Evaluation of seashore salinity measurement methods

Korea Institute of Construction Technology, Hanyang University, KSCE ○ Lee Jong-Suk
Korea Institute of Construction Technology, KSCE Choi Won-Sung, Lee Jang-Hwa
Hanyang University, KSCE Moon Han-Young

1. Introduction

Several methods are prescribed or reported for the measurement of the salinity developed in coastal areas. However, differences may occur in the salinity measured during identical periods and in identical areas according to the measurement devices. The selection of an appropriate salinity measurement method with respect to the objective is thus extremely important. Following, investigation on former salinity measurement devices and a device designed in this study is performed in view of the absolute values that can approach fairly the actual salinity.

2. Summary of the experiment

The tests have been carried out in both laboratory and field. The methods adopted for the tests were the Wet-candle (ISO 9225)[1)], Dry-gauze (JIS Z 2382)[2)] and Stainless method (PWRI)[3)], and K3 and K3h developed in this study. The latter combines the merits of the K3 device and Wet-candle method. The Dry-gauze method (JIS) makes use of a dry gauze of 10cm×10cm as sampling swab and the stainless-type device (PWRI) uses a stainless measuring plate of 10cm×10cm. The sampling device of the Wet-candle method (ISO) exploits a capturing gauze with an area of 10cm×10cm, its wig inserted in a solution as shown in Fig. 2. The K3-type salinity sampling device depicted in Fig. 3 presents an opening of 10 cm 10 cm with two measuring plates of 10cm×12cm installed inside the box and an isolating membrane disposed at a height of 2 cm at the bottom. K3h reflects the characteristics of the wet gauze of ISO 9225 by installing a water supply unit at the bottom of the K3-type measuring device.

In addition, an equipment able to simulate sea winds and salinity has been designed and manufactured to perform salt capturing performance test so as to evaluate the performance of the measuring devices in a short-term in laboratory (Fig. 4).

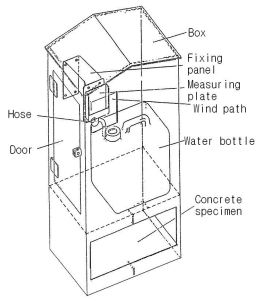

Fig. 1 PWRI type

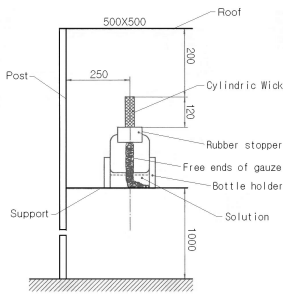

Fig. 2 ISO type

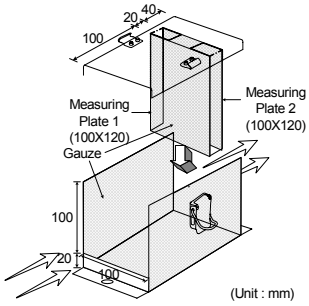

Fig. 3 K3 type

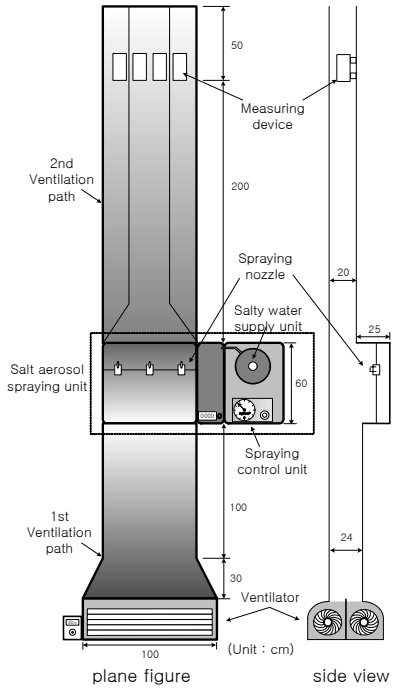

Fig. 4 Laboratory test equipment

3. Experimental results and investigation

3.1 Investigation of the laboratory test results

Fig. 5 illustrates the performance test results obtained for K3, JIS and PWRI devices. The tests were performed during 180 minutes with wind speed of 3 m/sec and salt spraying quantity of 55 g/min so as to simulate environmental conditions presenting relatively low salinity. Taking reference to JIS, K3 exhibits a measuring performance reaching 130% whereas PWRI remains at about 20%. The poor sampling performance of the PWRI device can be explained by the difficulty to control the air flow toward the rear side of the stainless plate.

A second series of tests was carried out to simulate the splash zone or rainy environment presenting large salinity. To that goal, the measuring devices were placed at proximity of the spraying nozzle of which the angle was adjusted. The tests were performed with wind speed of 3 m/sec and salt spraying quantity of 95 g/min during 90, 180 and 270 minutes. Test results arranged in Fig. 6 reveal that the relative salt capturing sampling rate of JIS decreases

Keywords : salinity, seashore, measurement, standard, inspection
Address: : 2311, Daehwadong, Ilsangu, Goyangsi, Gyeonggido, 411-712 Republic of Korea Tel: +82-31-910-0139

with time, and that the amounts of salt captured by K3 and PWRI after 270 minutes are 4 times and 2 times of the one of JIS, respectively. This indicates that JIS may be inappropriate to measure salinity in places swept by splash airborne salt presenting large moisture. On the other hand, the high salt capturing rate exhibited by the K3-type device under such conditions may be justified by the presence of the isolating membrane at the bottom of the device and the quantity of swab inside the box.

