Aqueous CYAN Progress

David Wilson
dw@ieee.org

June 8, 2021

Aqueous CYAN Basics

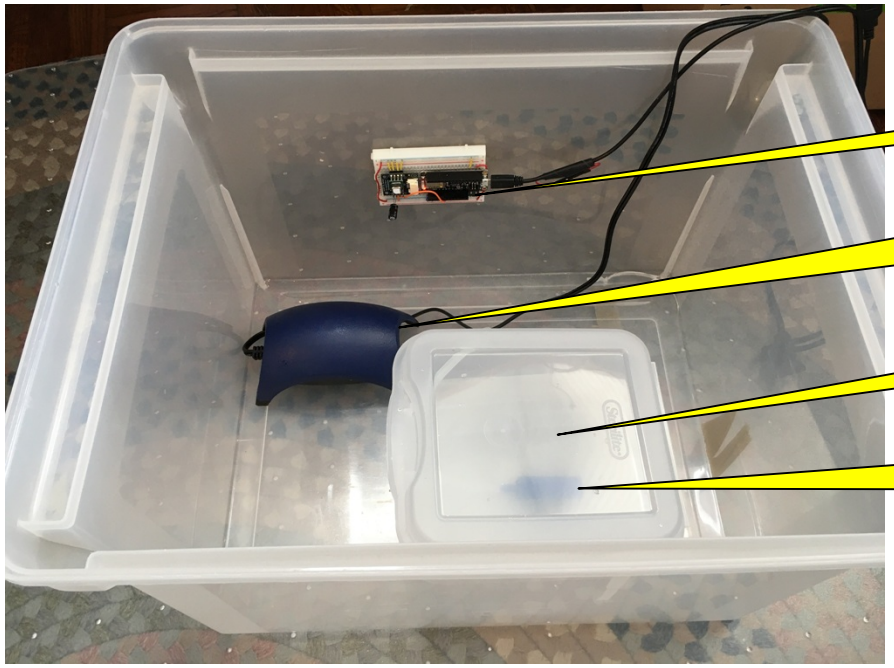
- Same reaction as Classic CYAN:

$$Ca(OH)2 + CO2 \rightarrow CaCO3 + H2O$$

- Parts reuse: Aquarium pump, air stone, box, chemicals.
- But the input material is dissolved (or at least mixed) in H2O, instead of open on a filter.
- NOTE: Solubility of Ca(OH)2 in H2O: 1.73 g/L at 20C.
- *(Naïve?)* Hypothesis: As Ca(OH)2 is consumed, pH approaches ~7. Partial answer later…

The Aqueous CYAN

In a box



Sensirion SCD41 CO2 Sensor

Aquarium Air Pump (same as Classic CYAN)

