Study of the Effect of One-Household-One-Meter Transformation on NRW in the Controlled Zone in China

Xiaoling（Ellen） Lei*'*,Li Li**,Haiyan Wang**,Xiaotao Fang*****

* Professor, Chongqing Academy of Science and Technology (CAST); No.2, Yangliu Road, Huangshan Avenue, New North Zone, Chongqing, China 401123, Tel：86-13983290829；E-mail：ellenlei2008@126.com

** Chongqing Jiaotong University; No.66, Xuefu Avenue, Nan'an District, Chongqing, China 400074

***Chongqing Architectural Design Institute (CQADI)

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Abstract

With the rapid economic development in China, the establishment of one-household-one-meter policy was an important reform of water supply charge system due to its significant influence on NRW (None Revenue Water). As the newest municipality directly under the jurisdiction of the Central Government in China, Chongqing is putting into practice of one-household-one-meter transform vigorously in this recent year. In order to study the influence of one-household-one-meter transformation on NRW, this study selected 5 representative controlled zone testing fields of one-household-one-meter transformation in Chongqing, China, collected and tested the corresponding data for a period of 6 months on site running, and analyzed the effects of one-household-one-meter transform on the rate of NRW. The contents include: analysis of the effect of construction quality of one-household-one-meter transformation on NRW; effect of conventional one-household-one-meter transformation on NRW; effect of improved transformation of one-household-one-meter on NRW; analysis of the function of drip-proof valve and its working rules; development of effective strategies on NRW control. It shows that: the construction quality of one-household-one-meter transformation can influence the rate of NRW significantly; the conventional transformation of one-household-one-meter will result in an increase on the rate of NRW. Furthermore, the standard atlas of one-household-one-meter should be developed and implemented in strict accordance with the pipeline design and construction standard. And an improved transformation of one-household-one-meter was developed, that is "drip-proof valve + meter". The on-site testing results shows that this kind of improved transformation of one-household-one-meter can effectively decrease the value of the rate of NRW in a certain time at the beginning; rust and sand founded in the pipe explains for the obvious declining or failure of the function of drip-proof valve after putting into use for 147 days; qualified pipeline maintenance and guarantee of pipeline water quality is necessary to keep the contribution of "drip-proof valve + meter" improvement one-household-one-meter transformation strategy on NRW; Installment of a movable union with filter in front of the drip-proof valve can prevent rust and sand particles entering the drip-proof valve.

Meanwhile, regular cleaning and removing of the rust and dust must be easily done at the same time to assure the normal operation and effect of the drip-proof valve on NRW. The results of this study are very important to the current practice of one-household-one-meter transformation in China.

Introduction

The original water meter in current residential districts of China was transferred to Management Company by the development organization or the developer. The ownerships of the pipeline, water meter and valve after the meter do not belong to water supply enterprises. And thus the reading difference between the master meter and chronometer increases unceasingly; the volume of the NRW which shared by users is on the rise obviously, and this causes the water fee the users actually paid is much higher than the sailor publicized by the government. As a result, it becomes increasingly difficult for the property company to charge the users for water supplying enterprises, which in return decreases the returns-ratio of water fee of the water supply enterprise. Water supply enterprises, the Property Companies and users share the same desire of the implementation of one household one meter policy.

In accordance with relevant national provisions, “urban water supply should implement installing the water meters at each household, copying at each household and charging by measurement.” That is one-household-one-meter transformation, which means a water meter for trade settlement measurement is installed in a household, and the meter is installed in the public parts of residence. Water supply enterprises charge by the measurement of the meter.

This article will introduce the effect of one-household-one-meter transformation on NRW on the bases of practical engineering in China, analyze its results and propose improvement methods to reduce the rate of NRW. The paper obtained two important factors influencing the quality of one-household-one-meter transformation, and it is of great importance for the transformation of one-household-one-meter in China and the decrease of the rate of NRW.

Methods

Selection of testing fields

Testing fields in this study are fields needing rectification with water leakage, pipe bursting, poor materials and installation failing to meet the standards, each field holding about 1000 households. The selection not only saves the costs, but also offers sufficient data to reflect the testing results. Since construction quality will affect one-household-one-meter transformation, testing fields of different construction quality levels are chosen for the study.

