

# Testing and Analysis of Drinking Water Quality in the Rural Areas of High-tech District in Tai'an City

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## Abstract

In order to understand the sanitation condition of drinking water in the rural areas of High-tech District in Tai'an City, and to provide scientific bases for drinking water quality improvement and public health protection, water quality was tested and analyzed using the methods recommended in the China national health standard GB5750-85, which included 14 indicators, i.e. sensory characteristics, general chemical indicators, toxicological indicators and bacteriological indicators. The results showed that the contents of total coliform, ammonia nitrogen and iron exceeded the standards, and the contents of volatile phenol and Cr (VI), and the total hardness slightly exceeded the standards. It was concluded that drinking water, especially well water in the rural areas of High-tech District in Tai'an City was slightly polluted. Therefore, currently the related government departments should focus on strengthening "the three wastes" treatment and sanitation management of drinking water transmission, and providing additional water disinfection facilities.

**Keywords:** Drinking water, Water quality testing, Indicators

## 1. Introduction

Water is a limited natural resource, which is essential for human survival. Water resources that met certain water quality standards are needed in industrial and agricultural production, as well as in many aspects of people's lives. Domestic water, in particular, is closely related to people's lives, and its quality directly affects public health. Tai'an City is the political, economic and cultural center of central Shandong Province, and in the past 50 years its urban population has surged, its urban area has expanded, and its industrial wastewater and sewage discharge have increased rapidly. As a result, the groundwater pollution has become more and more serious in Tai'an, and in some regions the groundwater contaminants have seriously exceeded the standards (Lu & Wang, 2009). In Tai'an, 60% of the urban water supply comes from groundwater. Since the late 1970's, because of the rapid urban development, industrial and domestic water usage has increased year by year, underground water has been overexploited for years, and the groundwater environment has showed the trend of degradation (Wang *et al*, 2009). To ensure drinking water safety, to identify and eliminate the water pollution factors, we tested and analyzed the drinking water quality in rural areas of Hi-tech District in Tai'an.

## 2. Materials and methods

Water quality surveillance stations were set up in 16 villages, including Dingjiahonggou Village, Shihuikuan Village, Tuo'ao Village etc. in High-tech District of Tai'an. At each station, in April (dry season) and August (raining season) of 2008, tap water and well water (with three repetitions) were tested and analyzed using the

methods recommended in *Standard Examination Methods for Drinking Water* (2001) and *Sanitary Standards for Drinking Water* (2001). The test indicators included sensory characteristics, eight general chemical indicators (color, turbidity, taste and odor, total dissolved solids, pH, total hardness, iron and volatile phenol), four toxicological indicators (Cr (VI), fluoride, nitrate and ammonia nitrogen) and two bacteriological indicators (total bacteria and total coliform).

### 3. Results and analysis

A total of 96 samples of tap water and well water from 16 villages were tested and analyzed, in which three sensory characteristics and general chemical indicators did not meet the national sanitary standards, two toxicological indicators and two bacteriological indicators exceeded the standards. The results were in Table 1.

As shown in Table 1, in general, drinking water in High-tech District of Tai'an met the *Sanitary Standard for Drinking Water* (GB5750-85) in terms of sensory characteristics and general chemical indicators. Only two water samples exceeded the total hardness standard, with an exceeding rate of 12.5%, and seven water samples exceeded the iron content standard, with an exceeding rate of 43.8%. In the toxicological tests, four water samples exceeded the Cr (VI) content standard, with an exceeding rate of 25%, and the ammonia nitrogen content exceeding rate was 75%, which indicated that the drinking water in the rural areas of High-tech District has been polluted by bacteria, sewage or animal feces. In addition, in the bacteriological tests, two water samples exceeded the total bacteria standard, with an exceeding rate of 12.5%, and nearly 70% of the water samples exceeded the total coliform standard, which indicated that the drinking water in the rural areas of High-tech District has been contaminated to different degrees by intestinal bacteria, such as *Salmonella*, *Shigella*, *Vibrio*, and intestinal virus, and are potentially hazardous to public health.

