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Urban waste water reuse pricing and research methods

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ABSTRACT

Starting with water price mechanism and pricing problem, this paper compares tap water price with reclaimed water price, makes a pilot study of reclaimed water pricing and analyzes the constitutes of reclaimed water price. Based on the confirmation of optimal pollution level, this paper analyzes the apportionment of wastewater treatment expenses, and investigates the influence that water price and public mentality effected on the wastewater reuse. Several suggestions are made to reclaimed water pricing finally in this chapter. The mode of wastewater reuse are multiplicative and many factors need to be considered, including technical requirement, expense, benefit, security and so on. Some of the factors can be confirmed quantificationally, and the others are difficult to be quantified. Analytic Hierarchy Process is a simple decision-making method combining qualitative means and quantitative means, which is fit for the fuzzy and complex decision-making problem. Based on the current situation of kaifeng, this paper establish the Analytic Hierarchy Process when reclaimed water are reused in agriculture ,municipal applications and industry, analyzes wastewater reuse in kaifeng city. This paper considers that wastewater reuse in agriculture is preferred. If condition permit, wastewater can be reused further in municipal applications and industry.

Key words: Wastewater; reuse; Agricultural reuse; Water price; Analytic Hierarchy Process

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INTRODUCTION

Water is a major constraint to agricultural production.Since the late 1950s, a number of water in the northern regions, such as more than 20 cities in Fushun, Shenyang, Dalian, Shijiazhuang, Beijing and Qingdao were irrigated with sewage.But these early carried sewage irrigation, reference is essentially untreated sewage, irrigation water pollutants exceeding serious, for the soil in these irrigated areas, crops, causing a certain degree of groundwater contamination and the health of the residents had some affected[1].

Early 1980s, Dalian, Qingdao, Taiyuan and other cities have undertaken water for industrial and municipal wastewater reuse research and practice, some cities and the construction of a home pilot project a success.Domestic urban wastewater as municipal water is nearly 20 years before gradually unfolded, at present, Beijing, Tianjin, Dalian, Qingdao, Taiyuan, Shenzhen and other cities have gradually established a wastewater reuse project.For example, Beijing Fang Zhuang district built 4×104 m3/ d of wastewater treatment plant Fangzhuang, where 2×104 m3 of effluent reuse for three quarters and FangzhuangFangzhuang power plant cooling water; Beijing North Creek sewage treatment plant into operation in 1992, of which 2×104 m3/d of water of as landscaping, road and river spilled supplement water[2].

Currently the development of urban waste water recycling technology and equipment cannot meet recycling construction and operation management needs of urban recycling technology development in the future should focus on the integration of existing technologies, comprehensive integration, industrialization and engineering, need to continue to improve and update existing technology, strengthen the new technology, new processes, new technologies and equipment product research, development and application[3], and to focus on research and construction of demonstration projects.By engineering and production testing, focus on solving urban recycling in

agriculture, ecology, municipal and industrial water purification technologies in water quality stabilization, water quality protection technology, safe water technology, engineering, operation and management of technology and complete sets of technical equipment problems.

KAIFENG CITY SEWAGE TREATMENT SITUATION

For example, in recent years, according to data Kaifeng industrial water consumption are more than 100 million m^3, 2003 is to reach 150 million m^3, urban domestic water also exceeded 50 million m^3[4]. Increasing water consumption is bound to generate more waste water.

Kaifeng City, the city's environmental monitoring detachment polluters regulate environmental pollution control facilities, the environmental pollution control device is shown in Table 1,2. In order to enable enterprises discharge standards, monitoring the implementation of more than 2 times per month detachment checks on day displacement of 100 tons of corporate environmental pollution control facilities. Implement monthly checks on Japan displacement of 100 tons of corporate environmental facilities.

Kaifeng City, the first sewage treatment plant sewage treatment construction scale of 80,000 tons, has been put into normal operation. Will soon start the construction of the Eastern sewage treatment plants, Kaifeng City, the second sewage treatment plant , an area 14.9hm^2, project investment 340 million yuan , the construction scale of 200,000 tons of sewage treatment . The treated wastewater can do irrigation, urban greening, industrial cooling water, etc., the remaining sludge can be used as agricultural fertilizer. After two sewage treatment plants were put into operation, the sewage treatment rate will reach 90% of Kaifeng. This two sewage treatment plant wastewater reuse can provide adequate and stable sources of water. Experimental results show that a large number of reuse water can be greatly reduced emissions from sewage treatment plant effluent and the emissions of pollutants[5].