Installation of measurement instrumentation

There are two approaches for water meter installation: (1) conventional water meters with speed type B play the roles of both total meter and branch meter. The live water is supplied by municipal administration pipe and the branch water meter is installed in the first floor well or outdoor water meter well with separate service rise in each single household. (2) Improved meter which combines drip-proof valve with conventional water meter with speed type B. The installation is basically the same as conventional water meter expect for the drip-proof valve before each branch meter.

Fields testing and operation

The research lasted for 6 months, and the duration not only can reflect the results effectively, but also can save cost. The shortest period to read meter is 10 days in order to better research the changes in different testing fields.

According to the requirements above, 5 testing fields of different construction quality levels were selected for the study, 2, 1, 1 and 1 field with excellent quality, good quality, average quality and bad quality, respectively. One of the two fields with excellent quality was installed with the conventional meter and the other was installed with improved meter, which is drip-proof valve + conventional meter. Then data of the 5 testing fields in 6 months were collected and tested on site running.

Analysis of the effect of construction quality of one-household-one-meter transformation on NRW

In order to study influence of the construction quality of one-household-one-meter transformation on NRW, different construction qualities controlled zones in Chongqing, China, had been selected as the testing fields for one-household-one-meter transformation, and the relative data had been tested for 6 months on site running. Basic information and testing results are given in Table 1.

Table 1 The effect of construction quality of one-household-one-meter transformation on NRW

Series No. of testing fields	1	2	3	4
Construction quality level	Good	Average	Bad	Excellent
Water supply effective rate（%）	91.1	88.7	83.4	96.1
Rate of NRW（%）	8.9	11.3	16.6	3.9

Note: water supply effective rate = Σ flow of each end point of the water supply / total flow of meter × 100%; rate of NRW= (1 – water supply effective rate) × 100%

Data in table 1 from testing field 1 to 4 reflect the effective rate and NRW rate of testing sites with different construction qualities. It showed that construction with different quality levels have different influence on NRW. Construction with excellent quality produced the lowest influence on NRW, while construction with inferior quality produced the highest influence on NRW, which is 3.9%, 16.6%, respectively. And the average is 10.2% on NRW.

To sum up, improvement in construction quality can significantly reduce the increase of NRW.

Effect of conventional one-household-one-meter transformation on NRW

In order to study the influence of conventional one-household-one-meter transformation on NRW, conventional and improved controlled zones in Chongqing, China, had been selected as the testing fields for one-household-one-meter transformation, and relative data had been obtained and tested for 6 months on site running. Basic information and testing results are given in Table 2.

Table 2 Effect of conventional one-household-one-meter transformation on NRW

Series No. of testing fields	1	2	3	4	5
Type of transformation of one-household-one-meter	Conventional	Conventional	Conventional	Conventional	Improved: drip-proof valve + conventional meter
Water supply effective rate（%）	91.1	88.7	83.4	96.1	110.19
Rate of NRW（%）	8.9	11.3	16.6	3.9	-10.19

Values of rate of NRW in table 2 from testing field 1 to 4 are all positive, while value of rate of NRW of testing field 5 is negative, which shows that the testing field of one-household-one-meter transformation with conventional meters increased the NRW, and testing fields with improved meters decreased the rate of NRW. It can be inferred that the drip occurred in conventional meter installation counted for the results. Meters with an initial high flow of failed to prevent the occurrence of drop, which is right the disadvantage of conventional meters. Thus it is an effective measure to install a drip-proof valve in front of a conventional meter in the transformation of one-household-one-meter, so it can avoid the phenomenon of drip and decrease the value of NRW.

Effect of improved transformation of one-household-one-meter on NRW

In order to study the effect of improved transformation of one-household-one-meter on NRW, water supply effective rates of two sites with the same superior construction quality level but different meter types are compared with each other. Figure 1 showed how water supply effective rates in both conventional and improved one-household-one-meter transformation change with time. The rate of NRW of the testing field 5 changing with time is shown in Figure 2, and the fitting equation is y=8.7649ln(x)-43.757.

