

Trenchless east and west

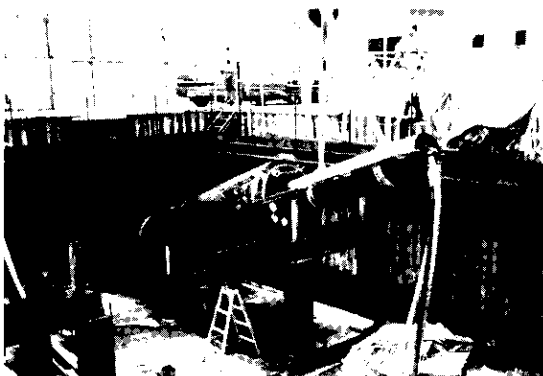
Those familiar with the construction industry in Hong Kong would be well aware that from the 1990s trenchless technology became a hotter and hotter topic. The past decade saw the growing popularity of the Cured in Place Process (CIPP) in drainage rehabilitation. Companies like Insituform, Multiliner, US First Liner, Preussag, etc. have successfully built up their market and job references here, although the application of CIPP in other utility fields is still at an early stage. Slip insertion has also been more commonly adopted with the aid of more automated kits.

Tunnel boring machines (TBMs) and micro-tunnelling techniques have found more common applications. Pipe jacking has been much more extensively adopted for the installation of all sorts of utilities, mainly for crossing of high-speed roads and highways. These are the more well known techniques adopted in Hong Kong, but each of them has its own pros and cons. Some of them are limited to particular kinds of services, some are limited by distance and some are limited by size. To make trenchless excavation a more successful, versatile and cost-effective term in the construction industry, we have to look at the creation or import of more new technologies.

Towngas and U-Tech

Towngas is the major gas manufacturer and supplier in Hong Kong serving over 1.4-million customers. It now operates over 3000km of gas mains in the territory and each year many more kms are added. As a customer-focused utility company, Towngas is well aware of the need to seek new technology to min-

Extending pipe ramming capability: 2m dia x 100m.



imise the inconvenience and nuisance to the public due to its roadworks.

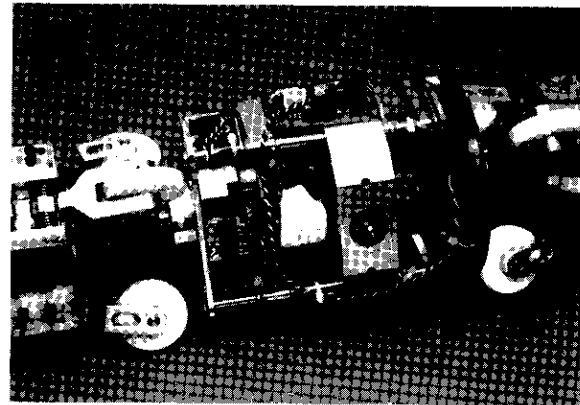
In the past decade, Towngas introduced no less than seven different techniques for gas pipe installation; many of them were pioneered by Towngas in Hong Kong. Collectively they achieve significant reductions in associated noise, dust and traffic congestion. One could produce a lengthy list of advantages to communities arising from trenchless works *eg* less disruption to traffic, fewer delays and diversions, reduced damage to land/roads, reduced impact on residents and businesses, and reduced impact to the environment through minimised excavation.

To leverage the 140-year experience and expertise of Towngas in building municipal gas facilities, U-Tech Engineering Co Ltd, a wholly-owned subsidiary, was founded in 1998 as the construction arm of Towngas to provide construction services ranging from installation, rehabilitation, survey, underground utilities inspection and various building services to clients in Hong Kong.

Two visions

There were two major visions stemming the formation of U-Tech. Firstly, while U-Tech started as a contractor for gas services installation, the long

Simon Ngo and David Brooks* draw on their experience of the application of trenchless technologies in Hong Kong and conclude that the costs of working in public highways will in future render large scale trenchworks prohibitively expensive. Their article will conclude next issue.



Drilling module.

term vision was to become a multi-utilities contractor capable of providing a one-stop-shop service for the installation of all underground services in one-go. The multi-utilities capability would also enable a 'common trench' approach to be realised. Secondly, capitalising on Towngas' long established expertise in trenchless technology, the company could further develop and promote the technology for the benefit of the industry. What U-Tech advocates is a multi-trenchless capability to deal with different environments. With continuous development in the past three years, U-Tech's visions have been realised and it has now become one of the vanguards providing the most comprehensive range of trenchless services to clients in Hong Kong.

Other techniques

Apart from slip insertion, pipe jacking, CIPP, TBM and Horizontal Directional Drilling (HDD), which are not new to

most stakeholders in the industry, perhaps it is worthwhile mentioning the other techniques promoted by the company in recent years:

Pipe Ramming Techniques: Driven by the hammering action of a pneumatic percussive hammer, an open-ended steel sleeve pipe is pushed into the soil from the launching pit towards the target pit. Sections of steel pipes are welded together and pushed one by one until the steel sleeve pipe reaches the target pit. Soil entrained in the sleeve is then removed by compressed air, high pressure water jet or auger drills. The final pipe or duct can then be inserted into the sleeve pipe. Using the ramming technique bores of up to 2000mm diameter, at lengths of 100m can be installed under suitable ground conditions.

