

Sulfuro de hidrógeno, el enemigo oculto

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- Åtland, Å. & Stenberg, S. 2019. "Water Quality". En: B. Hjeltnes, B. Bang-Jensen, G. Bornø, A. Haukaas and C. S. Walde, eds. The Health Situation in Norwegian Aquaculture 2018. Norway: Norwegian Veterinary Institute 2019. pp. 96–99.
- Boyd, C. 2019. Hydrogen sulfide toxic, but manageable. Global aquaculture advocate. March/April 2014 https://aquafishcrsp.oregonstate.edu/sites/aquafish-crsp.oregonstate.edu/files/boyd2014hydrogensulfide_gaa.pdf
- Barton L., Fardeau, M. & Fauque G. 2014. Hydrogen Sulfide: A Toxic Gas Produced by Dissimilatory Sulfate and Sulfur Reduction and Consumed by Microbial Oxidation. *Mets. Ion. Life Sci.* 14: 237-277.
- Bergstedt, J., Skov, P. & Letelier-Gordo, C. 2022. Efficacy of H2O2 on the removal kinetics of H2S in saltwater aquaculture systems, and the role of O2 and NO3-. *Water Research*, 222: 118892.
- Cline, J. 1969. Spectrophotometric determination of hydrogen sulfide in natural waters. *Limnology and Oceanography*, 14: 454-458.
- Cooper, C. & Brown, G. 2008. The inhibition of mitochondrial cytochrome oxidase by the gases carbon monoxide, nitric oxide, hydrogen cyanide and hydrogen sulfide: chemical mechanism and physiological significance. *J Bioenerg Biomembr*, 40: 533.
- Eaton, A., Clesceri, L. & Greenberg, A. 1995. Standard Methods for the Examination of Water and Wastewater. APHA.
- Fonselius, S. 1969. Hydrography of the Baltic deep basins III. Fish Board. Swed. Ser. Hydrol. Rept. 23, 97 pp.
- Hughes, M., Centelles, M. & Moore K. 2009. Making and working with hydrogen sulfide: The chemistry and generation of hydrogen sulfide in vitro and its measurement in vivo: a review. *Free Radic Biol Med.*, 47:1346-1353.
- Hjeltnes, B., Bang-Jensen, B., Bornø, G., Haukaas, A. & Walde, C. 2019. The Health Situation in Norwegian Aquaculture 2018. Animal Welfare, 29: 114-116.
- Kiemer, M., Black, K., Lussot, D., Bullock, A. & Ezzi I. 1995. The Effects of Chronic and Acute Exposure to Hydrogen Sulphide on Atlantic Salmon (*Salmo salar* L.). *Aquaculture*, 135: 311-327.
- Kristensen, T., Åtland, Å., Rosten, T., Urke, H. & Rosseland, B. 2009. Important influent-water quality parameters at freshwater production sites in two salmon producing countries. *Aquac. Eng.*, 41: 53-59.
- Letelier-Gordo, C., Aalto, S., Suurnakki, S. & Pedersen, P. 2020. Increased sulfate availability in saline water promotes hydrogen sulfide production in fish organic waste. *Aquac. Eng.*, 89: 102062.
- Lien, E., Valsvik, G., Nordstrand, J., Martinez, V., Rogne, V., Hafssås, O., Queralt, S., Fathi, B. & Aga, M. 2022. The SeaRAS AquaSense™ System: Real-Time Monitoring of H2S at Sub µg/L Levels in Recirculating Aquaculture Systems (RAS). *Front. Mar. Sci.*, 9: 894414.
- Poxton, M. & Allouse, S. 1982. Water quality criteria for marine fisheries. *Aquacultural Engineering*, 1: 153-191.
- Reiffenstein, R., Hulbert, W. & Roth, S. 1992. Toxicology of hydrogen sulfide. *Annu Rev Pharmacol Toxicol.*, 32: 109-134.
- Rojas-Tirado, P., Aalto, S., Åtland, Å. & Letelier-Gordo, C. 2021. Biofilters are Potential Hotspots for H2S Production in Brackish and Marine Water RAS. *Aquaculture*, 536: 736490.
- Rosten, T.; Åtland, Å., Kristensen, T., Braaten, B., Rosseland, B. & Winther, U. 2004. *Vannkvalitet og dyrevelferd i oppdrett. Utredning for Mattilsynet*. Trondheim, Norway: KPMG Senter for havbruk og fiskeri.
- Sommerset, I., Bang Jensen, B., Bornø, G., Haukaas, A. & Brun, E. 2020. The Health Situation in Norwegian Aquaculture 2020. Published by the Norwegian Veterinary Institute 2021.
- Tanudjaja, Y. 2021. Early Warning Signs and Dynamics of H2S Production In Recirculating Aquaculture System (Trondheim: Norwegian University of Science and Technology (NTNU)).
- Timmons, M. & Ebeling, J. 2007. Recirculating aquaculture. Northeastern Regional Aquaculture Center (NRAC), Michigan State University, Lansing.
- Teasdale, P., Hayward, S. & Davison, W. 1999. In situ, High-Resolution Measurement of Dissolved Sulfide Using Diffusive Gradients in Thin Films with Computer-Imaging Densitometry. *Anal. Chem.*, 71: 2186-2191.
- Weiner, E. 2007. Applications of Environmental Aquatic Chemistry: A Practical Guide. 2nd ed. Boca Raton: CRC Press.