The Construction of Emergency Response Platform for Water Pollution Accident in Binhai New Area

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Abstract. An emergency prevention and control management system for water environment pollution accidents will be constructed in Tianjin Binhai New Area. The basic information database of environmental risk sources and response system should be established. The construction of emergency disposal platform based on accident emergency monitoring and emergency response linkage mechanism. Through the introduction of on-site monitoring, pollution sources outfall information, equipment database, expert database, comprehensive analysis, optimization of pollution disposal program and information delivery of pollution source data can achieve effective control of sudden pollution accidents and timely disposal from the remote command to build integrative water pollution accident emergency disposal platform.

Introduction

As a national strategy new area and the national comprehensive reform pilot area, Tianjin Binhai New Area has realized high speed development of economy relying on superior geographical resources advantages and development policy. Environmental risk in the process of industrialization increased due to the characteristics of water pollution accident such as Sudden severity, extensiveness, and long-term impact. Sudden water pollution accidents will bring huge losses to the society and economy and affect people's health and safety. Therefore, it is of great practical significance to establish an emergency disposal platform for sudden water pollution accidents, which is also an important part of the environmental accidents capacity building for governments.

At present, surface rivers in Tianjin Binhai New Area are polluted and river water quality is mainly of class V and inferior class V. Metallurgical, marine chemical petroleum and chemical industry as the pillar in the Binhai New Area is high-risk industry also. People has witnessed the fatal damage caused by the imperfect of the environment warning system specially at the 8.12 explosion accident in 2015. Building water pollution accident emergency management system and emergency disposition monitoring platform in Binhai New Area can improve environment warning capability and effectively prevent water environmental pollution incident happening. Sudden water pollution incident can quickly be controlled properly and pollution losses can be reduced to a minimum once it happens.

The Necessity and Foundation of the Emergency Response Platform

Emergency response platform is able to reflect the environment quality accurately, illustrate pollution discharge conditions and respond to environmental emergencies. It can meet the needs including of infrastructure, technology, equipment, information network and talent guarantee. At present, our country of sudden water pollution accident disposal is based on the regional emergency response plans and equip reserve. Through digital automation means to set up a systemic treatment management platform can timely and quickly grasp the sudden accidents of water environment or hazard source and make accurate decision which can minimize the possibility of an accident and major losses. Using automatic online monitoring facilities to collect data of surface water and pollution source water can observe water environment changes and establish emergency rapid response.
Application of Automation Technology in Automatic Monitoring System of Water Environment

Automatic monitoring system for water environment can timely and dynamically monitor the target water quality and changes. It is a comprehensive on-line automatic monitoring system which is based on an online automatic analyzer including of modern sensor technology, automatic measurement techniques, automatic control technology, prevention and control technology, analysis software and communications network. This system allows simultaneously multi-parameters automatic monitoring of water quality. In this way, it can achieve the purpose of understanding the water’s quality of key water bodies in major rivers, predicting major water pollution accidents, solving water pollution accidents and supervising the implementation of the total control system so as to serve the management decision.

At present, water environment automatic monitoring station of river section in Binhai New Area has been checked and accepted, which is in normal operation. The automatic monitoring system includes water samples acquisition control subsystem, water quality monitoring subsystem, data transmission subsystem, information management subsystem, warning and forecasting subsystem. Everyday 15 river section water automatic stations continuously transmit automatic monitoring data to the system. The monitoring items includes pH, Dissolved oxygen Ammonia nitrogen, Total phosphorus, Permanganate index, Chemical oxygen demand, Turbidity, Conductivity, etc. These 15 sections including all the major rivers of Binhai New Area. In addition, 67 enterprises of water pollution sources in Binhai New Area have been included in online monitoring platform too. Among the 67 enterprises, there are 8 state-controlled wastewater enterprises, 8 city-control wastewater enterprises, 27 area-controlled wastewater enterprises, 13 state-controlled sewage treatment plants and 11 city-control sewage treatment plants. The pollution source online monitoring platform includes COD and Ammonia nitrogen which are sensitive indicators. Online monitoring equipment of pollution sources can transmit the changes of various indicators of pollutants at the sewage outlet in real time. Specially-assigned persons are responsible for monitoring the anomalies of data. We should also be soberly aware that the automatic monitoring system is deficient in data management, data analysis, predictive warning and comprehensive evaluation. GIS remote sensing technology, database system and water quality model should also be used to make dynamic simulation of sudden water pollution events [1]. The online management system should also be incorporated into the emergency disposal platform.

