Improvements on the drift of dissolved oxygen sensor (*RINKO* ARO-FT)

Shinichi Takai[1] ,Hua Li[1] ,Hiroshi Uchida[2]

[1] JFE Advantech Co., Ltd., Nishinomiya, Hyogo, Japan

[2] Japan Agency for Marine-Earth Science and Technology, Yokosuka, Kanagawa, Japan

Abstract

It has been documented (Bittig et. al. 2018) that optical DO sensors experience approximately -5 % per year drift during their storage and transportation in air. In order to suit the requirements of Argo float application, we developed DO sensor, "*RINKO* ARO-FT", which has well-known features of fast-response (<1 s) and long-term stability. To evaluate the storage drift, we stored the *RINKO* ARO-FTs in room temperature without providing power for 10 months and measured the drift every two months by our standard calibration procedure with 20 measurement points (4 temperatures × 5 DO concentrations). From this, we learned that the drift was -1.61 % of reading (average of two sensors at 20° C/100 % saturation) in 10 months. Aging of sensing foils, in general, result in overestimating on DO measurements. On the contrary, the drift during storage had a tendency to underestimate the DO values. To reduce the drift during storage, we have been studying the sensing foil materials that probably cause these unusual changes and searching for methods to minimize the influence.

Introduction

Stability of DO sensor is important for accurate dissolved oxygen measurement in automated measurement systems, such as the Argo float. Comparing with the drift during in-situ deployment which is usually very small (high stability), drift in storage and transportation is relatively high, which cannot be ignored in Argo float application. With long term experiences on developing DO sensing foil, we know how to research and improve sensors stable. Here in this presentation, we address the improvement on the drift of *RINKO* ARO-FT and report the results of our continuous test with periodical calibrations done in 10 months since the initial calibration.

Method

Two units of *RINKO* ARO-FT were prepared from the same lot of membrane which was manufactured 7 months before initial calibration. Once these units were ready, they were stored at in-house environment without providing power to them except for short period of times (28 hours each) for their calibrations. They were periodically recalibrated and compared with the initial one to calculate drift over time.

Our calibration is automatically operated as,

- Based on Stern - Volmer equation (Uchida et al., 2008).
- DO reference standard from NMIJ (National Metrology Institute of Japan) certified traceable gases with air saturation values of approx. 20%, 50%, 80% and 120%.

Figure 1 Calibration system at JFE Advantech factory.

