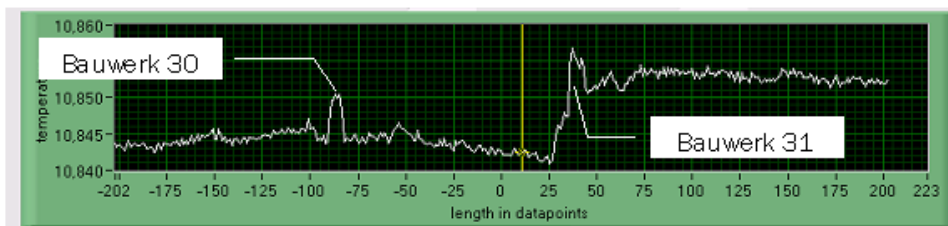


variations are quite small and the soil temperature was measured to be around 5°C. As a result a substantial temperature increase is associated to every leakage even in the case of low leak rates.

The pipeline construction phase was completed in November 2002 and the pipeline was fully operating in January 2003. In July 2003, a first leakage was detected by the monitoring system. It was later found that the leakage was accidentally caused by excavation work in the vicinity of the pipeline. Fig. 9 shows the occurrence of the leakage and its effect on the temperature profiles as they were displayed on the central PC in the control room. The graphs in Fig. 9 correspond to measured raw data, i.e. Brillouin frequency shifts, as a function of distance. By using the 0.927 MHz/deg temperature coefficient, the local temperature increase due to the leakage is measured to be 8°C. This corresponds to a leak rate as low as 50ml/min. An alarm was immediately and automatically triggered and the flow was eventually stopped.

Temperature profile before leakage



Temperature profile when the leakage is detected

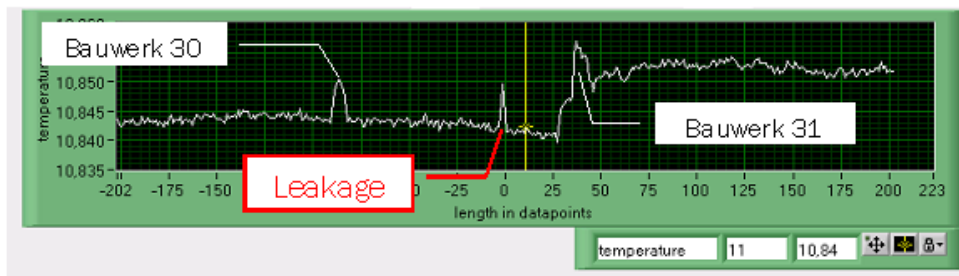


Fig. 9 Measured profiles before and after the leakage occurred at distance 17'970 meter from the pumping station, as displayed on the central PC in the control room. The vertical scale corresponds to raw Brillouin frequency shift given in GHz. The observed local temperature increase associated to the leakage was measured to be of around 8°C.

Taking into account the application requirements in terms of distance range and measurement time, neither Raman nor spontaneous Brillouin scattering techniques were applicable and only a stimulated-Brillouin-based system could perform an accurate temperature monitoring in the available time (monitoring of 55km with 1°C accuracy in less than 10 minutes). To-date the leakage detection system has been in operation for two years and two leakages were successfully detected.

On the other hand, leakage detection for water mains is ongoing at Noksan, Pusan, Korea. This project was initiated in June this year 2005 by Pusan Metropolitan city and 4.4km length of pipeline of which diameter is 900mm has been under construction. The local government worried about the leakage problem that might be stemmed from the ground subsidence because the territory Noksam is a reclaimed land from the sea to develop a big industrial complex.

Unlike the brine case, where the temperature of the liquid inside keeps relatively high so that the fibre underneath easily picks up the temperature difference in case it leaks, water detection by temperature is not easy due to the lower margin of the temperature difference between in and outside of pipe. It was