

Underway pCO₂ System Description

Laboratory: Plymouth Marine Laboratory, UK

Name/Vintage: AMT pCO₂ system

Reference: general operating principle described in Cooper et al. (1998) but electronics and software modified by Greg Jameson from 1999.

Where installed: British Antarctic Survey ship *RRS James Clark Ross*

Location of Data: To be sent to the British Oceanographic Data Center (BODC)

Analyzer: LICOR 6262 infrared analyzer

Method of analysis: Absolute analysis with two standards

Drying method: None

Equilibrator (setup, size, flows): percolating packed bed equilibrator designed at PML described in Cooper et al. (1998). Water flow rate of about 1 l/min.

Standards (number, concentrations, frequency): 2 standards with approximate concentrations of 250 ppm and 450 ppm. All two standards are run once an hour.

Source of calibration and accuracy: the standards come from Air Products, UK verified against NOAA primary standards.

Standard consumption: less than 1 tank a year

Operating cycle: Hourly sequence of standard 1, air, equilibrator, air, equilibrator, air, equilibrator, air, equilibrator, standard 2, air, equilibrator, air, equilibrator, air, equilibrator.

Parameters recorded/frequency: at the end of each phase the following parameters are recorded:

PHASE: standard, air, equilibrator

TEMP: equilibrator temperature measured using a platinum resistance thermometer

PRES: pressure recorded by the pressure transducer connected to the LICOR as auxiliary channel

FLOW: gas flow sensor connected at the sample out of the LICOR

DATE: system equipped with its own GPS

TIME

LATITUDE

LONGITUDE

LICOR parameters for CO₂ and H₂O, LICOR temperature

Seawater temperature and salinity available from the ship TSG, recorded separately.

Hardware details

Temperature measurements: PRT in the equilibrator

Pressure measurements: pressure transducer

Circulation pathway: See diagram. The system includes two pumps for equilibrator and air. The LICOR sample out through a solenoid valve back to the equilibrator.

Operating software: Quick Basic

Computer interface boards and sensors read:

Boards: Solenoid driver

Sensors: LICOR channels, gas flow, PRT, pressure transducer

Approximate Size and Footprint

Approx. 1m high x 2m wide for computer, LICOR, electronics

Equilibrator 1m high x 0.5m wide

“Unique” Hardware or operating principles worth highlighting:

- Automatic reset of the computer in case of "hanging" communication errors
- Shutdown in case of low gas flow

What improvements would you incorporate in this system?

I would connect a peristaltic pump between the seawater inlet and the equilibrator as the seawater flow is not constant, which might either flood the system or create a too big temperature difference between the equilibrator and the seawater.

Reference:

Cooper et al. 1998. Variation of pCO₂ along a North Atlantic shipping route (UK to the Caribbean): a year of automated observations. Mar. Chem., 60, 147-164.