1L H2O with *X* g Ca(OH)2

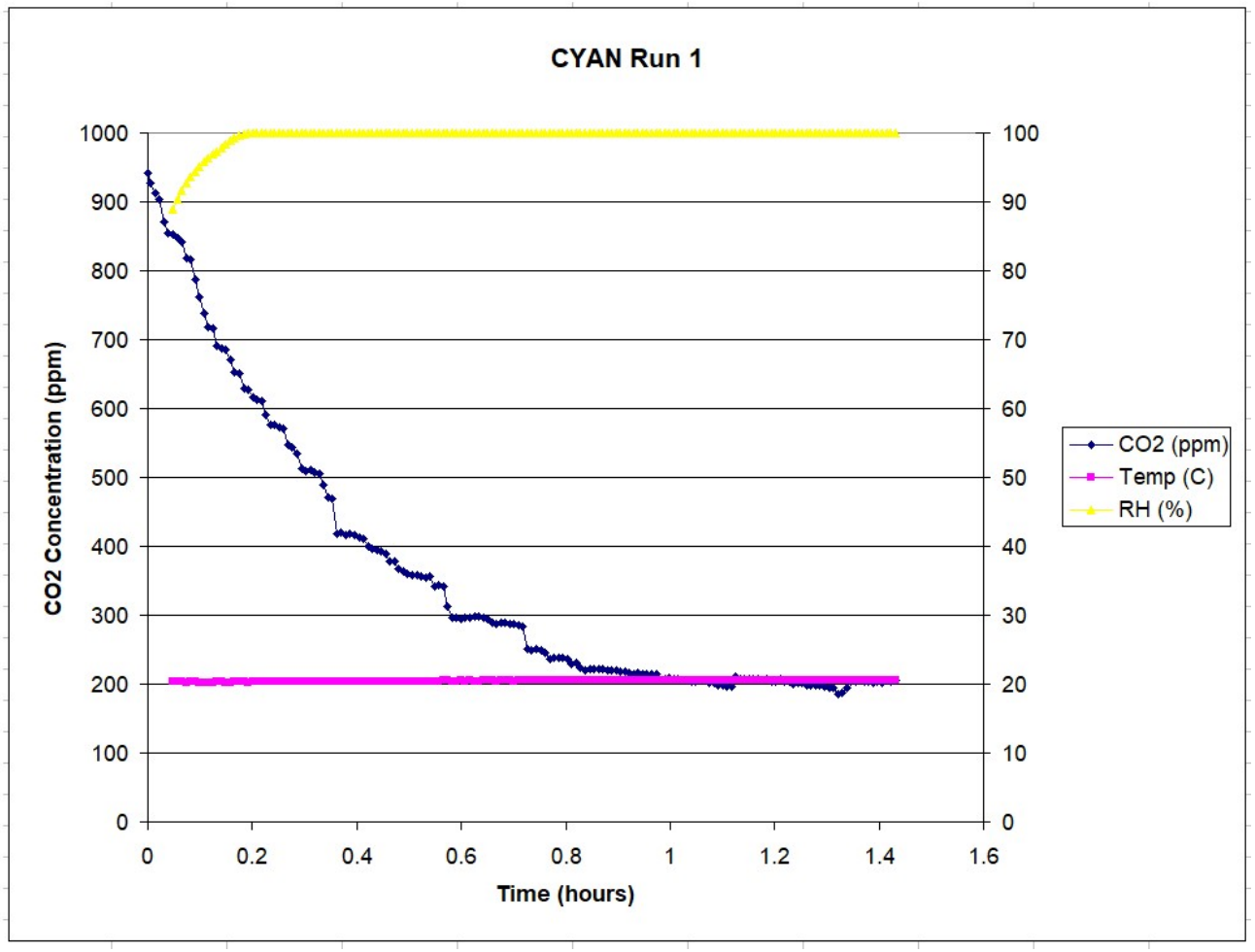
Aquarium Air Stone (same as Classic CYAN)

"Churning" due to bubbling air helps expose Ca(OH)2 to incoming CO2.

Q. If we put in more Ca(OH)2 than will dissolve, will fresh, undissolved Ca(OH)2 become available as it reacts with CO2?

Closed box run: Results

- Input: 1g Ca(OH)2 in 1L H2O



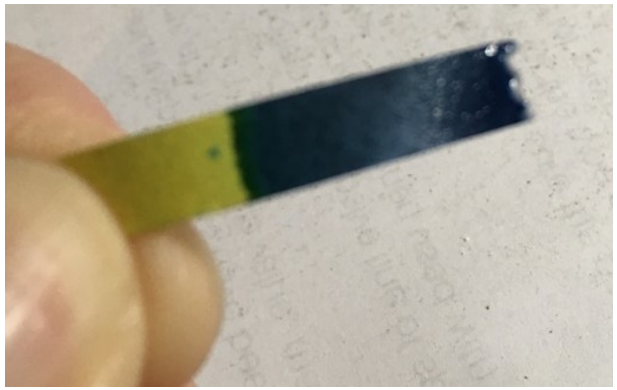
Analysis of Results (Closed box)