3.2 Investigation of the field application results

Fig. 7 summarizes the results measured during 1 month by installing the JIS, K3 and PWRI devices at proximity of the splash zone in seashore swept by salt with high moisture. K3 and PWRI presented similar sea salt capturing rates and exhibited remarkable performances compared to JIS, which proved their excellent applicability in places developing salinity with high moisture like the splash zone.

Field applications also investigated the performance of the measuring devices according to the distance from the seashore. Fig. 8 presents the measurement results obtained during 7 months for JIS, K3 and PWRI devices installed 10m, 200m, 500m and 1000m far away from the seashore. When salinity decreases as the distance from seashore increases, the salt capturing rate of each of the devices sequentially ranges from JIS, PWRI to K3. Consequently, it appears that PWRI device constitutes an inadequate method in such environmental conditions while K3 and JIS devices exhibit remarkable applicability in places with relatively poor salinity.

Comparative test with the Wet-candle method of ISO 1225 was performed for the K3-type measuring device, which exhibited the most remarkable performance among the experimental results. The K3h-type measuring device was also tested and compared. Measurements were executed during one year at distances of 15, 70, 500 and 2000 m from the seashore. Results revealed that the sampling performance of ISO method remains at a level running around 25% of the K3-type device, and that K3h using wet gauze improved the performance by about 10% compared to K3 using dry gauze. This indicates that the ISO method is inappropriate in measuring the absolute quantity of salt, which is the closest value of the real salinity, but can be applied to examine the relative salinity with respect to the measuring location since no variation occurred according to the sampling direction.

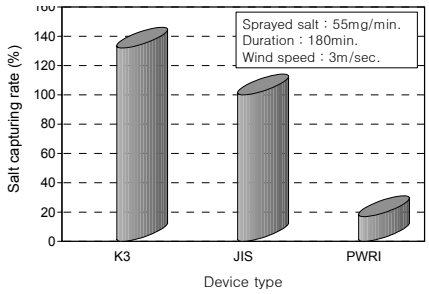

Fig. 5 Laboratory Test (Normal Condition)

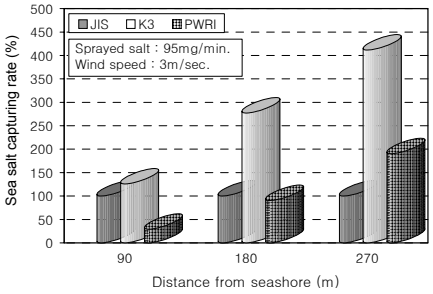

Fig. 6 Laboratory Test (Splash Zone)

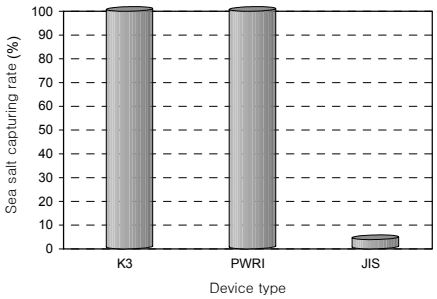

Fig. 7 Comparison in the Splash zone

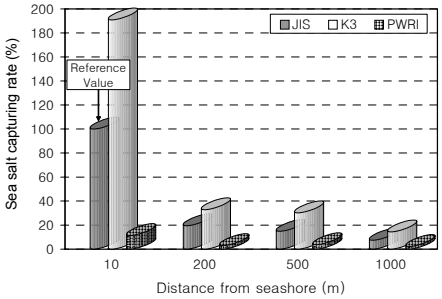

Fig. 8 Comparison to the distance to sea

4. Conclusions

Tests have been carried out in laboratory as well as on field to examine the sampling performances of salinity measuring devices. Results revealed the applicability of the Stainless-type (PWRI) and K3-type devices in splash zones swept by airborne salinity with high degree of moisture, while the Dry-gauze (JIS) and K3-type devices exhibited remarkable applicability in places presenting normal salinity. On the contrary, the sampling performance of the Wet-candle type device (ISO) appeared to be relatively poor, but the absence of variation regard to the sampling direction renders it applicable for the examination of the relative salinity according to the measuring location.

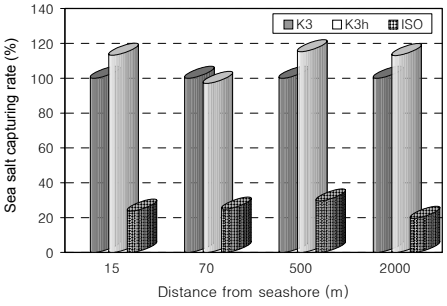

Fig. 9 Comparison with ISO standard

References

1. ISO 9225, International Standard, "Corrosion of metals and alloy - Corrosivity of atmospheres - Measurement of pollution", 1992.
2. JIS Z 2382, Japanese Industrial Standard, "Determination of pollution for evaluation of corrosivity of atmospheres", 1998.
3. PWRI, "Nationwide inspection of airborne sea salts(IV)", Public Works Research Institute, 1994