Water resource management and water quality issues in Beijing

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Introduction of Beijing

Beijing, a world famous megacity with 3500 years history, is the capital of P.R. China. It is located on the northwest fringe of the North China Plain, and is about 150km away from Bohai Sea in the southeast direction. The total area of Beijing is more than 16,800 km² with 62% mountainous region. The southeast of Beijing is an alluvial plain by Yongding River and Chaobai River.

1. Introduction of water resource
The Map of China
Water resource in Beijing
Society and Economy development in Beijing:

In recent years, the economy and society of Beijing has expanded very quickly because of the government open and developing policy.

- Up to 2003, the total population of Beijing has reached 13.82 million.
- The total GDP of Beijing has reached 361.2 billion RMB, including 9.5 billion RMB of primary industry, 129.9 billion RMB of second industry and 221.8 billion RMB of third industry.

This trend will be continued in the near future, especially for Year 2008 when the 29th Olympic Games will be held there.
Water resource in Beijing:

Beijing is a rather dry city with shortage of water resource.

– The annual rainfall average is about 625mm. The surface water resource of Beijing is only 2500 million m\(^3\), the ground water is about 2600 million m\(^3\), and the total water resource of Beijing is only 4100 million m\(^3\) after reduced the overlap water resource.

– The water resource per capita in Beijing is less than 300 m\(^3\) which is only the 1/8 of the nation and only 1/32 of the world, even less than that of some very dry countries, such as Israel, Yemen, and Jordan etc.
– For keeping the balance of water supply against demand, Beijing has exploited too much ground water for drinking water and industrial use. Such situation will have much negative influence in the future.
– Therefore, water shortage will be a barrier in the development of Beijing.
– Beijing should treat the contradiction between economy development and water resource shortage, very carefully, because for a megacity, it is very important to have a sustainable development.
2, Drinking water Treatment in Beijing

Water sources

- In early years, ground water was used as the main source of drinking water in Beijing. It is not enough to satisfy the water demand along with population and economy development.
- In 1980’s surface water was started to be used as additional source of drinking water. There are over twenty reservoirs around Beijing, but only three could be used as drinking water source, including Miyun reservoir, Huairou reservoir and Guanting reservoir.
Water resource in Beijing
Water resource protection in Beijing
Drinking water treatment plants

- In the urban area of Beijing, there are 10 drinking water treatment plants. The total capacity of water supply has reached 2.63 million m³ /d.

  7 plants, use ground water as drinking water sources.

  2 plants, Tiancunshan water treatment plant with the capacity of 170 thousand m³ /d and the ninth drinking water treatment plants with the capacity of 1.5 million m³ /d, use surface water from Miyun reservoir and Huairou reservoir.
The sixth water treatment plant, which supplies the water for industry use with the capacity of 170 thousand m$^3$/d, employs surface water from the south moat of Beijing.

In year 2003, the actual amount of water supply from these plants is about 650 million m$^3$ (i.e., 1.8 million m$^3$/d), in which the exploited surface water resource has reached 430 million m$^3$, and is 2/3 of total exploited water resource.
Distribution of drinking water treatment plants in Beijing

- 第九水厂（1990-1995年）
- 第五水厂（1958年）
- 城子水厂（1987年）
- 第三水厂（1955年）
- 第二水厂
- 第八水厂（1982年）
- 第一水厂
- 田村山水厂（1986年）
- 第四水厂（1958年）
- 第七水厂（1972年）
- 第六水厂（1965年）
– In the suburbs of Beijing, the drinking water treatment plants follow the rule of draw-out water in site.

- the Chenzi drinking water treatment plant use surface water from Jing-Mi canal;
- the Nankou drinking water treatment plant use ground water.
- All of them, the capacity is smaller.
Drinking water standards

- For ensuring people’s health and safety, the Chinese government issued the quality standard for drinking water. Its new edition is the same or very close to the one issued by WHO and USA. It is necessary that all of the drinking water produced from treatment plants should meet the standard.
Drinking water treatment processes

- **For ground water:** Most of the ground water in Beijing is classified to the type of carbonate water. The quality of ground water from deep well is good. The raw water is only disinfected by chlorine in the water plant.

