ORP Meters, Principles And Misconceptions

ORP Meters simple explanation

Oxidation-reduction potential can be measured using a potentiometer (voltmeter) or an ORP meter.[1] Water produced from **electrolysis** (ionized water), as well as other forms of **hydrogen water**, exhibit a negative ORP.[2] But what is the meter actually measuring? And how does it work?

Basically* you have different chemical species in the water that can either undergo oxidation or reduction; these form "redox couples".[3] For example, adding ascorbic acid (vitamin C) to water gives a negative ORP[4] based on the ratio of reduced ascorbic (HA) acid to oxidized ascorbic acid (DHA) according to the Nernst equation.[5]

The redox probe is able to measure this electromotive force for electrons to pass from the reduced species to the oxidized species. In our vitamin C example, if the concentration of the oxidized and reduced forms of ascorbic acid are the same, then we will measure an ORP voltage of -570 mV. This is according to the standard redox half-reaction:

DHA +2e- => HA = -570 mV.[6]

The voltage can be made more negative by increasing the HA concentration and/or decreasing the DHA concentration. Conversely, you could make the ORP positive by increasing the DHA concentration and/or decreasing the HA concentration.

Molecular Hydrogen Gives Water a Negative ORP.

In **alkaline ionized water**, the ORP ranges from -100 mV to – 900 mV.[7] The chemical species responsible for the negative ORP is the redox couple molecular hydrogen (H_2) and the acid (H^+) concentration. This is according to the standard redox half-reaction:

$2H^+ + 2e \Rightarrow H_2$ (g) E° = 0.00 V[7]

You can make the ORP negative by decreasing the H^+ concentration (raising the pH) and/or increasing the dissolved molecular hydrogen concentration. Conversely, you can make the ORP positive by increasing the H^+ concentration (lowering the pH) and/or decreasing the dissolved molecular hydrogen concentration.

Important Considerations

This is an important part to consider regarding the molecular hydrogen concentration. Because the pH plays such a large role in the ORP, you can have one glass of ionized water with an ORP of -800 mV and another with an ORP of -400 mV, but (because of pH differences) the second glass can actually have more therapeutic molecular hydrogen than the first glass. Remember, a negative ORP is more of an indicator of the presence of H_2 gas than a measure of concentration. Indeed, it's not a measurement of concentration at all.

Another important point is that once the water is at a pH around 9.5 the ORP meter is virtually an invalid method to compare any solutions H_2 concentration.[8] Possibly because at these higher pHs the H^+ ion concentration is very low (1×10^{-10} M) and may be near the the detection limit of an ORP meter resulting in spurious readings.[8] MHF has measured some waters with equal pH and ORP, but one has a concentration four times as great as the other one. This can make a significant difference in the therapeutic value of the water.

These important points underscore the importance of actually measuring the molecular hydrogen concentration and making comparisons between hydrogen-water devices based off H_2 concentrations, as opposed to pH and ORP alone.

ORP Misconceptions

The fact that molecular hydrogen is the therapeutic ingredient in ionized water eluded scientist for decades.[9] It is no wonder that misconceptions of ORP have been promulgated over the years. Some have suggested that the reading is due to free electrons, actual physical charges on water molecules, charged or ionic minerals,[10] and virtually everything else except for molecular hydrogen.

Some have falsely taught that adding minerals to the water gives a negative ORP, but it's not an antioxidant ORP. Adding mineral salts (e.g. magnesium chloride or calcium carbonate) alone will not give a negative ORP as that is not a redox couple that can readily undergo an electron transfer.[11] However, addition of magnesium metal to water obviously does produce a negative ORP[12]due to the production of therapeutic molecular hydrogen[13] (**as explained before**).

Another common misconception is trying to relate ORP to cellular voltage.[14] Some have claimed that because cells have a negative voltage, drinking negative ORP water is healthy.[14] However, these two voltages are very distinct from each other and do not relate under biological conditions. Cells have their voltage due to differences in ion gradients and carboxylate moieties from proteins and fatty acids.[15]

***Click Here for a Basic Explanation on ORP**

*Click Here for a More Complete Explanation on ORP

References

1. GONCHARUK, V. V., BAGRII, V. A., MEL'NIK, L. A., CHEBOTAREVA, R. D. & BASHTAN, S. Y. (2010). The use of redox potential in water treatment processes. Journal of Water Chemistry and Technology 32, 1-9.
2. SHIRAHATA, S. A. N. E. T. A. K. A. (2002). Reduced water for prevention of diseases. Animal Cell Technology: Basic and Applied Aspects 12, 25-30.
3. Postma, J. M., & Hollenberg, J. L. (2004). Chemistry in the Laboratory. Macmillan.
4. Rael, L. T., Bar-Or, R., Aumann, R. M., Slone, D. S., Mains, C. W., & Bar-Or, D. (2007). Oxidation–reduction potential and paraoxonase–arylesterase activity in trauma patients. Biochemical and biophysical research communications, 361(2), 561-565.
5. Ebbing, Darrell, and Steven D. Gammon. "General Chemistry Eighth Edition."
6. Harris, Daniel C. Quantitative chemical analysis. Macmillan, 2010.
7. Hricova, D., Stephan, R., & Zweifel, C. (2008). Electrolyzed water and its application in the food industry. Journal of Food Protection®, 71(9), 1934-1947.
8. Tyler LeBaron. (2013) "Changes in Oxidation-Reduction Potential of Aqueous Solutions as a Function of pH and Hydrogen Gas Concentration" The Journal of Kitchen Chemistry 2013. 1. P.12
9. Miyashita, Kazuo, et al. (2003) "Antioxidant Activity of Electrolized Sodium Chloride." Book Food Factors in Health Promotion and Disease Prevention. P. 274-288. American Chemical Society Symposium Series, V. 851
10. Personal observation and communication amongst ionized water advocates
11. Kotz, John C., Paul M. Treichel, and John R. Townsend. Chemistry & chemical reactivity. Cengage Learning, 2011.
12. OSTOJI?, S. M., STOJANOVI?, M. D., CALLEJA-GONZALEZ, J., OBRENOVI?, M. D., VELJOVI?, D., ME?EDOVI?, B., KANOSTREVAC, K., STOJANOVI?, M. & VUKOMANOVI?, B. (2011). Drinks with alkaline negative oxidative reduction potential improve exercise performance in physically active men and women: Double-blind, randomized, placebo-controlled, cross-over trial of efficacy and safety. Serbian journal of sports sciences 5, 83-89.
13. AOKI, K., NAKAO, A., ADACHI, T., MATSUI, Y. & MIYAKAWA, S. (2012). Pilot study: Effects of drinking hydrogen-rich water on muscle fatigue caused by

acute exercise in elite athletes. Medical Gas Research 2, 12.

14. http://futurefoundationwater.com/dvdsale.html
15. Silverthorn, Dee Unglaub, Bruce R. Johnson, and William C. Ober. Human physiology. Pearson/Benjamin Cummings, 2007.

- Home
- Research
  - Research
  - Articles
  - Scientific Studies
- Certifications
  - H2 Apprentice
  - Level 1 Certification
- Events
- About
  - About
  - Advisory Panel
  - Contact Us
  - Careers
- Donate

- Disclaimer
- Terms & Conditions
- Privacy Policy