Tab.1 Swage establishments in main corporations in Kaifeng

Name	Treatment facility name	Treatment	Facility capacity (tons / day)	The actual processing volume (tons / day)	Discharge destination after treatment
Asia Pacific Breweries	Sewage treatment station	Biological	4000	240	Municipal pipe network
Wool Textile Factory	Sewage station	Electrolysis float	1200	700	The west side of the east gate
Enda Rubber Company	Circulation tank tower		300	300	Huiji River
East Chemical Group	1 set of sewage treatment station AnciTota	Materialized	2400	600	Huiji River
Fertilizer Plant	Arsenic wastewater treatment plant	Materialized	4800	2500	Huiji River
Striker pharmaceutical	RC series of water purifiers	Anaerobic oxygen ups and downs	60	50	Municipal pipe network
Pharmaceutical companies	Water purifier	Flotation	960	400	Huang Bian River
Kaifeng chemical dyes	RC_400 water purifier	Chemical method	1920	1185	Plant outfall
Chemical fiber dyeing plant	Sewage processor	Chemical method	960	960	Huang Bian River
Kaifeng dyeing	Sewage treatment facilities	Biochemical	4000	1500	Huang Bian River
Silk dyeing	Sewage treatment station		200		Plant outfall
The second dyeing	YR comprehensive sewage treatment tower	Complex	1500	1200	Huiji River
Province a hair	Roots blower lift pump	Biological oxidation	2000	793	3 outfall
Kaifeng woolen factory		Electrolysis float	500	450	The 1st outfall
Meat processing	Sewage treatment station	Biological	1500	300	Huiji River
Reclaimed rubber factory	Circulation tank tower		300	300	Sewer
Chemical Plant	Wastewater treatment plant	Complex	100	100	Municipal pipe network
Cigarette Factory		Electrolysis	20 / h	400	Wo River
Dyeing factory	Sewage processor	Drug	100	50	Huang Bian River
Washing factory	Sewage treatment station	Jet aeration	1560	60	Municipal pipe network

Tab.2 Swage establishments in hospitals in Kaifeng

Name	Treatment facility name	Treatment	Facility capacity (tons / day)	The actual processing volume (tons / day)	Discharge destination after treatment
Integrative Medicine Hospital	Sodium hypochlorite generator	Materialized	600	79	Municipal pipe network
Fifth People's Hospital	Sodium hypochlorite generator	Materialized	640	45	Municipal pipe network
First Hospital of	CLO_2 generator	Materialized	120	80	Municipal pipe network
Children's Hospital	Sodium hypochlorite generator	Materialized electrolysis	480	115	Municipal pipe network
First People's Hospital	YDT water purification equipment	Materialized	600	267	Municipal pipe network
Second People's Hospital	TZ_2 type oxidation treatment	Materialized	1200	234	Municipal pipe network
Fourth People's Hospital	CHW Sewage machine	Materialized	50	80	Municipal pipe network
Affiliated Medical loyal	Huaqing disinfection device	Electrolysis	1000	10.7	Municipal pipe network
Huaihe Hospital	RDJ_500,RDJ_200 RDJ_500, RDJ_200	Materialized	380	19	Municipal pipe network
One hundred fifty-five hospital	Oxidation	Oxidation	700	77	Municipal pipe network
Maternal and Child Health Hospital	CLO_2 generator	Materialized	7500	74	Municipal pipe network
Eye hospital	Sewage treatment plant	Materialized	140	30	Municipal pipe network
Hospital for Infectious Diseases	Chlorination station	Materialized	210	75	Municipal pipe network
Railway Hospital	Sewage treatment station	Materialized electrolysis	80	50 ~ 60	Huiji River

WATER PRICE STRUCTURE

Water is formed in nature, in order to meet human demand for water, it is the construction of water conservancy, water supply facilities, water has become a commodity, water pricing should be conducive to the optimal allocation of resources, improve water use efficiency and efficiency, while providing the water supply of this commodity companies should get a reasonable income, water charges should include all costs for businesses to invest.Water is also a special commodity, water is irreplaceable resource, the market is monopolistic pricing of water is largely controlled by the government.As a human production and life are essential resources, water pricing should reflect the fair and equitable, to meet the different needs of water users.Sustainable use of water resources requires not only the price of water reflects the cost of water supply enterprises should also be conducive to the protection of water resources, improve the ecological environment and meet the pollution prevention requirements.Water pricing subject to many factors and constraints, until now, has not stopped domestic and international academic research on water pricing, nor the formation of a unified point of view[6].

Although Essentially, water reuse water also, in a certain range, it can be used as a substitute for fresh water, so the water can constitute a theoretical price from the price of water back to study composition, but its price structure and made from nature Compared to tap water becomes very simple, here, we will tap water price structure and price structure back to make a comparison.

Combined with relevant tariff theory, we can put the price of water is divided into four parts: First, the water resources fee; Second, water conservancy fees; three water treatment fee; four sewage treatment fees[7].Water fee reflects the economic value of water resources, water conservancy fees and handling charges reflect the use of water inside the water costs, sewage treatment fee reflects the environmental value of water.

