Study on the Safety Risk Prevention Technology for the Urban Gas Pipeline

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Abstract: Along with the continuous development of our society and economy, the process of urbanization has been pushed forward. As one of the indispensable links in urbanization construction, the gas pipeline has brought great convenience to the life of urban residents, while has some potential safety hazards and brings certain risks to the life, property and safety of urban residents. The management status of the urban gas pipeline and safety risk prevention measures are mainly analyzed in this paper.

1. Introduction
Gas has become one of the indispensable materials in the life of urban residents in our country. It helps urban residents solve the diet problem in daily life. With the continuous acceleration of urbanization construction, the safety construction and management of urban gas pipelines have become one of the key issues of concern in China[1]. The factors threatening the safety of urban gas pipelines and the safety construction issue of urban gas pipelines are mainly analyzed in this paper, and corresponding measures according to the risk prevention technology are proposed to ensure the safety construction and use of urban gas pipelines.

2. Latent danger in the urban gas pipeline construction and management
2.1. Pipeline design issues
Improper design in the urban pipeline construction is likely to cause problems in the construction process of gas pipelines and harm the later use of gas. The problems in the design of urban gas pipelines are mainly caused by the following reasons: First, the gas pipeline design scheme has not been adjusted according to the actual construction situation. In the process of the house construction project in our country, there may be some adjustments due to several irresistible factors, causing the deviation of the house construction project from the original design plan. Hence corresponding transformation of the gas pipeline design scheme should be made according to the adjustment of the house construction project to meet the needs of gas pipeline installation. However, due to some reasons, the gas pipeline design scheme has not been adjusted accordingly, leading to various problems in the process of gas pipeline construction, which not only affects the progress of gas pipeline installation, but also brings hidden danger to the later use for residents. Second, the capacity of gas pipeline designers is inadequate. The gas pipeline designer is the main worker in pipeline design. He needs to design the house gas pipeline according to the national design requirements and make good preparations for the gas construction. But some designers’ lacking competent capacity will bring about mistakes in the pipeline design scheme. As a result, the construction of gas pipeline is inconsistent with the design scheme, which not only affects the progress of overall housing construction, but also brings hidden danger to the later use of gas. Third, the
acceptance work is not well done. The acceptance work mainly includes two aspects, one is the acceptance of the design drawings, the other is the acceptance of the actual construction. If the acceptance personnel can conduct acceptance of the design drawings and construction site according to the state's requirements, they will find the unreasonable phenomena in the pipeline design and construction. Therefore, these phenomena will be pointed out, and designers are required to make adjustments to meet the needs of gas pipeline construction, thus reducing the potential safety hazards of pipeline use in the later stage. However, some of the acceptance personnel fail to conduct the acceptance work with a fair attitude, leading to problems in some design drawings and engineering construction of gas pipelines, which not only cannot guarantee the overall quality of gas pipeline construction, but also brings many potential safety hazards in the later stage (Table 1)[2].

| The failure reasons          |
|-----------------------------|
| Third Party Damage          |
| Construction and material defects |
| Corrosion                   |
| Ground motion               |
| Valve operation             |
| Other causes                |

2.2. Construction material issues
The gas pipeline material is the fundamental factor that affects the later use of gas pipeline. In order to pursue higher economic benefits, some gas pipeline installation companies in China fail to purchase gas pipeline construction materials according to the national or local standards, which results in the fact that the overall quality of gas pipeline is not up to the standards and brings a lot of problems for the later use and management of the gas pipeline. At the same time, some of China's gas pipeline construction units do not have good management measures, which leads to the problem of internal personnel taking bribes in the work and carrying out procurement of some substandard products, reducing the quality of pipeline construction and bringing great danger to the later use of gas pipeline. Therefore, the gas pipeline construction unit should strengthen its management and do a good job in material procurement of the gas pipeline, so as to ensure the gas pipeline can meet the requirements of the state and ensure the life and property safety of urban residents.

2.3. Stray current interference
Stray current interference is one of the main causes of pipeline corrosion. It is a phenomenon that the current will enter from part of the pipeline and flow along the pipeline for a certain distance before flowing into the land. Pipeline corrosion exists in the outflow part, which makes it difficult to solve the safety risks of urban gas pipelines and increases the difficulty of management and work[3].

2.4. Pipeline management issues
The later-period management of the urban gas pipeline is an important measure to reduce the use risk of the gas pipeline. It can eliminate problems such as the gas pipeline leakage through periodic and comprehensive inspection and detection, so as to ensure the safety of gas pipeline during use. However, In China, the monitoring and management intensity of the urban gas pipeline by relevant units is not high and they don't realize the importance of the gas pipeline detection. The relevant staff did not take into account the actual use of the gas pipeline when maintaining it, without monitoring for the corrosion and excavation that may occur in the pipeline, which bring about risks in the use of urban gas pipeline.

