Development of the Gerdien type atmospheric ion concentration measuring instrument for earthquake prediction

Masahide Nishihashi[1]; Kiyoshi Wadatsumi[1]; Isao Yamamoto[2]; Yousuke Noumi[3]

[1] Bio-Geosphere Sys. Sci., Okayama Univ. of Sci.; [2] Dept. ICE, Okayama Univ. Sci.; [3] Fac.of Informatics, Okayama Univ. of Sci.

http://www.e-pisco.jp/

It has been indicated before that the atmospheric ions are effective in the short-term earthquake prediction (Tributsch, 1978). In addition, sudden changes of atmospheric ion concentration had been confirmed before Kobe Earthquake in 1995 (Satsutani, 1996). Moreover, the conduct of atmospheric ions is greatly concerned with the electric field in the atmosphere.

At the seismo-environmental laboratory of Okayama University of Science, aiming at earthquake prediction, continuous measurement of atmospheric ion concentration has been carried on since 1998. The positive large ion concentration in the atmosphere increased before western Tottori earthquake in 2000 and Geiyo earthquake in 2001 (Wadatsumi et al., 2003).

However, there is a limit in investigating the relation between atmospheric ion concentration and earthquakes in single point measurement of only Okayama University of Science. Therefore, measurement at multipoint is indispensable. For that purpose, many atmospheric ion concentration measuring instruments are needed. However, since the measuring instrument used now is expensive and large-sized, it does not fit multipoint measurement. In order to overcome such a background and to realize earthquake prediction, we have developed the cheap and small measuring instrument.

Now, we are testing with the measuring instrument in several sets of trial productions. The almost same data as the measuring instrument used until now is obtained. Moreover, we have got the data which has correlation between the measuring instruments of a trial production. However, there was no correlation with the conventional measuring instrument at the beginning of development. We report the main points of having repeated and improved much trial and error.

(1) In order to measure the very minute current of 10^-12 - 10^-14A, very high resistance is required. At the beginning, it was measuring combining 10^10 ohm resistor and the 20 times as many amplifier as this. However, in order to raise reliability, it exchanged for 10^12 ohm resistor sealed with glass.

(2) In order to measure large ion, 850V high voltage is impressed to a measurement pipe. And in order to measure the minute current which flows into measurement electrode, it is necessary to make it high insulation. At the beginning, electrode was supported to the both ends of a measurement pipe using Teflon. However, since the ion adhering to Teflon was emitted gradually, it turns out that exact measurement is difficult. Moreover, Teflon had report of not being suitable in the ion concentration measuring instrument (Misaki, 1979). Therefore, the both ends of a pipe were dropped on the ground and insulator of a measurement electrode was changed into polypropylene (PP).

(3) We exchanged the signal line from a measurement electrode to amplifier for the shield line, and cut the noise from the outside.

(4) Power supply equipment was changed into that reliable.

(5) We twisted the thin copper plate around 10^12 ohm resistor, and increased the capacity.

(6) We attached the pipe made from PP between measurement pipes, in order to cut the noise of fan.

(7) In order to remove the influence of humidity, we sealed amplifier and the power supply case, and installed silica gel. Moreover, the case made silica gel easily exchangeable structure. Furthermore, in order to always carry out the monitoring of the humidity variation, the temperature hygrometer was attached in the measurement pipe and the case.

(8) We cleaned the circuit board, the measurement electrode, and the shield line. In the last stage of measuring instrument manufacture, cleaning is very important.

Recently, we are groping for the calibration method of the measuring instrument using ion generators. We put the ion concentration measuring instrument in practical use early, and want to make multipoint measurement realized.