About water charges,both the living water, municipal water, industrial, agricultural water, are the product of human labor, are sold as a commodity, commodity prices are all, in any efficient market, the price of the commodity to be equal to the use of the product opportunity cost in order to achieve economic efficiency.If you only consider the water sector based on the marginal cost of treating water as water pricing is not comprehensive, because all of the opportunity cost of the marginal cost of water treatment does not reflect the water.Natural water as a natural resource, although not through human labor process, but people want to get natural water resources, but also a price to pay.This consideration includes other water users to reduce the loss of water, the other with water to reduce the loss of water categories.Even if individuals do not pay the price, community will pay the price, the price performance of

the price of water, that water resource fee.

Property is a modern market economy is a very important concept, simply, property is property rights.Clearly defined in the first chapter of Article IX of the Constitution, water and other natural resources belong to the state, and no organization or individual by whatever means seizure or destruction of natural resources.Therefore, any units and individuals to develop the use of water resources must pay a fee.Water scarcity is the basis of the value of its resources, the resource value of water scarcity rent is realized in the form of water rights in the economy, is a manifestation of the social costs of water, rather than reflect the cost of construction and management of water supply projects.Water resources in China are state-owned, the price of water resources should be imposed by the government, management and use, not as a profit water companies, their scarcity value embodied in similar circumstances ordinary commodity, that the more scarce water resources, and its scarcity value The larger; Conversely, the more abundant water resources, the smaller its scarcity value.If there is no scarcity of water, people can unrestrict access, water charges would not exist.As long as water resources are scarce, there is not enough water to satisfy people's unlimited needs; even if treatment does not require the cost of water will still be a price, and the price will increase to the total supply equals the total demand.

Fee reflects the scarcity value of water resources from the root.When resources are scarce, a person's use reduces the chance of someone else to use, now more use reduces the chance of future use, therefore, the opportunity cost of using resources to reflect this scarcity value.And this scarcity value, it is through that paid to acquire water rights Water rights to be achieved, the performance is realized in the form of water rights on the economy.Because it is precisely because water resources are scarce, so only water rights system; obtain water rights means to obtain the corresponding benefits, access to resources resource owner would like to pay.Natural Resources property value is its manifestation, if there is no scarcity of resources, resources that anyone can use in any way, using the resources nor the opportunity cost (excluding the cost of resource processing), it does not matter to obtain payment of the resource property.However, the fact does not exist forever take the endless natural resources, especially water resources.Water scarcity is a comprehensive reflection of regional water resources and related factors population, environment, structure and economic and social development.There is value in use of water resources for the purpose of discussion of water scarcity value.Therefore, to determine the value of the scarcity of water resources should be based on the value of its usefulness.

Despite the lack of water in some places, the water will be back with a scarcity of recycled water should not be included in the value of the water resource fee.The reason is that the main source of recycled water is discharged effluent water use, the price of tap water already contains a water resource fee, or reuse water resources fee included has paid off in the first use.Water reuse is the repeated use of water resources, and does not increase the amount of fresh water is taken.So companies are allowed and encouraged to conduct their own sewage treatment and recycling, and reuse this never would be charged accordingly.

About hydraulic fees,hydraulic fee refers to compensate for geological exploration, water quality monitoring and rivers, reservoirs, canals and other water conservancy facilities construction and operation and maintenance management costs and fees charged, should include appropriate taxes and profits.

Water is a natural resource, despite water method is very simple, but most people are not using water drawn from natural water sources, but after a certain intermediate process.Urban water supply, for example, water is usually from lakes, underground rivers or reservoirs built on the river water through water pipes into the city water department, water quality to meet the requirements through the pipeline until after treatment for water users to use.Water use in the manufacturing process and the process put a lot of manpower, material and financial resources, and therefore must be included in the price of tap water in this part of the cost, in addition, taxes and profits of the water sector in the water sector should be paid also included.

Many ways to use recycled water for different use from the hydraulic engineering fees vary widely.And unsolicited different water reuse water is municipal wastewater, reuse water before use also need to go through some of the middle of the process, such as recycled water for agricultural irrigation, the need to go through water, stored procedures and the introduction of irrigated by water channels, costs arising from this process should be included in water conservancy fees.

About water charges,water treatment fee is to compensate for obtaining raw water, processing and distribution of water and other transportation costs occur, namely the construction and operation and maintenance costs of water and related facilities and the fees charged, should include appropriate taxes and profits.In practice, water facilities and water conservancy facilities and there is no uniform physical area boundary, the key is to look at facilities belonging to water conservancy project management unit or units are water management, but need to ensure that

when water conservancy fees and charges are not repeated in water treatment costs calculation of an expense.

Recycled water is low quality of urban sewage treated water back to the water prior to use of sewage treatment and then transported to the user.Treatment process determines the way back to the water reuse, reuse water treatment costs is a key part of the water back to the price composition.Handling charges are talking about here is a broad concept, water treatment fee in return should be included in the production process of reuse water costs, sales, management, finance charges, taxes, corporate profits back to the water supply.This part of the cost can be accounted for by recycled water supply company's financial statements.Similarly with water, recycled water facilities and water conservancy facilities no uniform physical area boundary, the key is to look at facilities belonging to water conservancy project management unit or units belonging to reuse water management.

