PROJECT: WATERQUAL (in collaboration with associated project RAS 4.0)
SYSTEM: RAS
PARTNER: Nofima
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Optimizing CO_2 degassing in RAS

HYPOTHESIS:

Air-based CO2 measurements can be used to optimize CO2 degassing in RAS

DURATION: 2019-2023

SALINITIES TESTED: Fresh water and brackish water

HIGHLIGHTS:

- A review of existing commercially available solutions for CO_2 degassing were done providing their advantages and challenges.
- The carbonate system and its implications on CO_2 and alkalinity has been illustrated for commercial RAS. An extended, theoretical calculator has been used that takes pH, alkalinity, salinity, and temperature into account.
- CO_2 degassing can be monitored in real-time with air-based, online CO_2 monitoring of off-gas from degassing units. This offers a real advantage for future automated degassing control loops and energy savings algorithms compared to existing submerged sensors. Aside from very fast reaction time, biofouling of water-based sensors is not an issue.
- Air based measurements showed a good correlation with dissolved CO_2 removal from water and allowed for assessing degassing performance (Figure 1). The results were in line with the predictions based on results from the carbonate calculator. Once the system is calibrated, air-based CO_2 measurements allows for estimating CO_2 removal rates and CO_2 concentrations in water.
- The adjustments of the air to water flow ratio in degassing columns that are based on the current biomass and feed loads in the RAS should allow to more energy efficient degassing. In our case, the degassing fans uses ten times less energy than pumping water into the degassing column. This topic will be further explored in CtrlAQUA associated project RAS 4.0.

RECOMMENDATIONS - what to do or not to do:

- Air flow meter (anemometer) and online air-based water vapor compensated CO2 analyzer can be used in new CO2 degassing designs. Here pump frequency and degassing fan/blower speeds can be controlled by the CO2 volume gas flow out of the degasser.
- Adapting water flow over the counter-current degassing columns to match CO2 stripping requirements offers the largest potential for energy savings.

ADDITIONAL INFO:

- Energy consumption measurements and E saving aspects of CO2-degassing were researched as a shared effort with the associated project RAS4.0.

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

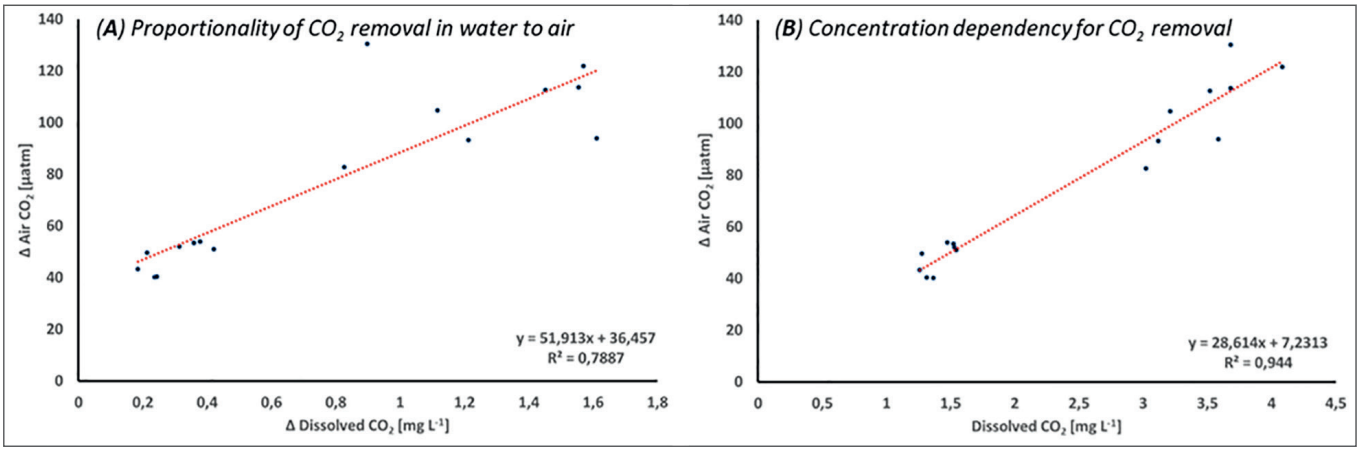
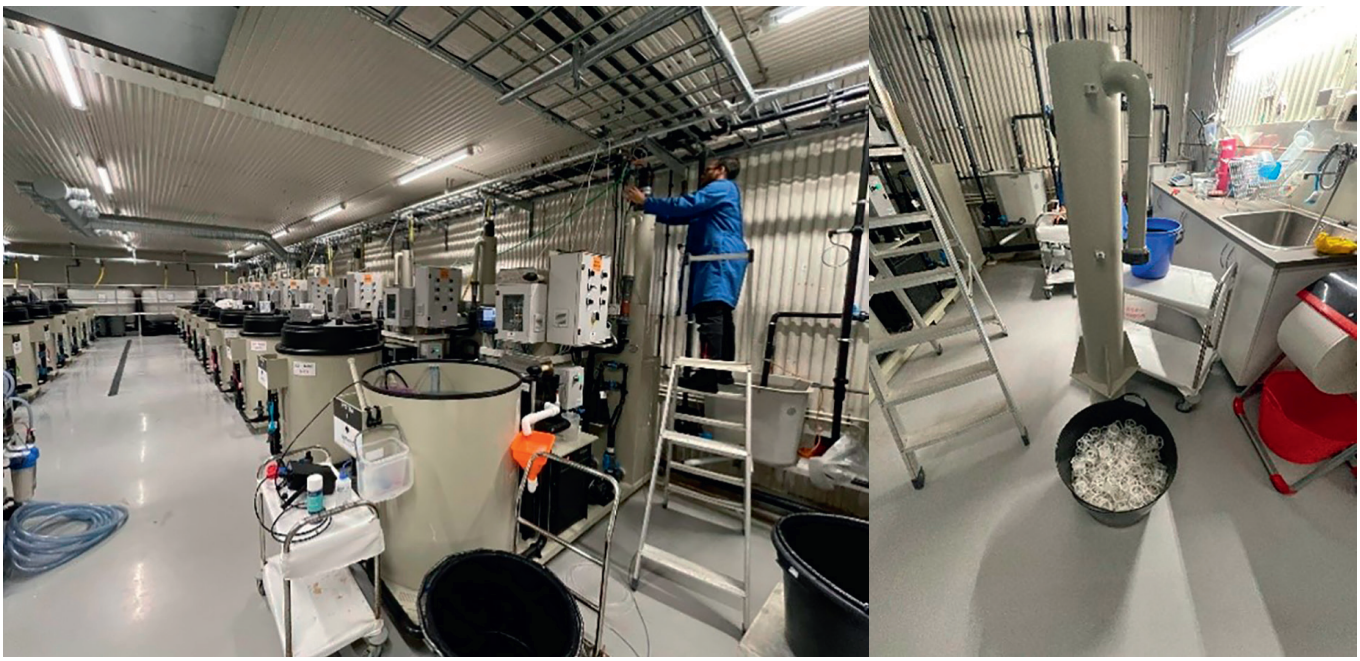


Figure 1: Air-based CO2 measurement in the BENCHMARK 2021 experiment have shown that CO2 measurements in the off-gas of a degasser can approximate CO2 removal from water. Once the system is calibrated for air and water flow across a relevant CO2 range, it is possible to use the CO2 concentration in the off-gas to extrapolate dissolved CO2 concentrations and CO2 removal rates in water in real-time.



Working at the Degassing towers at the MiniRAS systems in Sunndalsøra.