Results

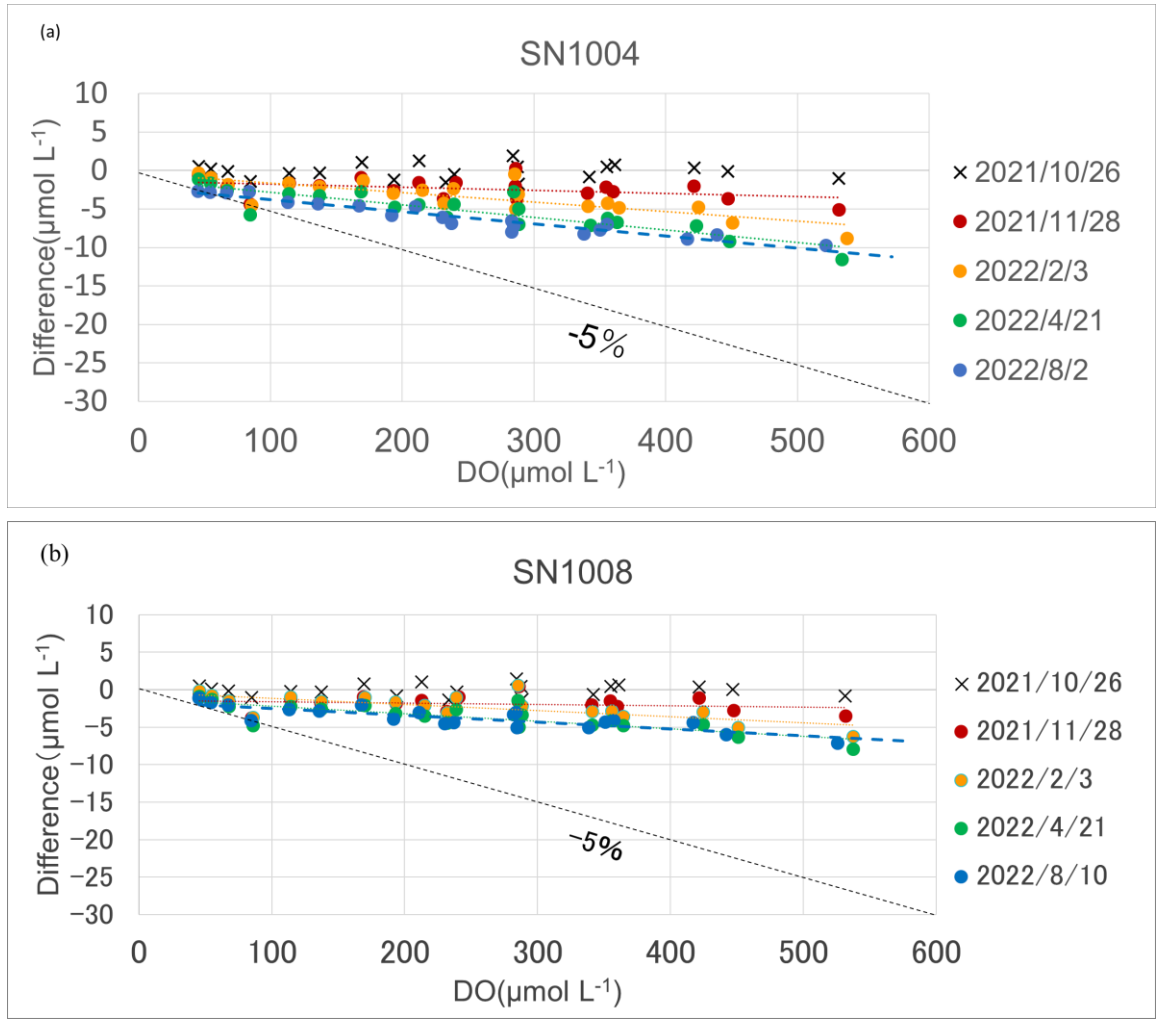

Figure 2(a)(b) Drift in storage over time in 10 months for SN1004 and SN1008 respectively.(Storage under room temperature)

Figure 2 (a) and (b) show the results on the drifts over 10 months for two units of *RINKO* ARO-FT. SN1008 has smaller drifts(about 1% of reading in 10 months) in comparing with SN1004 (2% of reading in 10 months). At oxygen concentration of 100% air saturation and water temperature 20° C, the drift is within -1% of reading for first 100 days, which is within accuracy of ±2% of reading warranted by the manufacture. The changing rate of time drift from initial calibration becomes smaller over time, and there are almost no further changes after the following 200 days.

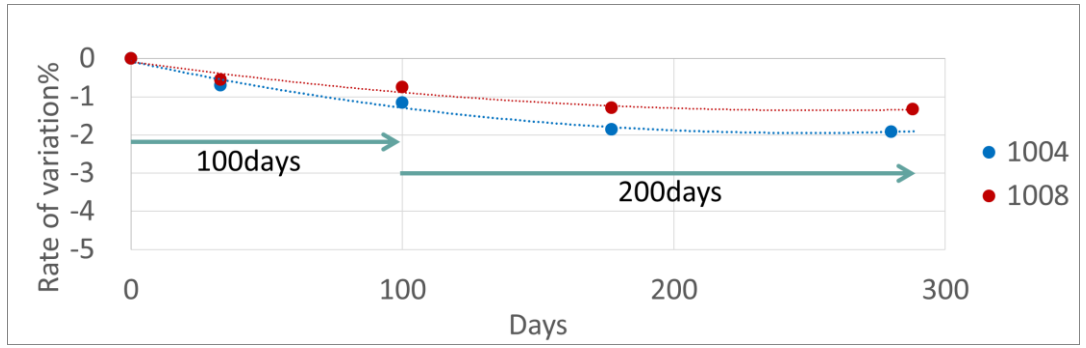

Figure 3 Changing rate of time drift from initial calibration (oxygen concentration 21%, water temperature 20° C)

Conclusion

- The amount of drift with *RINKO* ARO-FT during storage was confirmed by repeated calibrations with factory facility for 10 months.
- 10 month continuous experiment shows that max drift is within 2% of initial calibration.
- The drift is less than 1% at first 100 days, which is only half of accuracy guaranteed by the manufacture. After that, further 1% of reading drift are caused by longer time (200 days), suggesting a slower drift speed.
- It could have smaller drift of less than 0.5% of reading if the initial calibration is conducted after foil is pre-stored for a year.

References

Bittig, H. C., and Körtzinger, A. (2015). *Tackling oxygen optode drift: nearsurface and in-air oxygen optode measurements on a float provide an accurate in situ reference.*

Bittig, H. C., and Körtzinger, A. et.al (2018). *Oxygen Optode Sensors: Principle,Characterization, Calibration, and Application in the Ocean*

Uchida, H., et al(2008). *In situ calibration of optode-based oxygen sensors.*