Since water use is also a problem of sewage treatment, and therefore a critical issue back to the cost of water treatment is to distinguish between cost recovery from sewage treatment fees and cost recovery by recycling water.

About sewage treatment fee,as already discussed, the use of water will be discharged after a certain amount of waste, which pollute water, bring to the social and personal harm, in order to protect the water environment pollution need to pay a certain price, which is part of the consideration is reflected in the price of water the charges.

Do you want to consider the issue back to the water sewage charges, the key is to look at the results of whether to increase the reuse of sewage discharge.Back to the water after use may also have certain wastewater discharges from the usage point of view, back to life as water and industrial water to produce effluent reuse some time, and for agricultural irrigation, clean water, landscape ecology water, groundwater recharge time, would not bring back the water or is consumed or contaminated after use, of course, would not exist sewage treatment fee.Therefore, the price of recycled water for different purposes should be treated differently.

PRICINGWASTEWATER REUSE

About externalities and sewage charges,externality theory in 1991 by the famous economist Marshall raised by its students Pigou enriched and developed the theory of externalities.[8]The so-called externality refers to the impact of interest beyond the activities of real economic activity in the activities of producers and consumers to producers and consumers of other subjects range.Externalities into the external economy and external economy of producers and consumers adversely affected, but did not give appropriate compensation called external diseconomies of others in the course of their activities to others.Development of upstream areas such as industrial production generated a lot of waste, namely those of untreated wastewater into the river, causing contamination of the river, so the river water quality decline, producers in downstream areas when the use of these sources in order to make the water meet the requirements, the need spend more on water treatment costs, which is an example of external diseconomies.

The purpose of the production of the producer is to pursue maximum efficiency and minimum cost.Pollution takes manpower, resources leading to higher costs in the profit motive of domination, the producers will not take the initiative to consider options for environmental pollution control, or try to reduce the adverse impact of production on the environment, but will result in the production of environmental damage costs required to pass a community that private costs socialization.Private social costs lead to resource development and utilization of external diseconomies, causing waste and destruction of resources.Fundamentally solve the resource development activities in the external economies of ways to make internalize external costs.Internalization of external costs there are many ways and means, one of the main ways is to use economic means to compensate for the external economy.Additional sewage charges in tap water are to make a way to internalize external costs.

We have already mentioned, the main difference between recycled water and tap water is that water, recycled water use in the most critical issues are also water only up to a certain quality standard can be used for appropriate purposes, the cost of water in the back, it is a large part of the water treatment process, then the cost is not all spent on sewage treatment costs are counted back to the water go?We know that even without water reuse, considered from the environment, the city should have a certain degree of sewage treatment to meet emissions requirements, the processing fee is not required for this part produced water reuse, water does not belong to the cost of return, Only the cost of subsequent treatment carried out for reuse need only be included in the cost of water to go back.In actual production, the majority of sewage treatment work could be done in a sewage treatment equipment, and not necessarily in accordance with the emission requirements and reuse require explicit divided into two unrelated processes.In addition, although the price of tap water contains sewage charges, but does not represent all of the urban sewage discharge are carried out before treatment and reached the standard emissions.

Water after use is inevitable to a certain amount of waste water discharged, if the discharge process wastewater discharge requirements are not treated in accordance with, the process for recycling purposes, the cost is bound to

cost more.Urban sewage treatment process will be the cost of treatment to achieve reuse requirements arising from the cost should be apportioned between the water and reuse water costs.

Traditional economic theory does not consider or did not fully consider the external economy, the role of water sewage charges are included in the price of water will be used to internalize externalities, although in many places the water is added to the sewage charge this one, but wastewater disposal costs and no complete counted, people use water while a hidden pass the cost on society.

We need determine the optimal level of pollution,this involves environmental capacity issues, environmental capacity is the number of air, water, soil and other environmental pollution allowed by order of the Carolina substances[9].It is one of the basic properties of the natural environment, economic development is inseparable from the environmental capacity, and environmental capacity resources are scarce and loss characteristics.Scarcity is the limited amount of resources, environmental capacity cannot meet the needs of the people indefinitely; may drain refers to the environmental capacity of resources to provide services for its function, and its functional value is combined with the time factor, can be use may also be lost over time.Because the characteristics of environmental capacity resources, determined that we cherish in caring for the environment of resources, make full use of environmental resources.Because of the nature of environmental capacity resources when environmental contamination is less than the capacity of nature to accommodate and purify pollutants, such as emissions from a region of small amounts of treated industrial waste gas purification, can take advantage of the atmospheric environment capacity resources so that atmospheric pollutants will not cause significant dilution to the extent of environmental pollution, and to purify pollutants are broken down or in the normal cycle of nature, the impact on the environment would be controlled; But when pollutant emissions significantly exceed the environmental capacity has caused the environmental pollution and ecological damage, resulting externalities.It is not within the control of environmental pollution levels in the capacity of even no emissions it is the optimal level of pollution, it is clear that it is not, the purpose of opening up resources to achieve maximum economic benefits, if the blind pursuit of low pollution emissions, inevitably affect the achievement of economic efficiency.But we cannot desperate at the expense of the environment to economic development, to resolve this contradiction is to find an appropriate level of contamination.According to environmental economics point of view, the optimal level of pollution is the contamination level can make to maximize net income community.

