Environmental Risk Assessment of Chemical Industry Park Based on Analytic Hierarchy Process

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Abstract. The rapid development of chemical industry park in China has brought considerable economic benefits for the country, but also caused the complexity of environmental issues. Chemical enterprises in the park intensive, complex production processes, many kinds of hazardous substances, so it is necessary to evaluate the environmental risk. In this paper, according to the principle of environmental risk assessment, combined with the regional environmental risk of chemical industry park and the characteristics of complexity, based on the consideration of environmental risk the risk source in the system, the control mechanism, the receptor and the enterprise management level, selection of dangerous chemicals, safety management and production process of Rios and receptor sensitivity of three-dimensional integrated index system, to evaluate the chemical the industrial park environmental risk. Evaluation using the analytic hierarchy process comprehensive environmental risk of chemical industrial park. According to the evaluation results, according to the different risk levels of the enterprise, put forward the environmental risk management suggestions. The results have application value, can provide a reference for the environmental risk management process, and provide technical support and decision-making basis for the decision makers.

1. Introduction

With the rapid development of chemical industry, chemical industry park as an energy recycling rate, little pollution, high development model for centralized management, rapid rise in our country. With the continuous improvement of the level of industrialization, the number of chemical industry parks is increasing, chemical industry park has become a main direction of China's development of chemical industry, it appears to promote the development of the chemical industry to the scientific, intensive, professional direction.

According to the site China Development Zone statistics, China's national, provincial industrial parks and industrial concentration area of more than 1600, the industrial park has become a new economic growth point, but also become the focus of prevention and control of environmental pollution and regional environmental risk. Therefore, the environmental risk assessment in this research field emerge as the times require [1]. At present, China chemical industry park is roughly divided into four types: the large petrochemical, fine chemical industry, the relocation of the city and the old enterprise expansion. Obviously, chemical industry park has the industry "cluster" effect, is the inevitable trend of chemical industry for economic development, but also to the local economy, employment has a huge role in promoting. But at the same time, many kinds of dangerous chemicals in chemical industry park, the significant dangerous source of the surrounding dense population and the environment, bring huge risks and hidden dangers of accidents [2-4].

Analysis of environmental pollution accidents in the past, it is not difficult to find, flaw of risk management and emergency response system is the main cause of major environmental accidents, so it is urgent to establish a scientific and comprehensive environmental risk assessment system, in order to comprehensive assessment of chemical industry park of the whole ring of environmental risk, prevent trouble before it happens.

In our country, for the relevant environmental risk assessment guidance to regional hazardous chemicals environmental pollution emergency work of the late start of the study, is still not perfect,

in recent years gradually released the "enterprise burst environment event risk assessment guide" and other evaluation criteria. However, not a detailed evaluation of each enterprise risk level and risk index. Therefore, this study through the investigation and expert questionnaire scoring form, using the analytic hierarchy process to construct the judgment matrix, the industrial park environmental risk evaluation index and weight were studied.

2. Research Methods

AHP (Analytic Hierarchy Process, AHP) is a kind of analysis method combined with qualitative and quantitative, systematic and hierarchical. The main solution is composed of many factors and the interrelated factors, mutual restriction and lack of systematic quantitative data analysis [5]. AHP modeling can be divided into 4 steps: first, to establish the hierarchical structure model; judgment matrix in the structure of all levels; the single hierarchy ordering and consistency inspection;

The hierarchy total ordering and consistency inspection. AHP provides a simple and practical modeling method for decision-making and sort the problem, has been widely used in the field of environmental risk assessment [6-7].

The principles of index screening and screening results. AHP modeling of index selection principles: the principle [8] of environmental risk assessment of risk source, risk supervision of receptor and the three core elements of the chemical industry park; environmental risk area and complexity; in the environmental risk source assessment, the differences reflect the characteristics of high risk materials mainly caused by environmental risk principle. The industrial park environmental risk assessment index selection mainly refer to the GB18218-2009 "major dangerous chemical hazard identification", GB50483-2009 "chemical construction project environmental protection design code" HJ/T169-2004 ", the construction project environmental risk assessment guidance," HJ/T610-2011 "environmental impact assessment" and other standards and technical guidance of groundwater environment, directly from the screen.

The environmental risk of hazardous substances, raw material storage or the maximum amount of pollutants, direction, production process, risk prevention measures, environmental risk receptor density, the surrounding residents a total of 7 indicators; according to the complexity of environmental risk of chemical industry park, the area and the importance of regional environmental risk environmental regulation characteristics, added the possible pollution, environmental emergency plans and emergency management, safety management, accident of history, plant area affected by natural disasters, a total of 5 indicators. In summary, a total of 12 selected chemical industrial park environmental risk evaluation index.

AHP modeling and consistency test. According to 12 indicators of environmental risk assessment of Industrial Park, the AHP analysis model is shown in Fig. 1. The model is mainly divided into 3 levels, namely: the target layer is A, final accounting and decision model of the ultimate goal, namely the industrial park environmental risk comprehensive value; the criterion layer is B, the classification of elements of the model of index layer, namely the 3 elements of the accounting of environment risk comprehensive value, including hazardous chemicals and production process, safety measures and receptor sensitivity; the index layer C, specific indicators in the model calculation of Industrial Park Comprehensive Environmental Risk value. The study only for the weight of index layer and rule layer to the calculation of chemical industrial park environmental risk comprehensive value research.

