

The Development of Technologies for the Renewal of Aged Pipes inside Customers' Premises

By

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1. Introduction

With the aim of facilitating the improvement of aged buried pipes inside customers' premises, one of the most important challenges for ensuring the safety of city gas, and under contract to Japan's Ministry of Economy, Trade and Industry (METI) for a period of five years beginning in 2001, the Japan Gas Association (JGA) conducted the development of a new approach to pipe improvement, namely, a method of inserting a new gas tube into existing gas piping, thereby resulting in reduced improvement cost. This paper reports on the achievements of this development project.

2. Background and Objective

A report published by the Committee on the Sophistication of Gas Safety Technologies in March of 1998 proposed to reduce the number of city gas accidents to a level as low as reasonably achievable by 2020, and pointed out the imperative need to promote the replacement, renewal, and repair of aged pipes as a way to reduce the number of associated gas accidents.

Even though gas companies are accelerating the application of such measures to aged pipes, they are facing a difficulty with pipes inside customers' premises. Since these pipes belong to the customers, gas companies have to obtain approvals from them before they can make any improvements. Difficulty in obtaining approvals has become a major hindrance to the speedy execution of a plan to improve aged pipes.

In this project, we developed techniques that facilitate the improvement of pipes inside customers' premises by reducing the cost of such improvement and thereby help achieve goals for improved safety.

3. Problems with the Conventional Method for Improving Aged Pipes

The improvement works are now generally undertaken on buried piping, which usually requires the open-cut technique, for outdoor piping extending up to the building (Figure 1) while the works are carried out on exposed piping on the external walls of the building and inside of it (Figure 2). With such a method, the improvement is costly not only because of the length of the piping that must be replaced, but also because of the requirement of additional works such as the removal and restoration of paving; drilling and patching of holes that penetrate the exterior walls of the building; installation of hangers and bracings for the exposed piping; and so on.



Figure 1 Buried piping



Figure 2 Exposed piping

4. Achievements of the Development Project

4.1 Development of Instruments for Preliminary Surveys on the Buried Piping

To help decide whether or not the insertion method can be used and determine which section of the pipe requires restoration, we developed technologies that provide information related to the buried piping without digging up the ground, e.g., the number of bends, length, diameter, the reducing piece and branching.

(1) Acoustic inspection device

Installed to the rising pipe at the gas meter, the device, by means of acoustic waves, measures the number of bends and the piping length. The device can be applied to a length of pipe up to 30m with a diameter in the range of 25mm to 50mm.



Figure 3 Acoustic inspection device

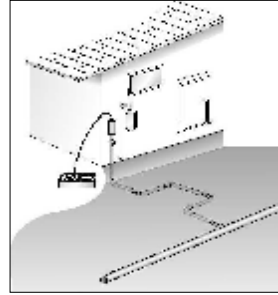


Figure 4 Survey method

(2) In-pipe camera inspection device

Inserted from the rising pipe at the gas meter, the in-pipe camera inspection device travels through the piping via rotation, displaying images on a monitor that can be analyzed to determine the pipe's joints and branches, the distances thereto, or to estimate the diameter. The device can be applied to a pipe measuring up to 15m in length with a diameter in the range of 25mm to 150mm.

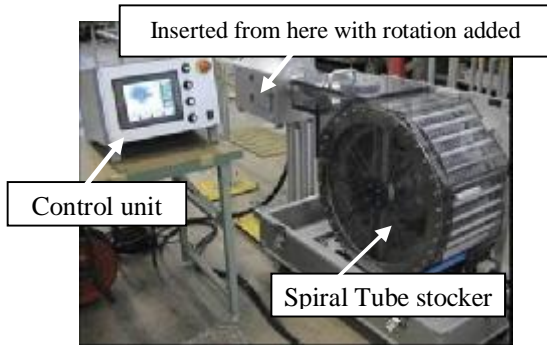


Figure 5 System view

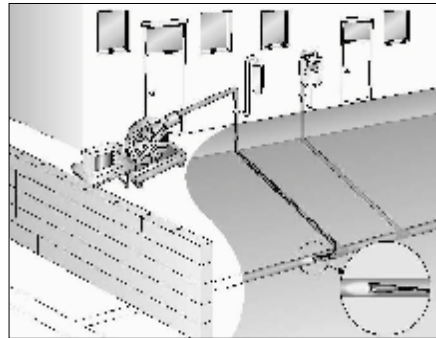


Figure 6 Survey method



Figure 7 Camera head



Figure 8 Spiral tube

(3) Ground Penetrating Radar

The ground penetrating radar emits electromagnetic waves and analyzes the reflected waves to determine the position of the aged buried piping on the horizontal plane as well as its depth. The ground penetrating radar we developed is more compact and light (30kg) than conventional models, and has a better image resolution.