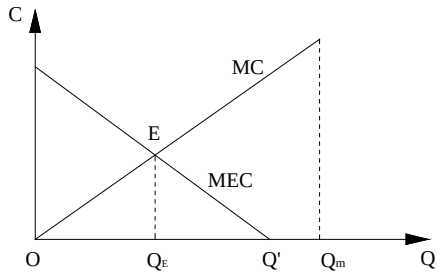

Fig.1 Sketch map of optimal pollution level

Costs to determine the optimal level of emissions based on the marginal cost and marginal external governance (damage),as Fig.1 shown, which means that the marginal cost and the cost of using the vertical axis C, the horizontal axis represents pollution quantity Q, MC is the marginal cost curve of governance, it is the first derivative of the cost function of governance, which means that different levels of governance on each unit increase in the amount of the increased pollution control costs.The marginal cost of governance in the figure on the sloping curve is a curve to the right, because as governance capacity increases, increasing the difficulty of a unit of pollution control increases, the cost of spending is also increasing.MEC is the marginal external (damage) costs, marginal external costs are external costs of the first derivative, which represents the different governance levels of pollution, the remaining external costs per unit of pollution damage caused, MEC tilt to the right, because as the amount of pollution increases, fewer and fewer residual contamination (due to self-purification capacity of the environment play a role but not the cumulative effect of the role), the damage caused by pollution per unit of surplus also decreased.Q_m represents the maximum amount of pollution emitted, MEC to Q' as the end point, where (Q_m-Q') is the environmental capacity.When Q>Q', that pollutant emissions within the capacity of the environment, the environment will not be affected by pollutants, marginal external cost is zero.

E point of intersection of the MEC and MC, the marginal cost equals the marginal external cost of governance, social net income reaches a maximum, and then the corresponding point is the optimal level of contamination.Point E on the left, despite the increase in the amount of pollution will lead to increased pollution control costs, but because the marginal cost is less than the marginal external cost of governance, increase the amount of control you can achieve greater social net income.

Point E on the right, despite the increase in the amount of pollution can still reduce the marginal external costs, but the marginal cost is greater than the marginal external cost of governance, increase the amount of treatment will lead to a faster increase in the cost of pollution, and to the social net income declined.So this part govern the amount of pollution is uneconomical.

Based on the above theoretical analysis, in order to obtain the greatest social net income, the amount of social pollution control should maintain position at point E, the amount of pollution at this time for Q_E.

Using the above-described process can be expressed as the following mathematical expression.Let the social net income for the TSB, the total amount of the external cost of governance when Q TEC, when Q is the total amount of governance costs TC, there are: TSB = TC + TEC

TSB social goal is to make the largest.Because TNPB, TEC function is Q, the TSB is also a function of the discharge quantity Q, the function maximum value TSB conditions:

$$\frac{d(TC)}{dQ} = -\frac{d(TEC)}{dQ},$$

When that marginal private net income and marginal external costs (absolute value) equal to the largest social net income, optimal level of emissions.

About sharing the cost of sewage treatment,get the definition of the optimal level of pollution, we can theoretically analyze the cost of sewage treatment should be how to share water and tap water in the back.To achieve maximum social net income, sewage contamination should be optimal target level, all in the optimal emission levels of pollutants in the above process belongs to the cost of the cost of water used in the following only the optimal pollution emission levels before treatment costs should include in cost of reuse water.

We are talking about more than a theoretical analysis, in fact, we cannot get such a precise optimal level of emissions, so even with the optimal level of pollution, and our country cannot implement such standards.

In order to protect surface water and groundwater quality in rivers, lakes, canals, channels, reservoirs, and oceans kept in good condition, reduce water pollution and maintaining ecological balance, promote economic development, countries have developed "Integrated Wastewater Discharge Standard" (GB8978-1996).The standard water drainage system according to the water storage function requirements, the wastewater discharge standards are divided into three levels.When the pretreated wastewater reuse for a particular region, in addition to the use of recycled water to ensure that emissions do not affect their final admission of the use of environmental water features, but also to ensure their compliance with the final effluent water in the storage function of phase corresponding national wastewater effluent discharge standards and local standards, and to meet the total pollutant control requirements.Since we cannot make accurate pollution optimal level of pollution emissions, so the state in the development of effluent standards and pollution charges can only be determined when possible so that emissions close to the optimal level of contamination, since according to this standard can be determine the apportionment of the cost of sewage treatment, and then return that water treatment costs.Due to the country's regional development imbalances, the degree of pollution in all regions vary greatly.The actual calculation, we can simply put the cost of enhanced primary treatment process or as a secondary treatment after back water treatment costs.Already mentioned earlier, even a secondary treatment of sewage through enhanced treatment basically meet or partially meet the needs of irrigation water, so the water reuse for agriculture will not be included when the total cost of water treatment costs.

