Decreasing degasser aeration to increase buffer capacity

Fish and bacteria produce CO_2 into the production water of RAS farms. If 100 kg of CO_2 is produced in a single day, 100 kg of CO_2 should be removed. Otherwise CO_2 will accumulate in the system. If pH is low the accumulation of CO_2 in the system is seen as elevated levels of free CO_2. If the pH is higher, the free CO_2 will bind in the water as bicarbonate. Accumulation of CO_2 can have detrimental effects on fish welfare and growth. It is therefore essential that a farm has complete control on the degassing efficiency of their system.

Case

A farm had problems with quite low buffer capacity despite being at full feeding. In an effort to solve this Blue Unit advised them to turn down the ventilation across the degassers. Other options could have been to either add bicarbonate directly or simply increase pH, so free CO_2 can bind as bicarbonate. In this case the CO_2 concentration from the fish tanks was only 8 mg/L, therefore we did not see an issue in decreasing the aeration. The aeration was lowered from 100% to only 25% on the 21/1

Data

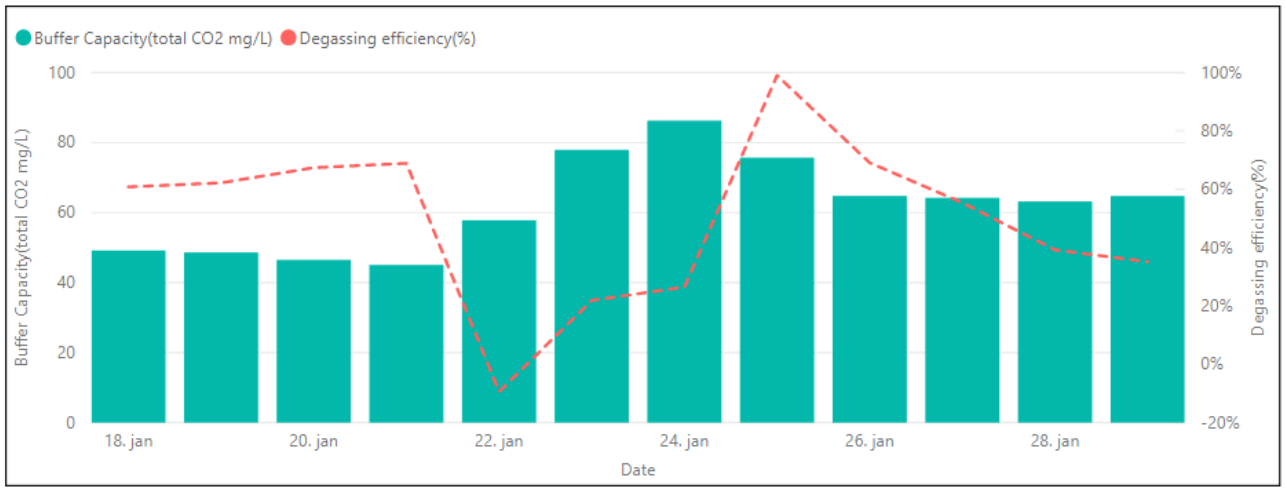

Figure 1 The green bars are the buffer capacity measured as Total CO2 in mg/L. The dotted red line is the degassing efficiency.

Figure 1 shows that on the 22nd of January when the degasser was turned down, there was an immediate reduction of degassing efficiency. It dropped from 69% to -9%, meaning for that day the degasser added Total CO2 to the system. Next day as the aeration blowers were turned down, the system stabilized a bit more. Buffer capacity now increased from 45 mg/L to 78 mg/L, and the degassing efficiency seemed to stabilize around 21%-26%. On the 24th the buffer capacity peaked at 86 mg/L. On the 25th the farm had to move the batch to another system. During this transport they bring in a lot of new water, which leads to a drop in bicarbonate.

Figure 1 clearly shows an increase in buffer capacity (green bars) after aeration in the degasser was decreased. When reducing the aeration, it is imperative that pH and free CO_2 is also under control. Figure 2 shows pH and CO_2 levels during the same period. pH from fish was stable around 7,18 up till the 23rd, then the elevated bicarbonate levels can neutralize acid generated by CO_2 release. This causes pH to increase with 0,1 and stabilize around 7,26 (Figure 3). This is despite increasing CO_2 levels, which would normally cause pH to decrease. But this is exactly the positive effect an increasing buffer capacity can have on a system.