- **For surface water:** The surface water from reservoir in Beijing often has the odor and color, the drinking water treatment plant usually adopts the activated carbon adsorption process or the ozone oxidation process after the traditional drinking water treatment processes including flocculation, sedimentation and filtration. And after disinfection process at last, the treated water with good quality will be distributed to the consumers.
The ninth drinking water treatment plant
Recently, a new contingency water source is constructed. 274 thousand m$^3$/d (100 million m$^3$/year) of ground water from Pinggu through 83 km pipeline are drawn into the eighth and the ninth water treatment plant. In connection with 330 thousand m$^3$/d of ground water from Huirou, they make up of an emergency system for solving water shortage in Beijing.
3, Wastewater treatment in Beijing

- Gaobeidian WWTP, 1 million m³/d
- Jiuxianqiao WWTP, 0.2 million m³/d
- Qinghe WWTP, 0.2 million m³/d
- Fangzhuang WWTP, 40 thousand m³/d
- Beixiaohe WWTP, 40 thousand m³/d

Five wastewater treatment plants with the capacity of 1.48 million m³ /d in the urban area of Beijing. Including the suburbs, the total capacity has reached 1.89 million m³ /d.
Distribution of wastewater treatment plants in Beijing
Wastewater treatment processes:

In general, these wastewater treatment plants usually use activated sludge processes. But there is a little difference between different plants.

- Gaobeidian WWTP adopts traditional activated sludge process.
- Jiuxianqiao WWTP adopts oxidation ditch process, which could remove nitrogen and phosphorus in the wastewater.
- Qinghe WWTP adopts extended aeration process, which also have the function of removing nitrogen and phosphorus.
Gaobeidian wastewater treatment plant
Jiuxianqiao wastewater treatment plant
The perspective of wastewater treatment in Beijing

- In the plan of 2008 Olympic Game in Beijing, 14 wastewater treatment plants in urban areas will be operated. The total capacity will be reached to 2.8 million m$^3$/d, and over 90% discharged wastewater will be treated by secondary biotreatment processes.

- Moreover, 39 wastewater treatment plants with the total capacity of 335 thousand m$^3$/d in suburbs will be also constructed. It is certain that the quality of aquatic environment in Beijing will be more and more improved.
4, Water reuse in Beijing

Water transformation engineering

- A good way to solve the problem of water shortage in Beijing
- 3 projects of canal (east route, middle route and west route) are putting in discussion.
- But it will spend a lot of money, manpower, and material resources.
South-north water transfer
Wastewater reuse

- the secondary biotreated effluent could be reused after advanced treated, it will be another good way to solve the serious problem of water shortage.
- Now 400 thousand m$^3$/d treated wastewater in Gaobeidian treatment plant is transferred into the sixth water supply treatment plant to be advanced treated, and to be reused as industrial consumption at last.
- In Jiuxianqiao wastewater treatment plant, 20 thousand m$^3$/d treated wastewater is advanced treated for urban miscellaneous use.
By year 2008, nine new advanced wastewater treatment plants will be constructed, after that the ratio of reused wastewater will be raised from 15% to about 50%
5, Water resource management in Beijing

Water resource management should include managing the affairs of:

- water source,
- flood control,
- drain waterlogged fields,
- drinking water,
- wastewater,
- water reuse, and
- save on water.
Before 2004, the different parts of these affairs were managed by different departments

- drinking water works --- department of public utilities
- Industrial wastewater, pollution control --- department of environmental protection
- drainpipe network and the facilities, municipal wastewater --- department of municipal engineering
- reservoir and river, flood control and drain waterlogged fields --- department of water resource
“多龍治水”

Many dragons control the water

Therefore, such management of water resource could not optimize water resource utilization.
On May 19 in 2004, the **department of Beijing water authority** was established. Except for the general affairs of management, the Beijing water authority are facing following new problems:

- Capital in the construction and operation of drinking water and wastewater treatment plants
- Price policy of drinking water and wastewater
- New techniques of water and wastewater treatment
- Techniques and equipments on water saving
- Exploitation of new water resource, such as water transfer, sea water utilization and rain water utilization.
Thank you for your attention