2.5. Third Party Construction
The third party construction problem is one of the main problems that cause the damage of urban gas pipeline. With the continuous acceleration of urbanization, urban surface construction will be carried out in the process of construction. In the process of construction, it is easy to cause damage to gas pipelines, thus increasing the working intensity of urban gas pipeline safety risk prevention.
3. Application of safety risk prevention technology for urban gas pipeline

Safety risk prevention technology is an important measure to forecast and evaluate the safety risk of gas pipeline in China. It evaluates the potential problems and hidden dangers in the use of gas pipelines through risk assessment, and evaluates the consequences caused by the problems and hidden dangers. On this basis, corresponding improvement measures are proposed to avoid the loss of life and property caused by urban gas pipelines\(^5\). China’s relevant departments can apply the safety risk prevention technology for the urban gas pipeline from the following aspects, reduce the risks of gas pipelines during use, and ensure the life and property safety of urban residents.

3.1. Internal detection technology

The internal inspection technology is one of the important ways to carry out the internal inspection of pipelines. It can use science and technology to detect and analyze the internal conditions of the pipeline, timely find the internal problems of the pipeline, and provide the repair basis for relevant staff through the test data, so as to avoid the gas leakage, gas explosion and other events caused by the internal problems of the pipeline, and improve the safety of the gas pipeline use.

The later-period maintenance and management of gas pipelines in China has a wide range of applications of the internal detection technology. China’s gas pipeline maintenance department will purchase equipments for internal detection technology according to the actual needs, continuously combine advanced technology to carry out scientific management of the gas pipeline, timely and comprehensively monitor and test the gas pipeline. As a result, It reduces the accidents in the use of gas pipeline, improves the reliability of the gas pipeline operation, and ensures the gas use safety for urban residents in China. The internal detection technology mainly detects the internal gas pipeline from three aspects: abnormal geometry detection, metal loss detection and crack detection.

Internal detection technology is shown in the following table\(^6\).

| Internal detection devices | Detection content | Metal damage | Crack | Geometry | Surveying and mapping |
|---------------------------|-------------------|--------------|-------|---------|-----------------------|
|                           | Corrosion defects etc. | Corrosion crack etc. | Stress corrosion crack etc. | Denting and compression of the pipe shell | Track |

Magnetic flux leakage detector is used as the main method for gas pipeline monitoring. See Figure 1:

![Fig.1: Magnetic flux leakage detector](image)

Its working principle is to detect the corrosion, crack, weld seam, defect, construction damage of the inner and outer pipe wall, the pipeline characteristics and length of the pipeline by using the magnetic flux leakage detection principle, so as to reduce the pipeline operation and management risk and the occurrence of operation and production accidents. Magnetic flux leakage detector is an intelligent detection system, which can detect and record the abnormal defect information and pipeline accessories on the metal pipe in real time. And the defect information and the exact location and size of
related pipeline accessories can be determined through the data analysis and processing in the later stage. Meanwhile, the magnetic flux leakage detector can carry a pipeline mapping system. After the detection, the data collected by the detector can be intelligently analyzed and quantified with the special data analysis software, so as to realize multiple users inquiry with the network. Besides, it has many functions such as pipeline integrity management and risk assessment, testing urban gas pipelines with efficiency and improving the safety risk prevention and control work efficiency of gas pipelines.

3.2. External detection technology

External detection technology is the main measure to guarantee the service life of the gas pipeline in China. It carries out the strict inspection to the external use environment and the use condition of the gas pipeline through the related technology, guarantees the pipeline will not have various kind of problems due to the external factors, enhances the gas pipeline service life. The external detection technology of the gas pipeline is mainly to carry out anti-corrosion protection for the pipeline, and use the corresponding detection method to monitor the external situation of the deep underground gas pipeline, so as to prevent the using problem of gas pipeline due to external corrosion, fracture and other problems, which will cause harm to the life of urban residents. External anti-corrosion coating and cathodic protection system is the main way to carry out external detection of the gas pipeline, both of which have been widely applied in the management of the gas pipeline in our country. But their high cost increase the cost of the gas pipeline management, bringing pressure to urban construction projects.

| Table 3 External detection technology |
|---------------------------------------|
| Detection content | Anti-corrosion coating | Cathodic protection |
| Detection method | Multiple frequency pipe current test method | Close interval potential survey method |

3.3. Management and improvement

To conduct urban gas pipeline management, the management and maintenance of the pipeline itself is not enough, the surrounding environment of the gas pipeline should be taken into account as well. The urban government and relevant responsible units should realize the importance of the surrounding environment of the gas pipeline for the normal use of the gas pipeline, and strengthen the renovation of the surrounding environment and facilities of gas pipelines. As for the illegal buildings around the gas pipeline, we should persuade the people concerned to make them demolished by means of communication, do a good job in the environmental management around the gas pipeline, avoid harm to the gas pipeline caused by the external environment or buildings, reduce external risk factors, and improve the using safety of the gas pipeline[7].

