**Hydrogen sulfide: The Silent Killer on a fish farm**

Elevated levels of hydrogen sulfide (H₂S) have lethal effects on fish. The presence of oxygen will work against the production of H₂S, but it is a very slow process that cannot protect the fish in situations with sudden spikes of H₂S. Anaerobic environments with H₂S can form anywhere on a fish farm, particularly in biofilters and stagnant piping systems.

\[
\text{SO}_4^{2-} + 2\text{C organic} + 2\text{H}_2\text{O} \xrightarrow{\text{Volatil fatty acids limiting}} \text{Sulfate-reducing Bacteria} \xrightarrow{\text{Anaerobic}} \text{H}_2\text{S} + 2\text{HCO}_3^{-}
\]

The concentration of SO₄²⁻ is significantly higher in seawater (2700 mg/L) compared to freshwater (5-50 mg/L). Consequently, a fish farm needs to operate below 5 ppt in salinity before SO₄²⁻ becomes limiting for H₂S-formation.

Sulfate reducing bacteria competes with nitrate reducing bacteria for volatile fatty acids. As a result, if the fish farm operates at a higher nitrate level, then nitrate reducing bacteria can outcompete the sulfate reducing bacteria for limiting volatile fatty acids.

**How does it kill? Are there any symptoms?**

Fish are very sensitive to H₂S. Levels of even 2 µg/L in freshwater and 5 µg/L in salt water can stress them, and concentrations above 25 µg/L can be lethal.

The symptoms of a H₂S-uptake are reduced appetite, together with the fish beginning to swim side-ways. Uptake cannot be detected on gills or other organs.

**What happens to H₂S around the RAS?**

The effects of H₂S are most dangerous at low pH-values. Conversely, it becomes less dangerous at higher pH-values, where it exists as HS⁻. H₂S-gas binds into the water to form HS⁻. At pH 7.5, around 75% is bound, while only 50 % is bound at pH 7.0.

Luckily, there is a constant removal of H₂S and HS⁻ across fish farms. HS⁻ binds with metals to form metal sulfides, H₂S can be degassed, while ozone, oxygen, and nitrate all oxidize H₂S to less toxic forms.

**How does Blue Unit manage H₂S?**

For fish farms, it should be the goal not to have any H₂S accumulating at all. Blue Unit’s Lab Station measures total hydrogen sulfide 6 times a day across 12 locations on a RAS, creating up to 72 data points daily. Blue Unit helps farms to manage their buffer capacity in the water, which means a smaller pH drop across the fish tank and a generally more stable water quality, while binding more H₂S to HS⁻. Additionally, Blue Unit helps customers manage turbidity levels. This minimizes the creation of anaerobic zones and helps to maintain healthy, well oxygenated biofilters.