Set up Information Platform and Database

**Expert Database of Environmental Emergency.** According to the emergency management measures of the country ecology environment ministry, the environmental departments at the provincial and city should establish environmental emergency expert database. Experts will help handling emergency environmental accidents, developing emergency disposal plan, providing decision-making advice, participating subsequent pollution damage assessment and technical training. At present, Binhai New Area has already have the resources of environmental emergency experts. The experts of the database come from senior engineers and doctoral candidates in the field of environmental protection. They have been engaged in environmental emergency management and environmental protection research projects for a long time.

**Emergency Equipment Storage Facility.** Emergency equipment resources are essential for emergency disposal of sudden water pollution accidents. According to dominant industry characteristic and area characteristic, the following three aspects of equipment should be equipped.

**Equipped with Emergency on-site Sampling Vehicle.** Some devices such as portable multi-parameter water quality monitor, portable water flow meter, water sampling equipment (small sample boat), on-board weather system, communication and protection devices should be equipped in the sampling vehicle.
Equipped with **Emergency Mobile Laboratory.** Some devices such as portable GS-MS analyzer, luminescent bacteria toxicity detector, portable multifunctional water quality detector (including portable ultraviolet/visible spectrophotometer), portable oil gauge should be equipped in the mobile laboratory, so that it can achieve the purpose of monitoring and analyzing all kinds of pollution events in the accident site.

**Configuration of Emergency Command Vehicle.** Equipped with vehicle-mounted communication equipment, mobile transmission equipment and positioning/navigation system, it is capable of understanding the progress of pollution event and commanding coordination.

**Build an Information-based Emergency Management and Control Platform.** Using existed environmental monitoring information resources, build the management system, network system, emergency equipment system, technology standard system, personnel system, emergency plan and emergency response system and quality management system as the basic elements of the Binhai New Area emergency response platform. The emergency response platform can follow the change of pollutant discharge timely, accurate warn response to all kinds of environmental emergencies, satisfy the need of environmental management. The platform has the function of issuing water environmental quality reports, which can promptly identify potential pollution processes or environmental safety hazards. The emergency response platform can strengthen the management of pollutants emissions to environment. Emergency system analyze the reason of sudden water pollution accident, formulate corresponding emergency management and rescue plan, provide safeguard measures in response to the accident. In the case of sudden environmental pollution incidents, experts can put forward disposal countermeasures and suggestions immediately and propose views of the surrounding environment restoration and long-term environmental impact.

**Water Pollution Accident Emergency Plan and Warning Function**

An YU had introduced emergency plans in detail to prevent water pollution and emergency disposal system construction in Nanjing chemical industrial park [2]. He put forward the construction of water pollution emergency response system and enterprise emergency plan, etc. These are the foundations for the construction of emergency response platforms. Ji-ping JIANG combed and summarized the basic process of warning emergency response, namely “emergency traceability” and “risk early warning” as the main line supplemented by “emergency monitoring” [3], which are the theoretical framework for the construction of warning disposal platform. Emergency treatment platform must have sound warning disposal technologies.

The Binhai New Area emergency warning and disposal platform is mainly used in the emergency monitoring and preparation response phase. The core is to use a combination of database management system and geographic information system to adopt a combination of decentralization and concentration of environmental information. The preparation period should include the following contents: basic information database management, pollution source and hazard source information, key infrastructure information, monitoring information, emergency resource management, emergency plan management, emergency capability assessment, emergency drill, forecasting and warning information management. Other important information must be displayed on the platform including physicochemical characteristics of pollutants, treatment and disposal methods, emergency experts information, emergency organization and personnel information, meteorological, hydrological, communication resources, police allocation, population distribution, etc. The response period should include the following contents: receiving warning information management jointed command coordination management, site information collection and interaction, emergency resource dispatch management, emergency decision support, emergency information release, etc.
Response Mechanism and Model Simulation Technology of Emergency Response Platform

Response Mechanism of Emergency Response Platform

In the design of platform data acquisition and warning function, we can learn from Li-rong Wang's water pollution monitoring and warning system design idea [2], combined with pollutant drift dynamics and diffusion regular pattern. It can achieve automatic alarm of sudden water pollution, locate the emergency pollution and automatically generate effective solutions for water emergency treatment.

