2.2 MONITORING AND MANAGEMENT OF GROUNDWATER

2.2.1 Groundwater Monitoring

The groundwater dynamic monitoring began from the 1960's in the departments of Ministry of Water Resourcess. After several years' hard work, a groundwater monitoring network with a certain scale which provides the evidence for water resources management and reasonable development and utilization of groundwater had been set up. The Monitoring items include groundwater level, water amount, water quality and water temperature and so on, which could collect, transmit store and analysis data at one time. Because of the promptitude, veracity, and scientificity, the Monitoring items have been used in several aspects instead of manual observation.[7]

A kind of new-type groundwater monitoring system has been developed to carry out the demand of remote observation of groundwater. The technique is based on PLC&GSM short massage data transmission. [8]

But the work of groundwater monitor is still weak and it's difficult to meet the demand of water resourcess management and regulation. Many problems are still existed including the sparse density of observation wells, lack of monitoring wells in the funnel area and important water sources, the old monitoring equipments, the laggard observation and transmission method which can't ensure the information will be transmitted in time and insufficient fund for groundwater monitor.

Because basins in China have special water resourcess characteristic, and based on scarcity and pollution actuality of water resourcess in many basins, researching and developing a real-time monitoring and management system is necessary. The system includes several aspects, such as rectification and improvement of current groundwater monitoring stations, modulation and examination of reservoir operational rules and technical parameters, regulation of flood resourcess and recharge of groundwater artificial, waste water treatment and eco-environmental water demand, unified operation of flood control and useful storage, monitoring and management of surface water and groundwater and the benefit, risk and standardization after the real-time monitoring and management project bring into effect. [9]

2.2.2 Management of Groundwater

One side, water resources is seriously short in China and the over exploitation of groundwater leads to many environmental and geological disasters. On the other side, wasting of the water resources is very severe. Irrigation is the main water consumer, which occupies 70% of the total water consumption in China. Because the irrigation technology is out of date, most of the channels are soil channels and the facilities are very old, the traditional irrigation technology is used in most of the agricultural areas. In some irrigation areas farmers even still use the flooding irrigation method, which waste water very seriously. The utilization rate of industrial water consumption is not high either. The water loss through the water transportation pipe and water facilities has reached over 20 percent.

In order to develop and utilize groundwater more reasonably, reduce the water waste, optimize the distribution of water resources and improve the water utilization rate, in recent years a lot of work has been done on the groundwater planning and strengthening the legalization of groundwater management, which is useful for restricting the groundwater over exploitation.

Tianjin city integrated applied ArcGIS technique, Database technique, Model of water quality evaluation technique to develop its Groundwater environment quality evaluation system. The system has several functions, such as management and analysis of groundwater quality data and GIS data, integrated evaluation of groundwater quality and so on. This system can easily grip situation of dynamic pollution, special distribution, evolution tendency of groundwater. [10]

GIS technology and its application is the main focus in the development of water resources subject. Most of the developed countries have use this technique to manage their groundwater, and have got a lot of experience.[11]A groundwater resources management information system base on GIS technology has been developed.[12] The tendency and direction of groundwater management model is founded multi-purpose dynamic planning model for groundwater management. While, it needs advanced intelligent optimization approach to solute the problem. [13]

Water Resources Demonstration & Management Rules of the Construction Project shows us for the new, rebuilding or expand construction projects that takes water from the rivers, lakes and underground directly, the owner of the construction projects must apply the water license, and should carry out the water resources demonstration and compile the report.

Besides the technical measures, administration management is also important to control the scarcity situation of groundwater. Reinforce the management and supervision of groundwater is imperative under the situation. [14]

2.3 RESEARCH ON GROUNDWATER ANALYSIS

Strengthen the research on groundwater analysis is the basis of the scientific management of groundwater. Resent years a lot of work has been conducted on groundwater analysis, some details are given as follows:

2.3.1 Assessment of Groundwater

The first national water resourcess assessment was carried out at the beginning of 1980's. During this period first national groundwater assessment were carried out, thid report provided important evidences for groundwater planning and management. But in the past 20 years, both of surface water and groundwater varied greatly because of human activities. Thus it is necessary to conduct the national water resources assessment again.