Next,we get affect the price of tap water reuse water prices.Recycled water is used as a substitute for tap water appears only under the following two conditions are fulfilled the conditions for possible reuse water is widely used, one is a serious shortage of water resources, must find new sources of water, the second is recycled water a price advantage, that it must cheaper than the cost of tap water.

For a long time, the water must be regarded as public goods, the price of water has remained at relatively low levels, the cost of a serious deviation from the price of tap water, and people lack awareness of water conservation, waste is serious, low water use efficiency.Meanwhile, the price of water is less than the cost of the water industry in a serious loss, a heavy burden on state subsidies.And the water was low compared to the cost of reclaimed water becomes relatively high, even much higher than the price of tap water, reclaimed water, of course there is no market.China in recent years carried out a reform of water prices, water prices began to increase.

September 2003, Kaifeng City, conducted a tariff adjustment, living water tariff metering practice. Basic tariff from the current 0.75yuan/m^3 was adjusted to 1.1yuan/m^3, raised 0.35yuan per household per month/m^3, the adjustment was 47%.Water as a basic monthly household 12m^3, 12m^3 至 18m^3 section by 1.65yuan/m^3 total income, 19m^3 or more portions by 2.2yuan/m^3 total income; industrial process water from the current 0.95yuan/m^3 was adjusted to 1.2yuan/m^3, raised 0.25yuan/m^3, 26% amplitude; business service water from the current 1.25yuan/m^3 was adjusted to 2.2yuan/m^3, raised 0.95yuan/m^3, AM was 76%; administrative units of water from the current 0.9yuan/m^3 was adjusted to 1.2yuan/m^3, raised 0.3yuan/m^3, AM 33%; specific sectors of water as an additional category, price is 3.5yuan/m^3.Currently Kaifeng City, also did not return water prices to Beijing water price of 1yuan/m^3 for comparison, although the price of recycled water has certain advantages, but it is not very obvious.

About psychology and influence public willingness to pay for the use of reclaimed water,in addition to its own cost, psychologically public acceptance of reclaimed water and wastewater reuse scope is also an important factor in the success of the promotion of the use.A general lack of public understanding of reuse water, sanitation problems are usually recycled water is the most public concern, the public acceptance of reclaimed water also determines the ability of public willingness to pay.

Researchers have conducted a survey of these two questions, surveys conducted by questionnaire survey results are basically consistent with the public for the purpose of reuse water poured green roughly in order of preference, flushing, sprinkling the road, landscape water, wash, the majority of the public is not in direct contact with the body for the purpose of comparison agree, but for bathing, laundry and other uses, the majority of people disagree.WTP survey proved that tap water prices have a significant impact on the willingness to pay higher water price, people can afford the higher price of recycled water, so the result is to be expected.

Therefore, the strengthening of public advocacy to address public safety concerns for reuse water and raise the price of water, can effectively improve public acceptance of reclaimed water.

Back to the water in the tap water pricing can refer to pricing in the water supply industry, widely used is cost-plus pricing method[10], which for reuse water supply pricing applies.For those of water runoff, in principle, should be required to recover costs, gain efficiency, water users want to be fair and reasonable for society as a whole is concerned, the use of recycled water should save water, to achieve efficient allocation of resources, and will help to improve the environment.

Recycled water price level can be determined by calculating the average marginal cost or cost, the average cost pricing is a widely used traditional pricing method, which based on the average cost of water services to determine the price level of the price of water, through the relevant historical data analysis to determine the income needs of water supply enterprises.Then based on the behavior characteristics of water divided into different types of users to assign service costs between different types of users to calculate the average cost of services of various types of water users, according to a rate structure design.Marginal cost estimates are based on the construction of the future investment needs and expectations and planning of water supply systems, water supply planning period marginal cost which is carried out in the selected measure and rate design.Generally considered the use of marginal cost pricing of water will help improve the efficiency of the development process to achieve optimal allocation of water resources.

Actual pricing may also consider the following aspects: user type and capacity of all types of users, among them to take cross-subsidies; against extravagant water and high water consumption industries adopt policies to stimulate high water conservation; adopt a more complex price structure, seasonal pricing.