Comparing to Pipe Jacking, the beauty of pipe ramming is the avoidance of a large concrete backing shaft thus largely reducing the overall cost and accelerating the speed of installation. Pipe ramming itself is not new in the local civil engineering field, but previously the technique suffered noise and vibration now largely overcome. Successful installations have been completed by U-Tech in the busy roads of Hong Kong at half the cost of traditional pipe jacking or micro-tunnelling.

HDD Techniques: While HDD is not new in the local application, the advent of new technology has enabled it to become more versatile with the capability largely enhanced. Many jobs that could not be done in the past become viable today, with the capability to achieve 600mm x 2km range, in difficult conditions. Crossing the Victoria Harbour using HDD is not now a miracle.

Swagelining: Slip insertion is the simplest technique for rehabilitating an old pipe, but in order for the process to be successful, the carrier pipe must be much smaller than the sleeve pipe resulting in a large reduction in capacity, which may not be acceptable to the client. To overcome that problem Towngas has brought in the advanced technology of Swagelining.

Swagelining is a patent rehabilitation technique developed by British Gas in the 1980s, now licensed by Advantica Technology. The technique makes use of the elasticity and memory effect of polyethylene (PE) to achieve a tight fit liner.

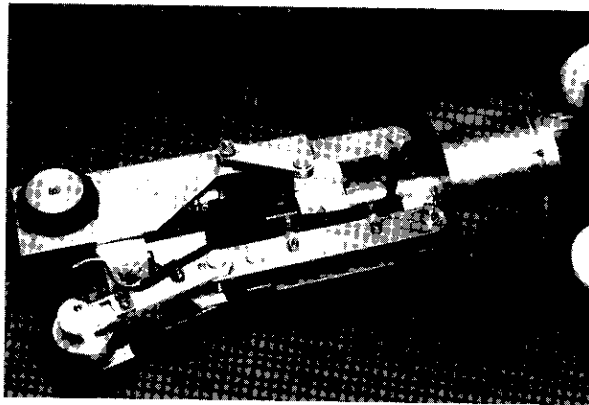
During the insertion process, the PE carrier pipe with its outside diameter slightly larger than the internal diameter of the old pipe is pulled through a reducing die, temporarily reducing the PE pipe diameter and allowing an easy passage into the old pipe.

Due to the memory effect of plastic, once the pulling force is released, the PE carrier pipe will gradually expand to form a close fit lining on the inside wall of the old pipe. This process sometimes incorporates a preheating process, called hot Swagelining, to allow easy insertion of larger pipe diameters. Without preheating the process is called ambient Swagelining.

Swagelining as a close fit relining technique restores a very high percentage of flow capacity of the old pipe, since the slight reduction in diameter can be compensated by the much smoother inner surface of the PE carrier pipe. A variety of pipeline diameters can be accommodated from 2½in (67mm) through to 36in (900mm). The wall thickness of the insertion liner can vary from SDR11 in the smaller diameters through to SDR46 in the larger diameters depending on the pipe requirements. Lengths of up to 1000m (3,000ft) can be lined in one operation depending on the site environment, size and condition of the pipeline.

If the host pipe still has reliable residual structural strength, a thin wall liner can be used to maximise the final flow capacity and minimise costs. A thick wall 'standalone liner' may be used for the case of pipelines with no residual strength.

The flexibility of PE liner enables it to sustain vibration, differential settlement and undue bending stress. PE liner pipe



Tractor module.

is a well-known material widely used for fluid transportation and there are a variety of standard connection fittings available. In addition, no substantial cleaning of the host pipe is required prior to Swagelining and liner failure due to poor bonding to the host pipe is not an issue.

Since 1996, Towngas has successfully completed numerous gas pipe rehabilitation projects using the Swagelining technique. The Swagelining work is now undertaken by its construction arm U-Tech which is currently the only licensed contractor to serve clients in Hong Kong, Singapore and PRC.

Pipe Bursting/Splitting Techniques: Pipe bursting is one kind of size-for-size or up-sizing pipe rehabilitation. Common methods used include pneumatic or hydraulic bursting. The operation is undertaken by pulling a cutting head along the path of the old pipe, which is shattered during the process. The expander connected after the cutting head expands the size of the path to facilitate the new pipe insertion. Pipe splitting is normally used for the longitudinal splitting along steel pipes or ductile iron pipes using sharp roller blades or cutters. Improving the existing pipe flow is the main merit but it is limited for straight pipe only with significant clearance from surrounding utilities required.

**Excerpts from a paper by Simon Ngo, General Manager of U-Tech Engineering Company Limited and David Brooks, Consultant Engineer - Advantica Technology, to be presented at Trenchless Asia 2002*

Service connection robot.