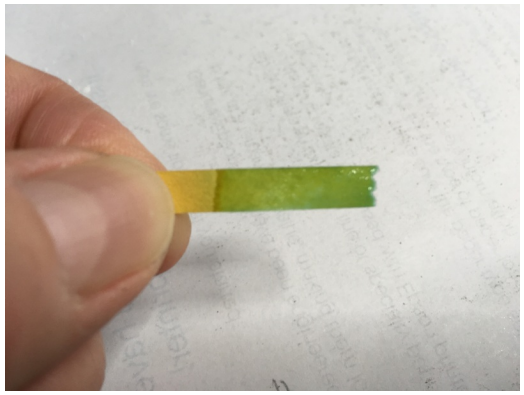
- Calculated CO2 capture from sensor measurement: 0.04g (based on box volume).
- Caveats: Accuracy and stability of sensor; box leakage.
- pH measurement:
  - 12+ at start
  - 12+ at end

Followup

Keep running system with box lid *open*, overnight to try to use up *all* the Ca(OH)2. Does pH ever drop towards neutral?

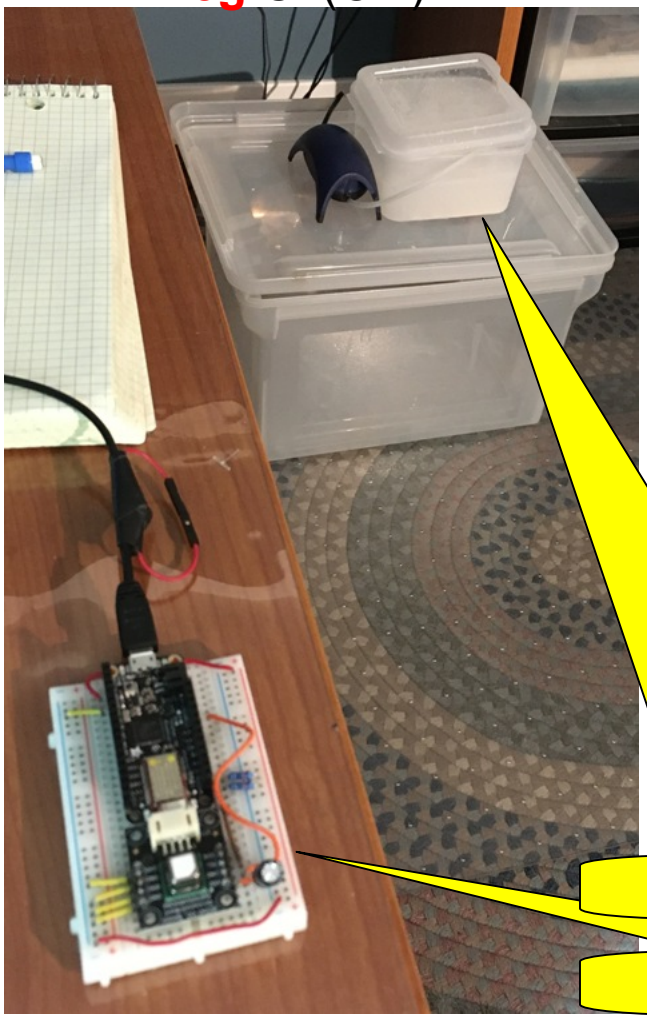
After 12 hours: pH is now ~6 ! Hypothesis confirmed, at least for **1g/L** solution (Note: an electronic pH sensor would be very useful here!).