The Domenico model is used in combination with ASTM E 1739 in a Tier 2 risk assessment of chlorinated organic solvents contaminated groundwater sites to predict potential contaminant concentration in groundwater down-gradient from the point of exposure (POE). Knowledge of the dispersivity parameters is necessary for carrying out this calculation. A constant longitudinal dispersivity of 10 m is often used in analytical and numerical calculation. However, because of the scale effect of dispersion, two other main approaches are currently often used. From the viewpoint of conservative principle in risk assessment, it is necessary to determine which dispersivity data will give a higher predicted concentration, corresponding to a more conservative risk calculation. Generally, it is considered that a smaller dispersivity leads to a higher predicted concentration. This assumption is correct when dispersion is the only natural attenuation factor. However, degradation of commonly encountered chlorinated organic solvents in environment under natural condition has been widely reported. Calculations given in this paper of several representative cases show that a general consideration of the influence of dispersivity on concentration prediction is not always correct when a degradation term is included in the calculation. To give a conservative risk calculation, the scale effect of dispersion is considered. Calculations also show that the dispersivity parameters need to be determined by considering the POE distance from the source, the groundwater velocity, and the degradation rate of the contaminant. [15]

2.3.2 Prediction of Groundwater Dynamic Analysis

Many institutes and experts did a lot of work on the prediction of groundwater analysis. The prediction of groundwater level is important for the utilization and management of groundwater resources. At present there are many ways to do the dynamic prediction of groundwater level. The main method is to set up a model of groundwater movement and simulate the process of groundwater movement and predict the state. One groundwater dynamic prediction model is based on inversion models and self-memory formulation. Examples show that, this model is effective, and it also has satisfactory accuracy rate. [16][17] Another model use principle factor time as main factor of prediction model, and river course's replenishment and precipitation as modifying factors, which makes the physics model easy to understand, problem easy to solve. [18] A new model of groundwater table simulation is developed using the mass-lumped finite element method and is coupled with the land surface model of Variable Infiltration Capacity (VIC). The simulation results show that the new model not only can simulate the groundwater table dynamically, but also can evade the choice of water table depth scale in computation with a low computation cost. [19]

According to the research of prediction models, there are two way to increase the reliability and accuracy of prediction of groundwater dynamic analysis. One way is to found affirmatory stochastic coupled model, which could describe both inner characteristic and outer characteristic; the other is to found groundwater system's FBSDE model, and make the inner factor of the system as random variables, while it's outer circumstance factor is also be treat as random time series to solve fixed solution problems, and the solution is showed as probability distribution. [20]

2.3.3 Analysis and assessment of groundwater pollution

In China groundwater pollution is quickly increasing every year because of the surface water pollution, irrigation with sewage water, unreasonable utilization of groundwater, leakage of harzadous substances from industrial factories and so on. Groundwater pollution has the characteristics of point, line and side distribution. The point pollution indicates the local severe pollution around the city and town or the farm because of the concentrated population, developed industry and feedlot with middle or large scale in rural areas. The line pollution indicates the groundwater pollution around the river caused by river pollution. The side pollution means the irrigation with sewage water and the pollution of misusing fertilizer and pesticide in agriculture.

In recent years, we strengthened the work of water quality monitor and assessment in departments of water resources and achieved many analysis and assessment results. One of the difficulties frequently encountered in water quality assessment is that there are many factors and they cannot be assessed according to one factor, all the effect factors associated with water quality must be used. In order to overcome this issues the projection pursuit principle is introduced into water quality assessment, and projection pursuit cluster(PPC) model is developed in this study. The PPC model makes the transition from high dimension to one-dimension. In other words, based on the PPC model, multifactor problem can be converted to one factor problem. The application of PPC model can be divided into four parts: (1) to estimate projection index function ; (2) to find the right projection direction; (3) to calculate projection characteristic value of the sample , and (4) to draw comprehensive analysis on the basis of . On the other hand, the empirical formula of cutoff radius is developed, which is benefit for the model to be used in practice. Finally, a case study of water quality assessment is proposed in this paper. The results showed that the PPC model is reasonable, and it is more objective and less subjective in water quality assessment. It is a new method for multivariate problem comprehensive analysis. [21]

In 2005 according to analysis of groundwater quality done by Ministry of Land Resources in 158 cities and areas of China, it is concluded that totally groundwater quality in China is good, but in most of the cities the groundwater is suffering point and nonpoint pollution threaten, which results in exceeding standard of some elements in local regions. The main polluting elements are the degree of mineralization, the total degree of hardness, sulphate, nitrate, nitrite, ammonia, nitrogen, chlorid, fluorid, Ph value, iron and manganese, etc. Regarding on the pollution degree, generally, the pollution in northern cities is much higher than those southern cities.

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