Development of real-time pipeline management system for the prevention of accidents

Younghwa Kim¹, Jinsuhk Suh², JaeYong Cho¹, Saravjeet Singh¹, JaeSoon Seo³
¹Rural Research Institute of Korea Rural Community Corporation, South Korea
²K-water Institute of Korea Water Resources Corporation, South Korea
³Wacon Corporation, South Korea
kimyh6115@hanmail.net, suhjs@kwater.or.kr, jryong72@hanmail.net, sabbyjosan@gmail.com, jsseo21c@naver.com

Abstract: Recently the importance of the management technologies for prevention increases. There are many kinds of pipelines under the ground of cities which have pipelines for waterworks, wastewater, oil, gas, electronic power, communications, heat energy, and so on. And these underground pipelines have different roles in supply the essential resources for citizens of cities and will be more important for citizens increasingly. So we call these pipelines as "LifeLine." By the way, these pipelines do not support their core roles to citizens and we can easily see that pipeline accidents have given inconvenient facts or serious man-made disasters to modern citizens as well. For examples, road settlement and sinkholes, waterworks leaks, pollutions by wastewater and oil, explosions by gas, and so on. Nowadays, we live in times using ICT - sensor technologies. So these environments have been advanced and are probably possible to resolve pipeline management problems using them beforehand in real time. Thus, ICT convergences will encourage us to make new technologies and paradigms on the field of pipeline management.

Keywords: Smart Pipe, Life Line, Pipe Accidents, Real-time Management

1 Introduction

It is quite difficult to manage pipelines for waterworks, wastewater, oil, electronic power, communications, etc. because they are laid under the ground. However, if it is possible to detect or find out the location of leakage or breakage by smart pipeline system, we can reduce social cost from managing pipelines under the ground. ICT - sensor technologies which have been increasingly developed. If these ICT technologies can be utilized to prevent pipeline issues in advance, consumers can be served better and also pipeline operators can give better services to them. So web programs linking the current pipeline management with the ICT technologies in real-time make it possible to prevent pipeline problems beforehand when carrying out different pipeline constructions.
2 Current waterworks pipe management systems

There are four kinds of waterworks pipe management technologies in Korea: 1) water works pipe block system, 2) waterworks pipe fiber-optic cable system for leakage management, and 3) film type of self-contained (embedded) waterworks pipe sensor cable system for leakage management. For waterworks pipe block system, it is the most common technology for the follow-up management by installing both hydraulic meters and flow meters. This system divides water networks into block units for better management efficiency. In addition, waterworks pipe fiber-optic cable system has an advantage of long-distance detection function for water leaks. On the other hand, it has a considerable error bound due to its temperature difference and does not have advanced prevention one. Lastly, there is the film type system with embedded waterworks pipe sensor cable. However, this technology failed to commercialize because the film easily comes off. Also, this technology does not have a leakage prevention function in advance. Therefore, waterworks pipe management system could be improved much if we can prevent pipeline leakage issues in advance and in real time through ICT technology.

3 Real-time Waterworks Pipeline System for Prevention

Prevention system includes ‘Substructure,’ ‘Real-time Prevention Service Program,’ and ‘User Device.’ The substructure consists of ‘smart warning tape,’ ‘smart sensing tape,’ ‘remote sensing equipment,’ ‘smart pipe,’ ‘joint leakage sensor,’ and ‘joint protection cover.’ For the real-time prevention service program, it is broadly composed of ‘underground facility information management system,’ ‘business supporting system for
GIS information management, ‘underground pipe management system,’ ‘service message bus,’ and ‘database’ as below.

4 Future work & Conclusion

It is the most important to utilize this program for safety management preventing serious man-made disaster. In particular, pipelines under the ground in cities as ‘LifeLine’ are often broken for operators’ carelessness while they are working for city maintenance and urbanization. Therefore, if the real-time system detecting breakage and leakage in advance can be applied, we expect that it would be very helpful for maintenance control for national property. In addition, if the system can be applied to different pipelines such as for agricultural water, water supply and sanitation, power, oil, and gas in cities, it can contribute to better services to citizens.
Acknowledgement. This research was supported by Smart Water Grid Research Program funded by Ministry of Land, Infrastructure and Transport of Korea government. Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science Technology(NRF-2011-0025300 and NRF-2014R1A1A1008524).

References

3. Korea Water and Wastewater Association(2010), Waterworks standards
4. Korea Water and Wastewater Association(2010), Water accident casebook,
5. Gumi West(2014), Infrastructure Asset Management Primer