Differential pricing model using recycled water pricing is a good choice.Third-degree price discrimination is carried out by market pricing based on the difference between price elasticity of demand[11], this will help make profits.Kaifeng City, the market is divided into domestic water supply, industrial water, hotel water, commercial water use, water authorities, based on the price elasticity of demand for water users in descending order are: living water> industrial water> water and guesthouses water commerce, and water pricing just the opposite, the lowest price of living water, water and guesthouses commerce highest water prices.This is because the elasticity of demand for the larger water users more sensitive to the price of water, the water is too high when the price of water will greatly reduce the amount of water, it will instead affect the profits obtained greater elasticity of demand for domestic water, in order to ensure basic public water demand, the price of water should not be too high.In contrast, the elasticity of demand, the lower the sensitivity of water users the price of water, even if the higher price of water will not have much impact on its water, which is conducive to the development of higher water prices to make a profit.Under this situation, reuse water pricing can also be used in the same way, on the one hand, the price is lower than the water back to the water price elasticity of demand for smaller runoff water users, since it is impossible to

reduce water consumption, use lower prices of recycled water will be a good choice, and the elasticity of demand for larger users, in addition to the use of recycled water usage, reduced water can also reduce expenditure on water.On the other hand, according to a survey conducted by the willingness to pay higher water prices by using the water for reuse water has a higher willingness to pay the price, so for this part of the user using the higher price of water is sufficient basis.

In addition to the use of water pricing for different users on different third-degree price discrimination, the use of the price ladder will help to promote the use of water back.Price ladder is divided according to different levels of water users, different levels with different tariff; the price ladder also includes the price ladder descending and ascending price ladder.For example, a standard set of two water Q_1, Q_2 (Q_2>Q_1), when the user Q does not exceed Q_1, the tariff is P_1, when the water Qis greater than Q_1 and Q is less thanQ_2 , the excess will be denominated P_2, when the water than Q_2, P_3 will follow the excess valuation.

At different water consumption, total water is:

$$C=\begin{cases} Q\times P_1 (Q_1 \geqslant Q \geqslant 0) \\ Q_1\times P_1+(Q-Q_1)\times P_2 (Q_2 \geqslant Q > Q_1) \\ Q_1\times P_1+(Q_2-Q_1)\times P_2+(Q-Q_2)\times P_3 (Q > Q_2) \end{cases}$$

If P_3> P_2> P_1, is called incremental price ladder, on the contrary, P_3<P_2<P_1, is called a descending price ladder.

In the water supply, people often advocate the use of incremental price ladder, its purpose is to conserve water, but only on the elasticity of demand for larger users have good results.In the use of recycled water, if the elasticity of demand for smaller users using decreasing price ladder, means that companies adopt more reuse water instead of tap water, water will further reduce spending, which is very encouraging enterprises to use recycled water advantageous.

The above said reuse water pricing is the face of the city back to the main water users, in fact, for agricultural reuse, pricing will become more simple, less demanding because of reuse water for agricultural irrigation, urban sewage secondary effluent treatment plant can be directly used for agricultural irrigation, and therefore not included in the cost of sewage treatment fees reuse water in agriculture, in addition to agricultural water reuse water channels can be used to make existing irrigation canals or channels on the basis of the original appropriate changes, due to lack of instance data, quantitative results cannot be given here, however, the actual cost of recycled water for irrigation from rivers and irrigation costs considerably, with the agricultural tariff reform in recent years, agricultural water prices are rising, farmers irrigated with water pipes have to pay the water sector, including not only the management fee Irrigation water pipes sector, operating costs, maintenance costs, but also including water fees.By contrast can get back to the water free from sewage treatment plants, eliminating the need for water resources fee.For Kaifeng City, the use of municipal sewage treatment plant effluent to irrigate surrounding farmland closer than the distance from the Yellow River water diversion, so the cost is relatively low.

ANALYSIS HIERARCHY PROCESS WASTEWATER REUSE METHODS FOR ANALYSIS

Wastewater reuse in different ways, reuse factors to consider when many, such as technical requirements, costs, benefits, operational safety, etc. Some of these factors can be quantitatively determined, is more difficult to quantify.Different recycling methods have advantages and disadvantages, because of various factors is difficult to use a uniform value expressed in units, so we can consider the relationship between these factors dominated by grouping formed orderly hierarchical model, based on the objective reality of people's judgments given quantified using mathematical methods to determine all the factors at each level relative importance weights to obtain the lowest level relative order of importance of the combination of top weight.The aim is to simplify the various factors; the programs will facilitate a uniform standard for comparison, and ultimately get useful results.

We will reuse wastewater Kaifeng way classified into three:back to agriculture, here refers only to crop irrigation;back to the municipal water used, including spraying pavement, green watering, water and other entertainment;back for the industry, including cooling water less demanding on water quality and a variety of process water.Use these three levels of analysis will serve as a model program layer factor P_1, P_2, P_3.

