial or chemical hazards from drinking water. But there a several more subtle effects from drinking water quality. I propose a set of indicators for drinking water quality assessment that allows for a ranking of its quality in terms of health impacts, aesthetics and corrosion potentials

Method

Each indicator has been defined by a target composition considered optimal for a specific impact. For example, compositions leading to a Calcium Carbonate Precipitation Potential of 5 mg/L were considered optimal for scaling control. Similarly, a composition high in fluoride and calcium, but within recommended guidelines, would be the target for dental health protection. The potential impacts are reported as a normalized distance-to-target-value ranging from zero to one. A value of one indicates that the composition equals the target value, while a value of zero indicates the largest distance-to-target out of the surveyed water compositions. As such, the normalized values indicate the relative position for each surveyed water quality, compared to the other water qualities in question. Until now seven impact categories have been assessed for 11 Nordic water supply systems: corrosion potential towards iron (Larson Ratio), Saturation index and precipitation potential for CaCO₃, dental health (DMF-S), cardiovascular disease (magnesium content), child eczema (total hardness), and taste (preferred ions vs unwanted ions).

Indicators with perceived optimal values (target values). The list is based on a literature review. *[Ca]+[Mg]+[HCO₃]+[SO₄]-[Cl]-[K]-[Na] expressed in mmole/L maximum allowable limit.

UIU

Indicator	Target	Explanation		
Larson ratio	0	$\frac{[Cl]+2[SO_4]}{[HCO_3]}$ is indicative of corrosion of iron and possibly steel. Lower is better.		
Saturation index $CaCO_3$	0.2	$log\left(\frac{[Ca][CO_3]}{K_s}\right)$ indicates saturation state. Slight oversaturation is preferred.		
Calcium Carbonate Precipitation Potential (CCPP)	5	Amount of $CaCO_3$ precipitated or dissolved to achieve equilibrium in a closed system (mg/L as $CaCO_3$). Calculated by PHREEQC and slight oversaturation is preferred.		
Dental health DMF-S	1.8	Predicted number of Decayed, Missing, or Filled Surfaces (DMF-S). <1.8 is assumed very low incidence by WHO.		
Cardiovascular disease	50	EU max guideline for magnesium (mg/L). Higher is better.		
Child eczema	0	Water hardness (mg/L as CaCO ₃). Lower is better.		
Taste	18	Sum of EU max guidelines for minerals contributing to taste perception (mmole/L)*.		



Conclusion

Drinking water quality guidelines aim to ensure an adequate rather than optimal water quality. The results reveal the variance of perceived water quality across water supplies that all adhere to current guidelines. Further work will seek to validate the proposed indicators and add indicators for more effects.

Stockholm Norsbe Stockholm L. Gothenburg Alehu. Stockholm Black Stockholm Gothenburg Gothenburg Gothenburg La	ckareb oslo skulle oslo oslo	Helsinki Pitkäkke Helsinki Vanhakaupo Copenh	agen Distribute Aarhus Truelson	Fallinn Ulenn
Corrosion and scaling Larson ratio Saturation index CaCO3 CaCO3 Pressored 	recipitation Potential Dental	health DMF-S Cardiovascu	ılar disease 📃 Child eczem	a Aesthetics

Assessment of drinking water quality for 11 Nordic water supply systems. Results are based on latest published water quality reports as of December 2017.

Contact

Martin Rygaard mryg@env.dtu.dk Department of Environmental Engineering Technical University of Denmark Phone: +45 4525 1570



References

Bruvo, M., Ekstrand, K., Arvin, E., & Spliid, H. (2008). Optimal drinking water composition for caries control in populations. Journal of Dental Research, 87(4), 340–343 http://jdr.sagepub.com/cgi/content/abstract/87/4/340

Lahav, O., Salomons, E., & Ostfeld, A. (2009). Chemical stability of inline blends of desalinated, surface and ground waters: the need for higher alkalinity values in desalinated water. Desalination, 239(1–3), 334–345.

de Moel, P.J. et al., 2013. Assessment of calculation methods for calcium carbonate saturation in drinking water for DIN 38404-10 compliance. *Drinking Water Engineering and Science*, 6(2), pp.115–124 <u>http://www.drink-water-eng-sci.net/6/115/2013/</u>.

Platikanov, S., Hernández, A., González, S., Luis Cortina, J., Tauler, R., & Devesa, R. (2017). Predicting consumer preferences for mineral composition of bottled and tap water. Talanta, 162(June 2016), 1–9. http://doi.org/10.1016/j.talanta.2016.09.057 Rygaard, M., & Albrechtsen, H. (2012). Redegørelse om sundhedseffekter af blødgøring i København specielt med fokus på caries. Kgs. Lyngby, Denmark.

Rygaard, M., Arvin, E., Bath, A., & Binning, P. J. (2011). Designing water supplies: Optimizing drinking water composition for maximum economic benefit. Water Research, 45(12), 3712–3722. http://www.ncbi.nlm.nih.gov/pubmed/21565384