Figure 9 Ground Penetrating Radar

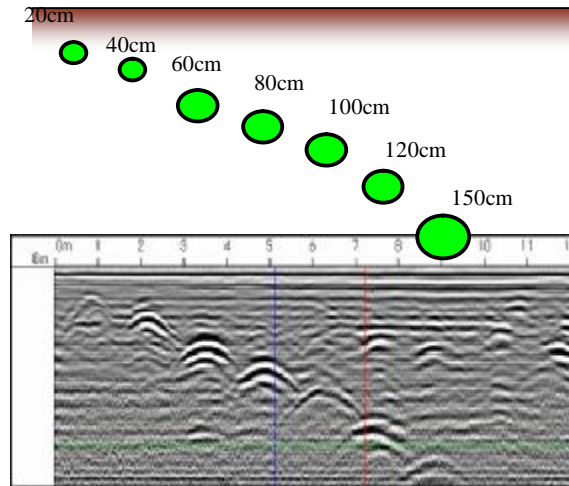


Figure 10 Probe image

4.2 Development of Insertion Techniques

(1) Development of inserted tubes and joints

Since the inserted tube has to travel smoothly through inside aged piping with bends, it must be flexible while maintaining a sufficient performance as a gas pipe.

For this purpose we developed double-layer corrugated tubes and thin-wall PE tubes, along with connecting joints.

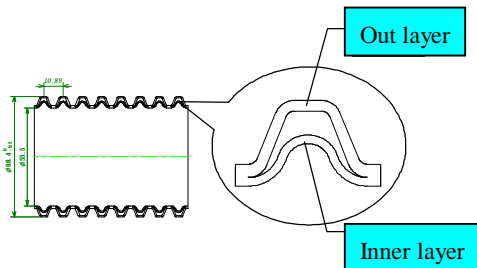


Figure 11 Double-layer corrugated tube

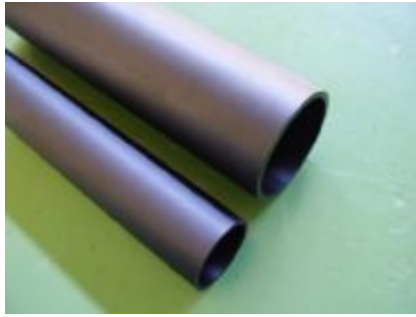


Figure 12 Thin-wall PE tube



Figure 13 Connecting joint for 32A

(2) Evaluation of the performance of inserted tubes

In order to ensure the inserted tubes could perform sufficiently as a gas pipeline, we conducted various performance tests (external pressure withstanding tests, internal pressure withstanding tests, seismic resistance tests, etc.), from which we obtained satisfactory results.

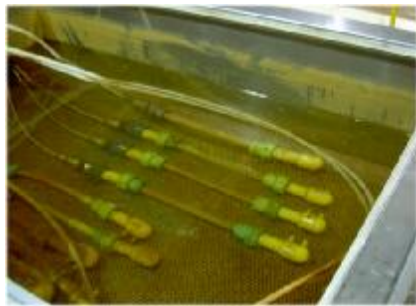


Figure 14 Inner pressure creep test at elevated temperature

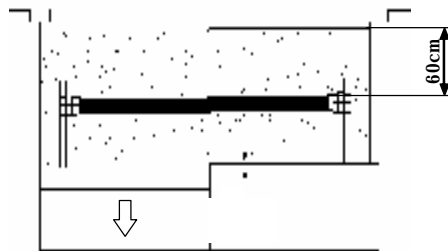
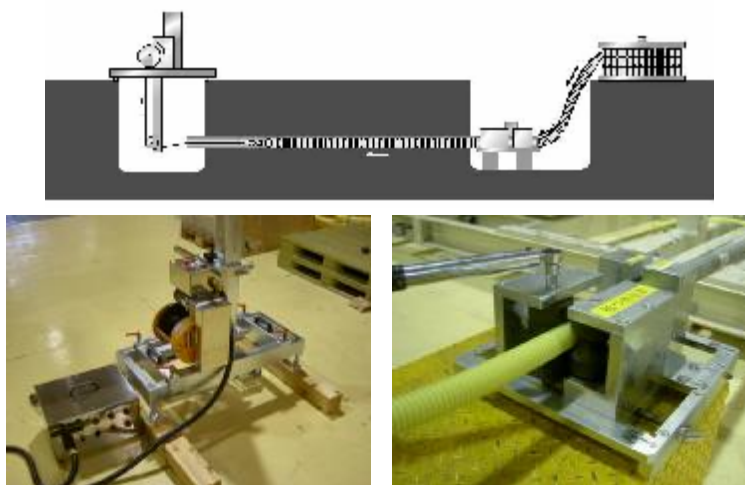


Figure 15 Differential settlement test

(3) Development of insertion tools

We developed tools that facilitate the smooth insertion of a tube into existing piping. We also developed tools that can be used for perforation and joint by working from the interior of the inserted tube without the need to dig up the ground. (The procedures are described below.)