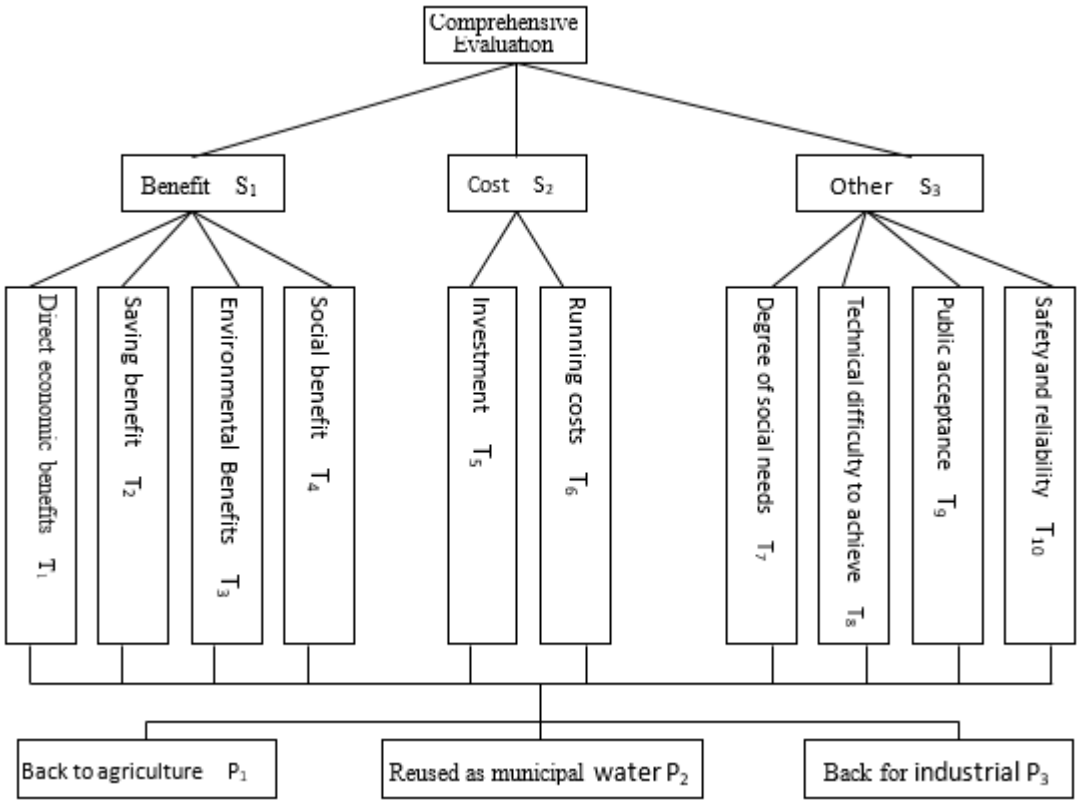

Fig.2 Ana1ytic hierarchy process of wastewater reuse

Guidelines layer includes a cost-effective, technical factors, social factors, including the factors of 10 T_1, T_2, ... T_{10}, these 10 factors and were normalized to the benefits, costs and other factors.Urban wastewater reuse hierarchical structure model shown in Figure 2.

P is calculated according to the above layer to the layer of target weight value P_1, P_2, P_3, respectively 0.5017, 0.1507, 0.3476.Therefore, $P_1 > P_3 > P_2$, according to this calculation, in Kaifeng City wastewater reuse plan, priority should be the weight of the largest reuse in agriculture, followed by industrial reuse, and finally the municipal water reuse.

CONCLUSION

Back to the water as an alternative to water, because the water quality is limited, its use is limited in scope, when the sewage is treated for reuse purposes, such reuse water becomes a commodity, each commodity has its price structure, rather reclaimed water price structure and price structure is closely related to water, this article is back in the water to achieve water pricing study conducted on the basis of full-cost water pricing.In theory, the water fee included in the price of recycled water is separate from the total cost of treating sewage in determining the optimal level of pollution out, in order to facilitate the implementation of sewage treatment or secondary treatment enhanced the level of after need to reuse water facilities costs also can be classified as convincing.Because the look from the perspective of protecting the environment, even without wastewater reuse, wastewater prior to discharge to the enhanced primary treatment or secondary treatment is also necessary.

Due to the different reuse processing and desired manner mode operation is very different, as the reuse approach will produce different costs due to the lack of necessary data, this paper does not specifically calculate different way back to back with the water pricing, but it is certain that the agricultural reuse of reclaimed water prices will be low, back to back with all manner of water prices are not higher than the price of tap water, otherwise the return will not be considered by the way.In addition, to take efficient pricing model will be used to improve the results back to the water, which should be the price of water content makers should consider.

Wastewater reuse in different ways, reuse factors to consider when many, such as technical requirements, costs, benefits, operational safety, etc. Some of these factors can be quantitatively determined, is more difficult to quantify, this article a list of 10 factors were classified in three categories, then the binding of Kaifeng City, the establishment of agricultural reuse, recycling of municipal and industrial use AHP model back.By solving the model, can be drawn

with three weights back way.

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