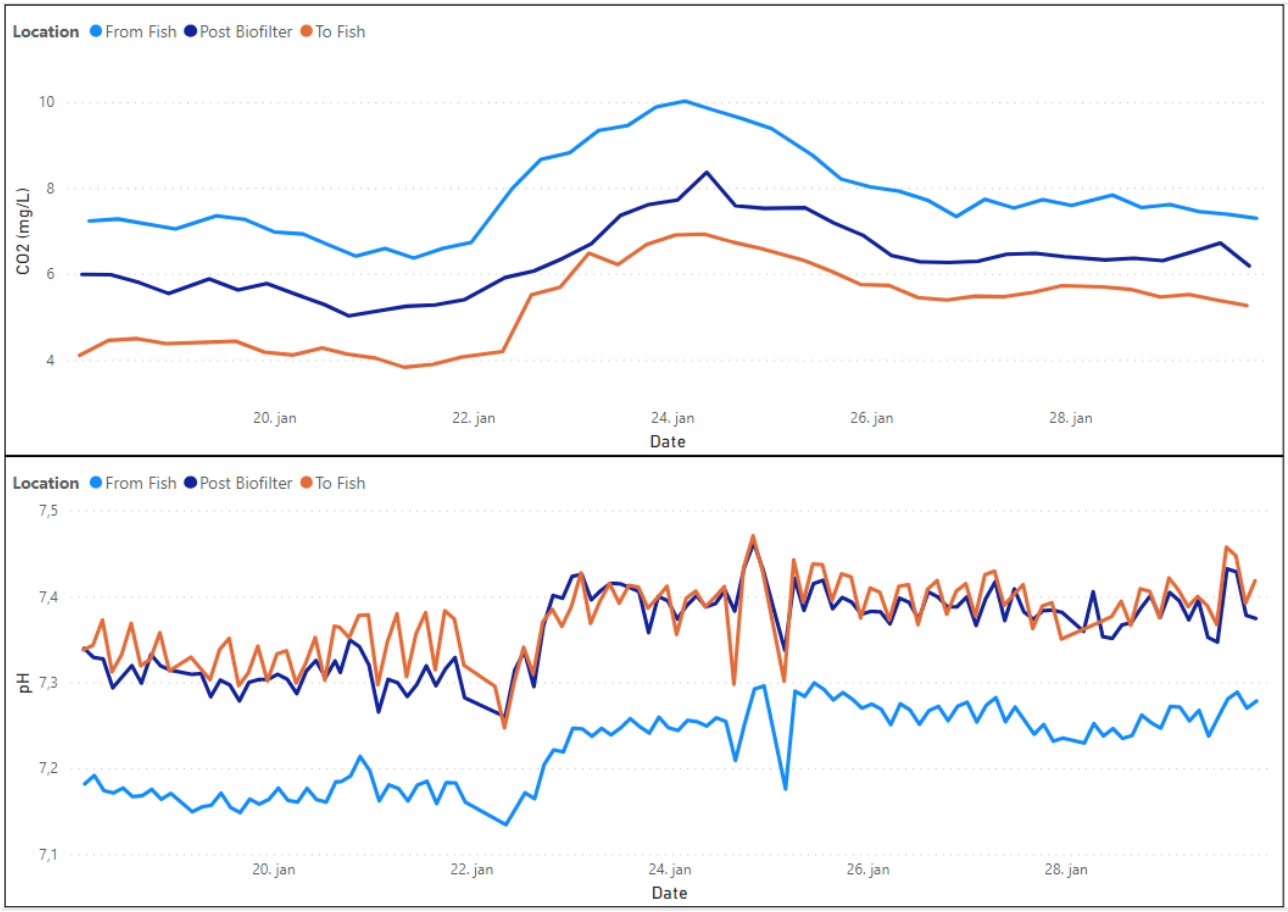

Figure 2 Top graph shows CO2 and bottom graph shows pH. In both graphs the colors are the same: Light Blue(From fish), Dark Blue(Post biofilter) and Orange(To fish).

Conclusion

Even though we were only able to run the degasser with low aeration for a short time, because of an impending fish move, it had a clear effect.

Within the three days of decreasing the aeration, buffer capacity increased with 91% from 46 mg/L Total CO_2 to 88 mg/L. It also showed a positive effect on pH levels and pH stability.

The farm did still manage to keep their CO_2 levels under 10 mg/L even though they decreased the aeration by 75%.

Therefore, in a case like this there will be other advantages than the improved water quality. Decreasing the aeration results in a cost reduction in electricity. The increased pH means a decrease in sodium hydroxide addition because of increased buffer capacity.

Table 1 The average data for each day in the given period. Total CO2is in mg/L. pH change across fish tank is the pH in water from fish - water to fish.

Date	Total CO2	pH from Fish	pH change (Tanks)
29-01-2020	66,27	7,26	-0,14
28-01-2020	64,93	7,23	-0,15
27-01-2020	65,87	7,26	-0,14
26-01-2020	67,30	7,27	-0,13
25-01-2020	79,53	7,27	-0,13
24-01-2020	88,29	7,26	-0,14
23-01-2020	79,75	7,25	-0,15
22-01-2020	58,39	7,18	-0,15
21-01-2020	46,96	7,18	-0,17
20-01-2020	49,06	7,18	-0,17
19-01-2020	51,23	7,15	-0,15
18-01-2020	51,67	7,17	-0,17