Judgment matrix AHP construction of Chemical Industry Park risk structure model, using the 1-9 scale method of importance degree evaluation. Consistency test of judgment matrix:

$CR = CI/RI$

$CI = \frac{\lambda_{max} - n}{n - 1}$

CR: random consistency ratio, when CR<0.1, thought that the consistency of the judgment matrix is acceptable, consistency or should be modified to the judgment matrix to make it has satisfactory; CI measure of judgment matrix.
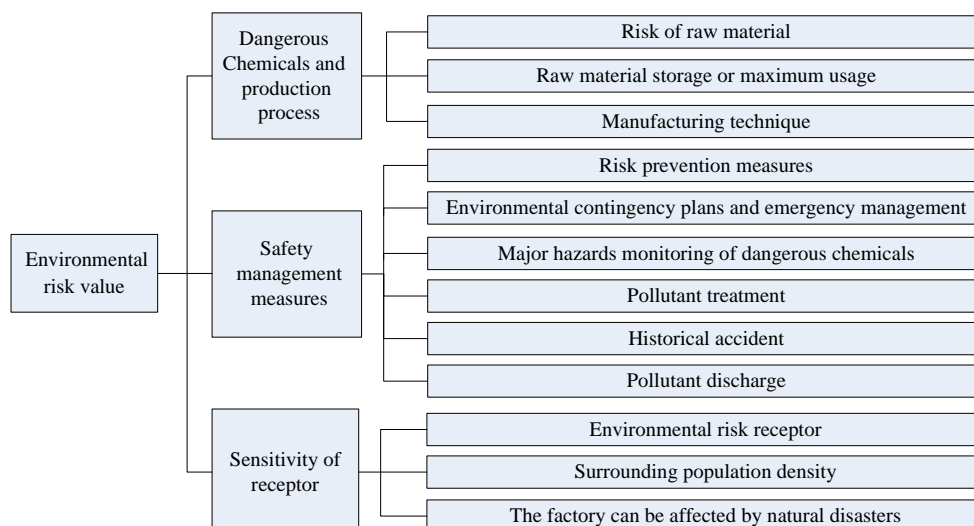
Fig. 1 AHP analysis model

Consistency index deviation; maximum eigenvalue of the matrix; n matrix; RI is the average random consistency index. From table 1 we can see, all the AHP modeling of the matrix CR<0.1, the whole, has the consistency of judgment matrix consistency inspection with satisfactory.

Table 1. Judgment matrix consistency check

Index Hierarchy	λ_{max}	CI	RI	CR
A-B	3.0183	0.0092	0.5199	0.0176
B1-C1-3	3.0291	0.0146	0.5215	0.0279
B2-C4-9	6.4102	0.0820	1.2602	0.0651
B3-C10-12	3.0126	0.0063	0.5207	0.0121

3. Results

Table 2. analysis results of AHP modeling

The criteria layer	The index layer	The weight of the index layer	Sorting
Dangerous chemicals and production process	Risk of raw material	0.0364	10
	Raw material storage or the maximum amount	0.1296	4
	Production process	0.1536	2
12 the index weight analysis results are shown in table 2. Safety measures	Risk prevention measures	0.2395	1
	Environmental emergency plans and emergency management	0.1486	3
	Supervision of major hazard of dangerous chemicals	0.0144	11
	Pollutant treatment	0.0568	7
	Historical accident	0.0377	9
	Fate of pollutants	0.0615	5
Receptor sensitivity	Population density around	0.0594	6
	The factory may be affected by natural disasters	0.0095	12
	Environmental risk receptor	0.0531	8

A questionnaire investigation on China's environmental experts convenient and chemical park management personnel, a total of 100 questionnaires, 87 valid questionnaires were recovered. Based on 87 valid questionnaires, and AHP modeling and analysis, 12 index weight analysis results are shown in table 2.

According to the industrial park of 12 indexes weights analysis results, through the related standard docking and based on expert consultation, "enterprise burst environment event risk assessment guide (Trial)" scoring principles of each index.

4. Conclusion

Environment risk assessment of chemical industry park in criterion layer index weights are safety measures (0.5584), and the production of dangerous chemicals (0.3196) and receptor sensitivity (0.1220), from the 3 criteria layer index weight, safety measures and Quan Zhongyuan was higher than that of dangerous chemicals production and receptor, therefore, chemical Industry Park in environmental risk prevention and supervision in the process of emergency management work, focus should be to strengthen the enterprise risk management and environmental emergencies, and sources of risk classification management of existing enterprises.

Analysis results from AHP modeling, risk prevention measures (first) and environmental emergency plan and emergency management (third) was higher than that of pollutant treatment index weights (seventh) and historical accident (ninth) and other indicators, it also has become an important measure of environmental risk prevention in the Industrial Park level ring exit the daily supervision, and environmental risk prevention regulatory system is more important than the supervision of environmental risk accident emergency response.

From the 8 indexes weights, weights for the receptor elements in ecological environment quality and safety index is very low, this also shows that Chinas environmental risk assessment and supervision system in the ecological environmental quality and safety aspects of the inadequate attention, therefore, in the industrial park environmental risk assessment should also strengthen the prevention and control of ecological environment quality and safety.

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