Open Box, Run Overnight

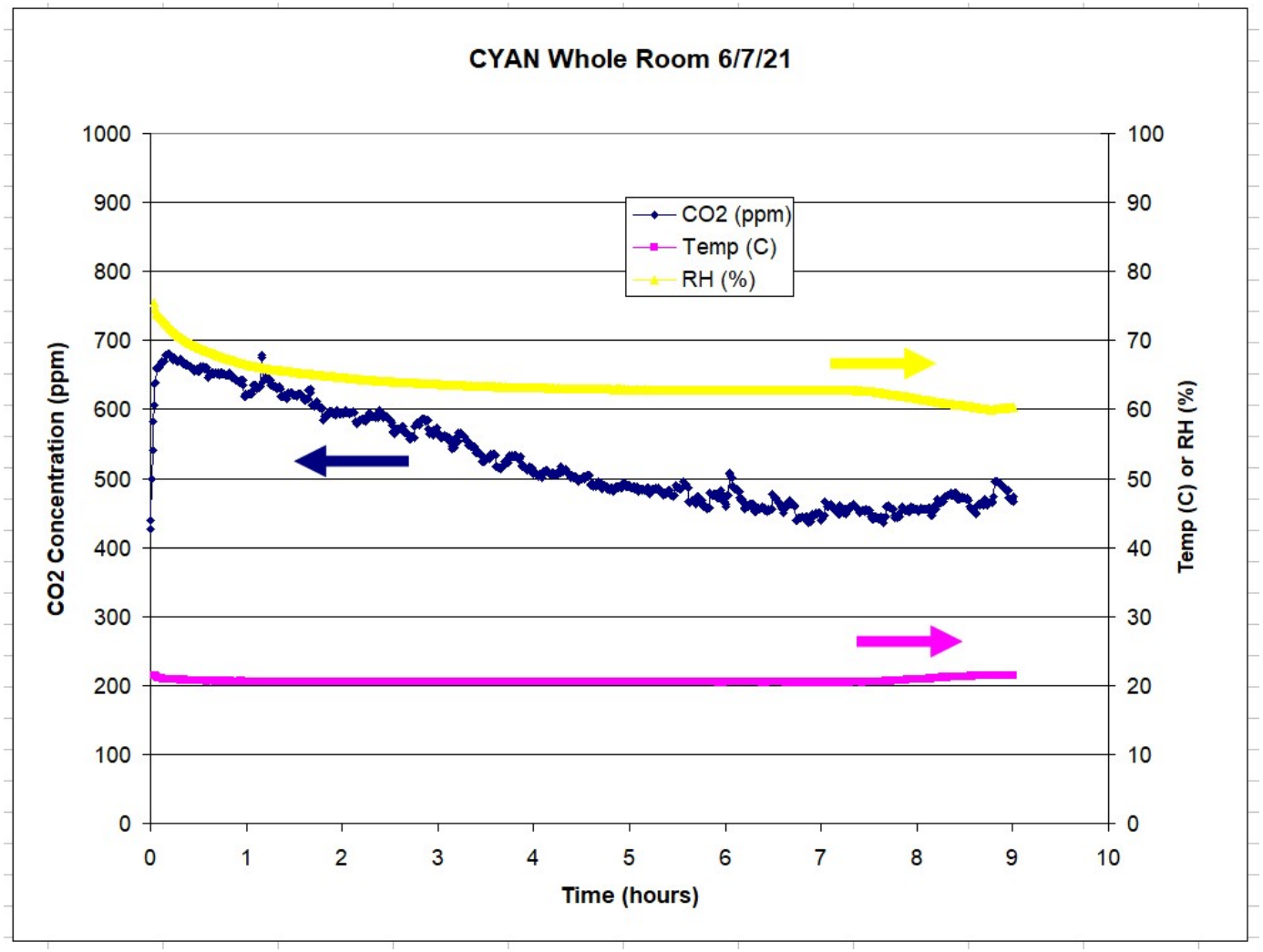
- Closed room, with fan, to try to capture CO2 from entire room volume.
- **5g** Ca(OH)2 in 1L H2O. Does not all dissolve, as expected.



CYAN on top of box now

CO2 Sensor

Open box, full-room run: Results



Analysis of Results (Open Box)

- Calculated CO2 capture from sensor measurement: 16.17g (not believable! from only 5g input)
- Caveats: Accuracy and stability of sensor; homogeneity of room air (need more air blowing?).
- pH measurement:
  - 12+ at start
  - 12+ at end
  - **Ran system for 24 more hours; pH still 12+**
  - ➢ With large amount of input material, we never reach neutrality.

Questions for Followup

- Need better-controlled experiment to determine actual CO2 captured.
- Is it still working (efficiently) if we input more Ca(OH)2 than will dissolve? What are limits?
- Can pH measurement be a useful way to determine endpoint? (what conditions?)
- What about other input materials? E.g. NaOH