### 4. Discussions and suggestions

Through the tests, it was found that the major contaminants in drinking water were coliform and ammonia nitrogen, followed by volatile phenol and iron, which indicated that the drinking water in High-tech District has been subject to different levels of pollution. Therefore, in the future, the related government departments need to strictly implement drinking water disinfection measures and regularly monitor drinking water quality, so that full compliance with the *Sanitary Standards for Drinking Water* issued by Chinese government will be realized. In High-tech District of Tai'an, there are many wells, but water from most wells is directly consumed without disinfection. In addition, some of the wells are in low-lying locations and with serious infiltration, and there are no protection facilities around the wells, therefore the hygiene conditions are poor, and dirt on the ground can easily penetrate into the wells. Although in most areas of High-tech District centralized water supply is adopted, but the management system is still not perfect, and most related government departments do not conduct water quality testing. When drinking water network was under renovation, the pipelines buried underground were relatively close to the ground and susceptible to external pressure or tillage, therefore secondary pollution caused by rupture sometimes took place. In addition, currently iron pipes and galvanized pipes are mostly used for transporting drinking water. As time passes, such pipes are easily rusted and the galvanized layer may peel off to cause metal go into water, which affects the water quality and taste, or has adverse effects on public health in the long run. As a result, the following suggestions were made:

(1) Water purification and disinfection need to be enhanced, and additional water disinfection facilities should be provided. No matter ground water or surface water is used as the source of drinking water, water body need to be disinfected, disinfection management need to be strengthened, and disinfection quality need to be improved.

(2) The locations of self-built wells should be chosen carefully, and locations with low elevation or close to sources of pollutions should be avoided. In addition, treatment of the three wastes – waste water, waste gases and waste solids should be enhanced, as a result to reduce water pollution and to protect water resources.

(3) Water disinfection personnel should receive regular sanitation training, so that they can master water purification skills and disinfectant adding rules. Special attention should be given to the amount of chlorine added into drinking water. Chlorine disinfection is cheap, simple and with better disinfection result. Since the effects of chlorine disinfection of drinking water and CBPs on human health are not conclusive, currently chlorine disinfection is still the most widely used disinfection method for drinking water (Lin *et al*, 2002). However, it is not to say that the more chlorine the better. Epidemiological studies suggested that chlorine disinfection of drinking water was related to the incidence of and the death caused by cancer among multiple organs, in which bladder cancer, colon cancer, and rectal cancer had a strong and stable relation with chlorine disinfection (Chen *et al*, 2006).

(4) In water supply networks, high-quality PVC pipes should be used to transport drinking water, and any

possible impacts of stress from roads above or from tillage should be avoided.

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Table 1. Drinking water quality test results

Indicator	Total number of samples	Number of samples exceeding standards	Exceeding rate (%)	Measurement range	Sanitary standard	Maximum measurement exceeding ratio
Total dissolved solids	96	0	0	1~56.7	1000mg/L	0
Turbidity	96	0	0	0.1~0.5	5 NTU	0
Color	96	0	0	3~12	15 TCU	0
Taste and odor	96	0	0	None	Without abnormal taste or odor	0
pH	96	0	0	6.5~7.0	6.5~8.5	0
Total hardness	96	12	12.50	120~488	450mg/L	1.08
Iron	96	42	43.75	0.1~1.05	0.3mg/L	3.5
Volatile phenol	96	18	18.75	0.001~0.003	0.002mg/L	1.5
Nitrate	96	0	0	15.2~19.1	20mg/L	0
Ammonia nitrogen	96	72	75	0.21~0.86	0.1mg/L	8.6
Cr(VI)	96	24	25	0.045~0.064	0.05mg/L	1.28
Fluoride	96	0	0	0.12~1.0	1.0mg/L	0
Total bacteria	96	12	12.50	4~445	100CFU/mL	4.45
Total coliform	96	66	68.75	2~28	Less than 3 in every 100mL of water sample	9.3