The platform has functions such as water warning dynamic analysis, grading warning and regional comprehensive warning. The platform can seamlessly link the information of each water quality monitoring site. The emergency response platform can obtain the geographic information of the alarm location, classifies the accident and initiates an emergency disposal plan. The water pollution accident response mechanism is shown in Figure 1.

![Figure 1. Water Pollution Accident Response Mechanism.](image)

Development of the Model Simulation Techniques for Emergency Response and Warning

Development of Emergency Warning Model for Sudden Water Pollution Accidents. The warning indicators and the emergency levels may be set according to the situation of pollution such as the affected population, the scope of influence, the size of the affected water body, the economic loss and the degree of degradation of the water environment quality, etc when a sudden water pollution
The system dynamics warning method is used to conduct the quantitative analysis of the severity of water pollution accidents [5-6], and the overall framework of emergency warning of sudden water pollution accidents is constructed based on geographic information system and various databases. The warning model can be used to determine the type and concentration of pollutants with the diffusion and attenuation model when the accident occurs. A suitable disposal plan can be given through combining the prediction of the range and degree of pollution by simulation of the pollution situation with the nature of the dangerous substance.

**Development of the Emergency Response Technology Program Dynamic Generation Model and Decision Support System.** The most critical requirement for sudden water pollution is “emergency disposal”, which requires the decision makers to select appropriate emergency disposal technologies and formulate emergency disposal technical solutions quickly and accurately.

Because of preparing the emergency plan in advance, the operation route of the emergency disposal project can only be implemented according to the typical pollution accidents, which means it is not possible to exhaust all the possibilities. Therefore, it is necessary to generate the disposal technical plan dynamically according to the specific pollution scenario or working condition. The three-step screening and decision-making model of “similar historical case screening - emergency disposal technology screening - emergency disposal material equipment screening”, which was proposed systematically by Ren-tao LIU et al[7]. It facilitated the formation of intelligent emergency response plans and hence greatly improved efficiency and scientific nature of the screening of water pollution emergency disposal technology and provided a strong program support for decision makers. Therefore has great reference significance.

**Development of a Visual Dynamic Model for the Diffusion and Migration Process of Pollutants.** Wen-jun LI et al.[8] studied the fusion method of water quality model and 3S integrated environment based on the visualization technology. The Songhua River was taken as a sample to construct the Songhua River Sudden Water Pollution Visualization Simulation System by simulating the diffusion and migration process of pollutants. It realized the dynamic visualization of the computer data of the water quality model through the construction of the triangulation network and the fitting of the water quality data, which has great reference significance. The remote command capability for timely dispatching and disposal of sudden pollution accidents can be realized through the comprehensive analysis and judgment, the preferred disposal plan, and the release of pollution information. The surface water in Binhai New Area is composed of multiple rivers of different scales and functions. The water with temporal and spatial distribution characteristics of pollutants were evaluated. The spread of pollutants in various sewage outlets along rivers is the main research content. The river model adopts the body-fitted mesh generation technology, and the pollutant diffusion process is calculated by using the sediment model, the chemical model and the biological model respectively. The distribution of water pollution factors such as ammonia nitrogen, total phosphorus, COD Cr, BOD 5 and potassium permanganate index in the river channel are to be demonstrated. This method realizes the visualization and predictability of pollutant diffusion process in rivers.

**Conclusion**

Since Binhai New Area has not established a systematic emergency warning management system for sudden water pollution accidents, this study is aimed at exploring the rational resources allocation of emergency treatment system. The key step to construct emergency response platform in Binhai New Area is to prepare emergency plans for sudden water pollution, establish an accurate, rapid and efficient emergency linkage response mechanism, construct automatic monitoring system and water pollution emergency facilities. The demonstration platform of water environment emergency management and disposal of Binhai New Area can be improved with visual simulation method and the optimization of emergency disposal technology.
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