(traction tool)

(pushing tool)

Figure 16 Insertion tools

Procedures for working on the branching point without digging up the ground

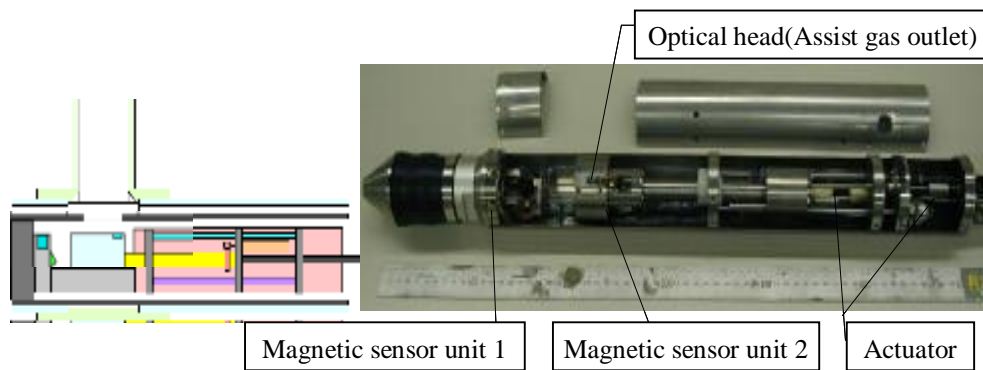
a) Inserting the target and thin-wall PE pipe

As a preliminary work, a target piece (used for identifying the perforation point) and a thin-wall PE tube are inserted into the main pipe.



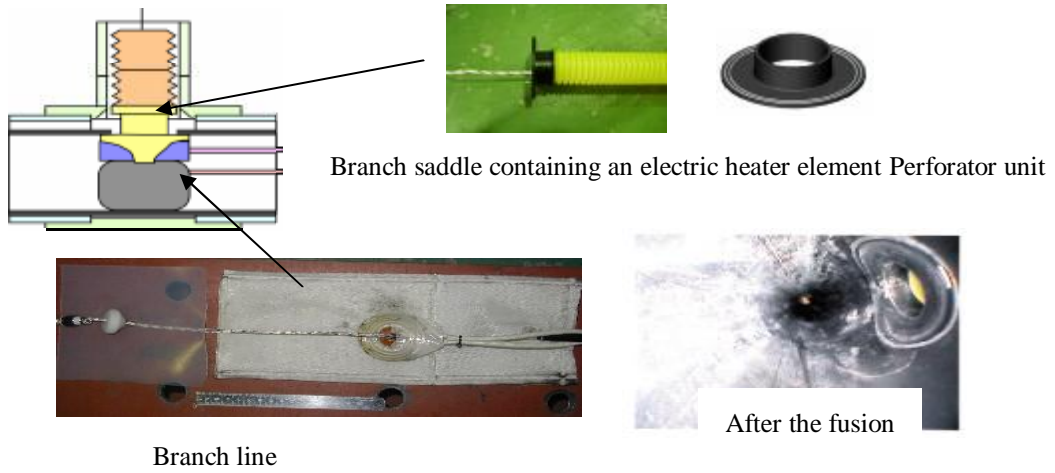
b) Perforation at the branch line

To make a hole for the branch line, a laser perforator is inserted into the thin-wall PE tube, positioned at the location of the target piece, and then activated to perforate the wall of the thin-wall PE tube.



c) Fusing the tube for the branch line

To fuse the tube for the branch line with the tube for the main line, a branch saddle containing an electric heater element is pressed against the thin-wall PE tube with the air packer of the inductor coil. The inductor coil is then turned on to activate the heater element in the branch saddle, fusing it with the thin-wall PE tube for the main line.



5. Acknowledgement

The development project reported herein terminated in fiscal 2005. In the future, we plan to promote our developed techniques. Finally, we would like to acknowledge our gratitude to the staff at METI and related organizations and to the members of the Special Committee for Aged Pipe Renewal Methods of the Japan Gas Association.

Source: “City Gas Symposium” handouts