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pH or pH/ORP Sensors and Moored Applications

Sea-Bird's pH and pH/ORP sensors (SBE 18 and SBE 27) were originally developed for use on profiling CTDs. Users familiar with laboratory sensors for these *electrochemical* parameters are generally aware of their inherent weaknesses and limitations (e.g., limited depth capability, drift and attendant need for frequent re-calibration, pressure hysteresis, fragility, limited life expectancy, etc). Carefully handled, they are nevertheless useful for water column profiling in many survey and research applications.

Results on moorings have been less satisfactory because frequent calibration is often impractical, and constant immersion hastens the diffusion of seawater into the reference (all pH and ORP sensors use some kind of porous interface between outside seawater and the inside electrolyte), which causes drift and eventual failure. Drift (uncertainty) is further compounded by bio-fouling, and we are unaware of a method to protect the pH electrode from fouling. We have also recently become aware of additional uncertainties associated with the intermittent sampling inherent in moored applications - where the host instrument (for example, a SEACAT) wakes up, powers the pH or pH/ORP sensor, and then goes back to sleep. Because electrochemical sensors such as these exhibit fairly long and somewhat indeterminate stabilization times, successive samples may be significantly different. These sample-to-sample differences appear as noise in the time series record, but the mean value may also be in error because the signal never fully equilibrates. As a result of the many uncertainties and problems associated with these sensors, **we no longer recommend their use in moored applications**.

In general, bio-fouling is not an issue when profiling, nor are stabilization times on the order of 30 to 90 seconds. Profiling does not entail continuous immersion, which means that the sensor is readily accessible for frequent re-calibration, and diffusion resulting from lengthy seawater exposure is much reduced.

Those who choose to continue using pH and pH/ORP sensors in moored applications should increase the time interval between applying power to and logging a reading from the sensor. A relatively long interval of at least 60 seconds is necessary to reach stabilization.

- ***plus* production SEACATs (SBE 16*plus*, 16*plus*-IM, 16*plus* V2, and 16*plus*-IM V2; SBE 19*plus* and 19*plus* V2 in moored mode) -**
  Set the delay before sampling to at least 60 seconds, using the appropriate command.
  - SBE 16*plus* (RS-232), 16*plus* V2 (RS-232), 19*plus*, and 19*plus* V2: set **DelayBeforeSampling=60**.
  - SBE 16*plus* (RS-485), 16*plus*-IM, 16*plus* V2 (RS-485), and 16*plus*-IM V2: set **#iiDelayBeforeSampling=60**.

- **Older SEACATs (SBE 16 and SBE 19 in moored mode) -**
  Set the voltage delay to at least 60 seconds. Note that the format of the command (whether the delay is entered in seconds or in milliseconds) and the SEACAT default that is added to the user-input delay varies, depending on your instrument type and the firmware version. Consult the manual that came with your SEACAT for the voltage delay command for your instrument.