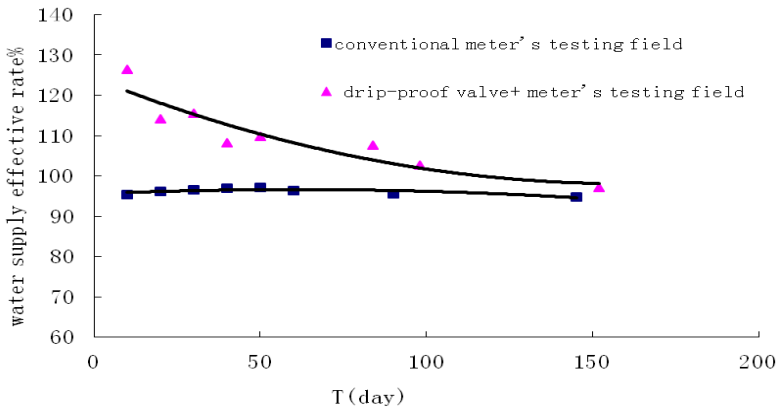

Figure 1 Changes of water supply effective rate with time under conventional and improved one-household-one-meter transformation

Figure 1 shows that water supply effective rate of testing field 4 stay stable in the testing period of 6 months, and the water supply effective rate of testing field 5 tends to decrease over time. And the water supply effective rate of the testing field 5 was remarkably higher than that of testing field 4 during the testing period. Conclusion can be made that improved meter (drip-proof valve + conventional meter) can increase water supply effective rate during a certain period of time.

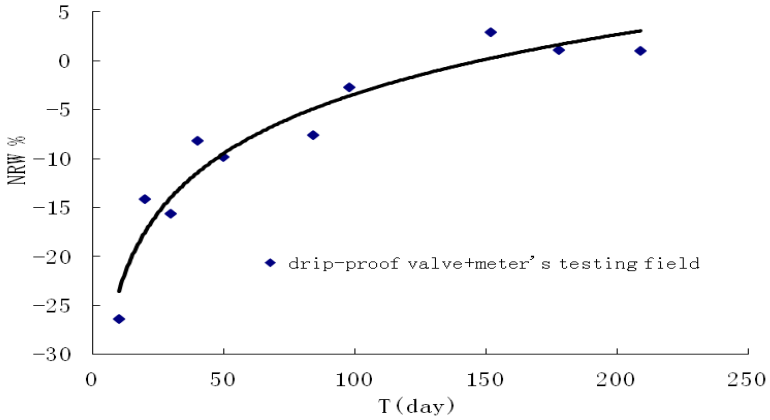

Figure 2 Changes of the rate of NRW with time under improved one-household-one-meter transformation

Figure 2 shows that the rate of NRW of testing field 5 with improved meters (drip-proof valve + conventional meter) increases over time from negative to positive, which illustrated that the large measurement of the starting flow of the total meter can be eliminated completely and the rate of NRW in the early time can be decreased as well. Besides, NRW caused by the transformation of one-household-one-meter can be eliminated in 147 days after installation. Compared with testing field 4 which has the same level of construction quality as testing field 5, the rate of NRW can be decreased efficiently in 229 days after installation. However, the function of drip-proof valve degraded obviously after 147 days' usage.

Analysis of the function of drip-proof valve and its working rules

At present, there are a great variety of drip-proof valves and measurement meters with high-sensitivity on the market. This article only introduces about the function of drip-proof valve involved in one-household-one-meter transformation above.

Dimensions and weight of drip-proof valve are shown in Figure 3 and Table 3.

