

Environmental Risk Assessment of Enterprises from Key Industries in Tianjin Binhai New District

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Abstract. This paper aims to comprehensive research methods both in China and abroad and develop a practical method of environmental risk assessment about enterprises from key industries based on the data of Tianjin Binhai New District. This method consider the following factors: types of industries, the enterprise production scale, emergency preparedness and protective measures, the distance between enterprises and environmental protection target, and use Delphi method to collect data in order to guarantee the accuracy.

1. Introduction

With the continuous development of regional economy in China, The coordinated development of beijing-tianjin-hebei has risen as a national strategy. Recently, the Tianjin free trade zone was founded in Tianjin Binhai New District. There will be a new development in Tianjin Binhai New District. So Environmental pollution and environmental risks will follow. A more realistic and accurate method of environmental risk assessment is necessary in order to forecast the environmental risk of enterprises in Binhai New District [1]. This paper considers two aspects of the probabilities of environmental emergencies and the consequences of environmental accidents to form a new method of environmental risk assessment based on the data of enterprises from key industries in Tianjin Binhai New District.

2. Methods of environmental risk assessment of enterprises

Due to the characteristics of industry, some enterprises are more likely to have emergency than other companies, so the environmental risk of those enterprises is higher. Due to close to the water source or residential areas, when some sudden environmental incidents occur in some enterprises, the environmental impact is even greater, so the environmental risk of those enterprises is also higher [2]. In summary, environmental risk of enterprises consider two aspects of the probabilities of environmental emergencies and the consequences of environmental accidents.

We use value of risk (R) express enterprise environmental risk, defined as the product of factor P which is the probability of enterprise accident and factor C which is the environmental consequences caused by accidents, so $R=P \times C$. It is generally believed the accident probability of enterprises (P) is related to the types of industries (L). And the consequences of environmental accidents(C) is related to the enterprise production scale (A), emergency preparedness and protective measures (K), the distance between enterprises and environmental protection targets (G) [3].

Therefore, the accident probability of enterprises can be defined as a formula: $P= L$

The consequences of environmental accidents (C) is defined as the following formula: $C=A \times K \times G$

While the environmental risk value of enterprises $R=P \times C$, so $R=L \times A \times K \times G$.

2.1 The factor calculation of different types of enterprises (L).

The paper is based on classification of enterprises from key industries in Binhai New District, and makes the expert consultation questionnaire about Delphi, then choose 10 to 15 experts from different industries to score the related content. Finally get key industries of Binhai New District environmental risk weights [4], the results shown in the following table:

Table 1 Environmental risk weights of enterprises from key industries in Binhai New District

Oil processing and coking industry	The manufacture of refined oil products	88
	Coking	85
Chemical raw materials and chemical manufacturing industry	The manufacture of basic chemical raw materials	87
	Fertilizer manufacturing	60
	Pesticide manufacturing	88
	The manufacture of coatings, printing ink, pigment and similar products	85
	Synthetic materials manufacturing	70
	Special chemical products manufacturing	81
Pharmaceutical manufacturing industry	Chemical and pharmaceutical raw materials manufacturing	85
	Chemical pharmaceutical preparation	67

Note: 60-70 points: environmental risk is in general; 70-80 points: environmental risk is larger; 80-90 points: environmental risk is big; 90-100 points: environmental risk is very large.

2.2 The factor calculation of enterprise production scale (A).

Due to differences in enterprise production scale, potential environmental risks for each enterprise are different. The larger the enterprise production scale gets, the greater the potential environmental risk get. So put the specific enterprise production scale (m) compare with their industry total production scale (n), we can get enterprise production scale factor (A) [5]. The specific formula is defined as follows:

$$A = \frac{m}{n}$$

2.3 The factor calculation of emergency preparedness and protective measures (K).

The factor of emergency preparedness and protective measures refers to the environmental emergency plans of enterprises, emergency training, and emergency drill and so on. The factor value is the product of the environmental risk value and weight of each index [6]. The specific evaluation index and score shown in the following table:

Table 2 The evaluation index system of enterprises' emergency preparedness and protective measures

The target layer	The index layer	Value of risk		
		High risk (3 points)	Medium risk (2 points)	Low risk (1 point)
The factor of enterprises' emergency preparedness and protective measures	Environmental emergency plans of enterprises	No	Yes	Yes
	Emergency training	No	No	Yes
	Emergency drill	No	No	Yes
	Emergency handling equipment	No	No	Yes
	Emergency material	No	Yes	Yes

	reserves			
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Invite experts from all industries to score the content that the evaluation index of enterprises' emergency preparedness and protective measures [7]. The weight of each index shown in the following table:

Table 3 The weight of the evaluation index of enterprises' emergency preparedness and protective measures

The target layer	The index layer	The weight
The factor of enterprises' emergency preparedness and protective measures	Environmental emergency plans of enterprises	0.31
	Emergency training	0.12
	Emergency drill	0.24
	Emergency handling equipment	0.22
	Emergency material reserves	0.11

2.4 The factor calculation of the distance between enterprises and environmental protection targets (G).

The study selected drinking water sources, the common water, protected areas, hospitals and schools as environmental protection targets [8]. The method about the factor calculation of the distance between enterprises and environmental protection targets as follows:

Table 4 The method about the factor calculation of the distance between enterprises and environmental protection targets

The environmental protection target	The value of distance factor			
	100 meters	500 meters	1000 meters	5000 meters
Drinking water sources	10	8.5	7	5
The common water	4	2	1	0
Protected areas	7	4	2	0
Hospitals	5	3	1	0
Schools	5	3	1	0

3. Summary

Through investigation and analysis of different enterprises get the weight value of each factor. Then take the factors: the types of industries (L), the enterprise production scale (A), emergency preparedness and protective measures (K), the distance between enterprises and environmental protection targets (G) into the value of enterprise environmental risk (R), so the larger the value gets, the higher the risk is. Compared with the methods of only considering environmental risk coming from work processes of enterprises, this method is more practical and more accurate [9].

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