3.4. Enhanced supervision

In recent years, China's natural gas consumption and production have been increasing. By 2017, China's natural gas sales had reached 240.4 billion cubic meters and production had reached 149.2 billion cubic meters. With the increase of gas usage, the gas pipeline construction is gradually strengthened. The Chinese government should strengthen the supervision of gas pipelines to avoid problems in the construction and installation of urban gas pipelines, which will affect the later use and management of gas pipelines. According to the requirements of the gas pipeline construction and installation, the government and relevant departments should supervise the construction site, conduct regular spot check and return visit, and improve the consciousness of gas pipeline construction departments. At the same time, the government and relevant departments should strengthen the monitoring work for gas pipeline construction materials, guarantee the safety of the gas pipeline material use, improve the procurement of relevant construction units and standardize the purchase specification of relevant construction units according to the national or local standards, making sure
that the relevant construction units will conduct procurement according to the standards to ensure the safety and specification of purchased materials.

Improve the acceptance efficiency of the government and relevant departments, do well the design and construction acceptance of gas pipelines, do well the preliminary work of gas pipelines, and avoid problems in the design and installation process of gas pipelines, which will affect the later use. This requires the government and relevant acceptance departments to improve their work attitude and acceptance standards to ensure the actual effect of acceptance work. First, the government and relevant inspection and acceptance departments shall check and accept the design drawings of gas pipelines according to national standards, conduct design drawings acceptance according to the actual housing construction needs, so as to avoid problems caused by designers in the design process that will affect the gas pipeline construction in the later stage and ensure the accuracy of gas pipeline design[8]. Second, the government and the relevant inspection department should improve their acceptance work for gas pipeline construction, carry out the pipeline construction site acceptance according to the national acceptance standards and design drawings requirements, as a way to ensure that the construction site conditions of gas pipelines conform to the national standards and design drawings, achieving the ideal state of the gas pipeline construction and installation. Finally, the government and related inspection department should improve their work attitude and work capacity, carry out acceptance inspection in strict accordance with national acceptance standards and requirements of design drawings, avoid the unreasonable acceptance phenomena due to bribery of the installation units, thus improving their sense of responsibility and ensuring the gas using safety for urban residents in our country.

3.5. Increase the inspection intensity
Inspection should be strengthened in the later stage of the urban gas pipeline management and a 24-hour on-duty system should be built to carry out detailed and comprehensive inspection of urban gas pipelines. In addition, ensure the comprehensive and round-the-clock supervision of the gas pipeline, so that problems in the use of the gas pipeline can be found and solved timely and the loss of town caused by gas problems will be reduced. This needs the government and relevant departments to transform the work content according to the actual situation of the gas pipeline management, arrange the work time according to the weather, the environment and other fact factors, ensure that the gas pipeline can be inspected in any time. Their responsibilities should be fulfilled, so that the safety arrangement of urban gas pipelines can be conducted well and the service life of gas pipeline equipments can be extended, increasing the use efficiency of urban pipeline resources.

3.6. Enhance promotion
With the continuous acceleration of China's urbanization construction, the number of urban residents has gradually increased, and the scope of gas pipeline laying has also gradually expanded. It is difficult to rely only on the government and relevant departments to carry out all-round management of gas pipeline. Therefore, the government and relevant departments should strengthen the promotion of the gas use, and use the Internet, television, newspapers, radio and other means to promote the safe use and monitoring of gas, enhance the awareness of urban residents on the safe use of gas, make them have the ability to test the safety of the gas pipeline and its related appliances in daily life. Hence not only the life safety of urban residents can be guaranteed, but also the management intensity of the government and related departments will be reduced, which is conducive to the urban society safety and stable development. And the fire-fighting promotion is shown in the following table.

| Fire fighting promotion |
|-------------------------|
| The escape knowledge    |
| The fire prevention and response |
| The fire prevention and extinguishing |
| The safety and fire prevention knowledge of |
| Self-rescue methods under accidental fire |
4. Conclusion:
To sum up, the safety problem of the urban gas pipeline has always been the key issue concerned by the state and the government. With the acceleration of China's scientific and urbanization construction, the scientific testing of the urban gas pipeline safety has been put on the agenda, and corresponding results have been achieved, reducing the harm of the urban gas pipeline during use, and ensuring the safety of urban residents. Although there are still some problems in the safety inspection and management of urban gas pipelines, the author believes that with the continuous development of China's socialist modernization, these problems will eventually be solved to meet the safety guarantee of urban residents' lives and promote the further development of China's harmonious society.

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