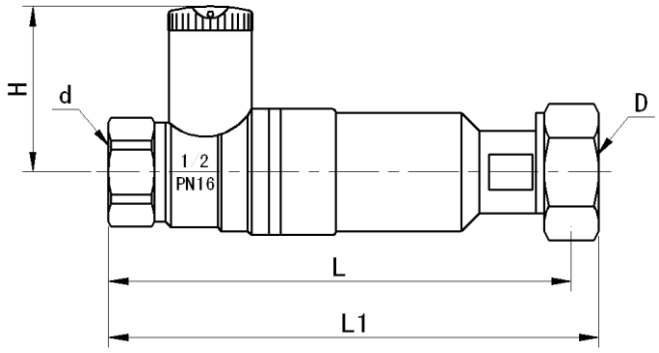

Figure 3 Design of the drip-proof valve

Table3 Dimensions of drip-proof valve

Caliber	L	L1	H	Connecting thread		Weight
(mm)				d	D	(kg)
15	116	125	44	G1/2B	G3/4B	0.3
20	119	130	46	G3/4B	G1B	0.5

Drip-proof valve are mainly composed of testing valve and regulatory system. Valve will close immediately when detecting fine flow in the pipeline. When the drip behind the valve is still going on, a certain flow will be accumulated behind the valve automatically. And small flows which can not be measured become big measurable and sensible ones when the valve opens all of a sudden, which achieves the measurement of the drip.

Conditions of drip-proof valve's usage: water temperature $3℃\sim40℃$, $0.1MPa<$water pressure $\leqslant 1MPa$

Pressure loss of drip-proof valve：$\triangle P<0.02MPa$ (state of valve opened)

Development of effective strategies on NRW control

Improvement of the construction quality of one-household-one-meter transformation

In order to improve the quality of one-household-one-meter transformation effectively, the standard atlas of one-household-one-meter should be developed and implemented in strict accordance with the pipeline design and construction standard. Atlas should include planar

graph, decency figure, manifold, master and detail drawing of several typical installation forms in one-household-one-meter.

Improvement of "drip-proof valve + meter" improvement one-household-one-meter transformation

Water supply effective rate of water meter installing improved meter (drip-proof valve + conventional meter) decreases with time, and it is significantly higher than that of other fields. It illustrates that installation of drip-proof valve played a certain role at first few months, but deteriorated over time because of impurities or aging.

After the remove of three drip-proof values which used in testing field 5, it is found that there are much rust particles between the putter and the suction cup that cause the loose of the valve(it is shown in Figure 4). After remove rust, the valve itself is well-component. Therefore, the reason why the function of drip-proof value drops after using 147 days is the rust in the pipe.

Figure 4 The rust and sand found in the drip-proof valve after used under the improved transformation

The promotion of one-household-one-meter transformation caused the increase of rate of NRW, and there are some effective strategies below to improve the transformation of "drip-proof valve + meter":

Maintenance of qualified pipeline and guarantee of pipeline water quality is necessary to keep the contribution of "drip-proof valve + meter" improved one-household-one-meter transformation strategy on NRW.

Installation of a movable union with filter in front of the drip-proof valve can prevent rust and sand particles entering the drip-proof valve. Meanwhile, regular cleaning and removing of the rust and dust can be easily realized at the same time to assure the normal operation and effect of the drip-proof valve on NRW.

Conclusions

The conventional one-household-one-meter transformation will increase the rate of NRW obviously.

The construction quality of one-household-one-meter transformation can significantly affect the rate of NRW. In order to improve the quality of one-household-one-meter

transformation, the standard atlas of one-household-one-meter should be developed and implemented in strict accordance with the pipeline design and construction standard.

The improved one-household-one-meter transformation with the installation of drip-proof valve will decrease the rate of NRW in a certain period of time at the beginning. However, the effect declines gradually along with the testing period and is almost expired after being used 229 days.

Rust and sand founded in the pipe explains for the obvious declining or failure of the function of drip-proof valve after putting into use for 147 days.

Qualified pipeline maintenance and guarantee of pipeline water quality is necessary to keep the contribution of “drip-proof valve + meter” improvement one-household-one-meter transformation strategy on NRW.

Installment of a movable union with filter in front of the drip-proof valve can prevent rust and sand particles entering the drip-proof valve. Meanwhile, regular cleaning and removing of the rust and dust must be easily done at the same time to assure the normal operation and effect of the drip-proof valve on NRW.

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