CHEMICAL ENGINEERING TRANSACTIONS
VOL. 62, 2017
A publication of AIDIC
The Italian Association of Chemical Engineering
Online at www.aidic.it/cet
Guest Editors: Fei Song, Haibo Wang, Fang He

ISBN 978-88-95608- 60-0; **ISSN** 2283-9216
DOI: 10.3303/CET1762093

Study on the Location and Mode of Energy and Heavy Chemical Industrial Area

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In order to study the site selection and method of industrial park, the gray level evaluation method and the gray relational analysis method are applied to the site analysis of industrial park. Through the analysis of the development trend and characteristics of the industrial zone, the problems in the planning and construction of the industrial area are discussed. The concept and countermeasure of industrial area planning under the background of rapid economic development are put forward. The environmental risk management system was constructed. The organic combination of environmental risk assessment and risk management was realized. The results show that the shock wave produced by the fire and explosion of the tank has potential risks to the surrounding tanks and devices. Therefore, in the urban planning and chemical enterprise location, the accident factors must be fully considered. Taking the lethal radius as the safety distance, the location and layout of the enterprise are planned reasonably.

1. Introduction

With the development of Western China, the energy superiority in the west can be reflected. A series of industries, especially heavy chemical industry, have been developed unprecedentedly because of energy advantages (Côté and Liu, 2016). The industrialization and the construction of industrial zones in the western region have begun to accelerate. Industrial site selection must take into account many factors that affect industrial location. These factors include natural conditions, economic factors, social cooperation, labor, technical factors, environmental factors and government (Dong et al., 2014). In different circumstances, the factors affecting the industrial layout are different. Therefore, in the formulation of industrial layout program, the advantages and disadvantages are comprehensively analyzed, so as to achieve the maximum benefit. Natural conditions play a decisive role in the layout and pattern of certain industries. Urban ecological system is mainly composed of urban ecological support subsystem and urban social and economic subsystem (Fang et al., 2013). The structural configuration, functional coupling and interaction between the two subsystems determine the characteristics and size of the whole urban ecosystem carrying capacity.

Because of various reasons, there are many problems in industrial areas of energy, heavy chemical industry and towns. The layout is not reasonable. The building, process, equipment, pipeline and transportation of the plant hinder the development of the city and the life of the residents. Enterprises in the industrial zone seek profits only and put environmental protection aside (Li et al., 2017). Due to the mixing of industrial and residential areas, the problem of industrial pollution nuisance is quite serious. The development of the city has transformed the suburbs of some industrial areas into downtown areas. The industrial area is surrounded by new buildings, causing pollution in the city. When the industrial area becomes the central area of the city, the pollution of the whole city has been greatly improved, which has great pollution to the residential areas, commercial areas, economic zones, political areas and cultural areas of the city. Sustainable development and ecological thought are the leading ideas of the transformation of energy and heavy chemical industry in urban industrial districts (Perales-Momparler et al., 2017). There are connections and differences between them. The idea of sustainable development mainly refers to the reuse of plant buildings, land and industrial waste materials in the industrial areas of energy type cities and towns. The practice of decades in Germany Ruhr has proven that sustainable development of regional ecology is an important choice for the revival of

Please cite this article as: Ran Jing, 2017, Study on the location and mode of energy and heavy chemical industrial area, Chemical Engineering Transactions, 62, 553-558 DOI:10.3303/CET1762093

traditional industrial areas (Rahman and Najib, 2017). It is also an important way to avoid problems in the construction of energy and heavy chemical town industrial area.

2. The basic procedure of industrial park location

Industrial Park site selection is a very strong policy and technical work, which is a very important part of the park construction work (Su et al., 2016). It is not only related to the rationality of the layout of the park and the park economy in the future operation of the situation, but also directly affect the park construction progress and investment. The choice of industrial park site can be divided into three stages: the preparation stage, the regional selection stage and the specific site of the selection stage. The main task of the preparatory stage is to meet the requirements of site selection, and to propose the technical and economic indicators needed for site selection. The region selection stage is mainly for investigation and collection of data, such as visiting departments and regional planning departments for site selection, the choice of regional society, economy, resource investigation, meteorology, transportation, environment and other conditions (Theo et al., 2016). The candidate regions were analyzed and compared, and preliminary opinions on regional choice were put forward.

In the specific site selection stage, a number of candidate addresses in the region should be investigated and surveyed. The historical statistics of the local meteorological, geological, earthquake, hydrological and other departments have been consulted. The data of power supply, communication, water supply and drainage, transportation and so on, and the connection of transportation lines and public pipelines are collected. The local construction costs, local tax system, transportation costs and other economic data were investigated. After research and comparison, several candidate sites are proposed. The corresponding reports should be made at all stages, especially in the final stage. Detailed reports and materials should be provided with various drawings for the leadership and management departments to make decisions. In the concrete operation, the basic procedure of industrial park location is shown in Figure 1.

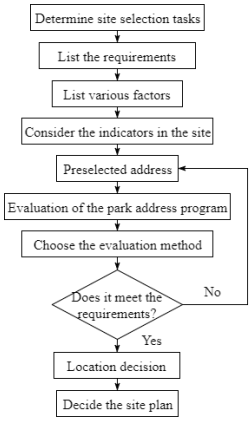

Figure 1: Flow chart of industrial park location

3. Methods

3.1 Analytic hierarchy process

Analytic hierarchy process is also called hierarchical consciousness decision-making method, which is developed by the United States operations researcher Professor T.L. Saaty in 1970s (Tian et al., 2014). It is a simple and effective method for system analysis. This method is a qualitative and quantitative decision analysis method, which can decompose complex problems into an ordered ladder hierarchy. By comparing and judging, the relative importance of various decision plans is calculated, and the best scheme is selected. An objective and reasonable scheme is sought in the case of vagueness or uncertainty. This method is suitable for dealing with complex problems of social, political, economic, technological and other structures. It can make some sensory things scientific and obscure, and find out the most reasonable scheme in several candidate projects. The method is simple and clear. It can be closely related to the subjective judgment and logical reasoning of the decision-maker, and quantifies the reasoning process of the decision maker. The decision maker's mistakes are avoided in the logical reasoning with complex structure and many schemes. In particular, it is more practical to quantify the judgment of decision maker's experience without the necessary data (Zheng et al., 2017). Therefore, this method has been widely applied in many fields, such as construction

engineering, skill training, energy saving, public transportation system, real estate and scenic spot in a few years. This method is introduced into industrial park location. The site selection of industrial park is more scientific in the actual operation, so as to lay a good foundation for the normal operation of the park in the future, and create more economic and social benefits. The flowchart of the analytic hierarchy process is shown in Figure 2.

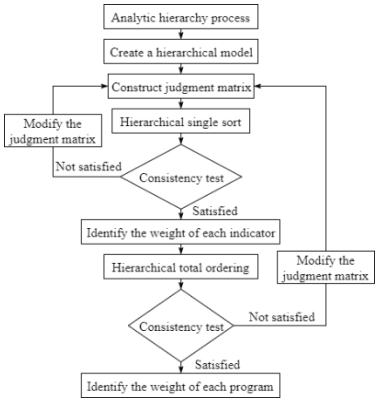

Figure 2: The flowchart of the analytic hierarchy process

3.2 Grey hierarchy evaluation method

In decision analysis method, the decision problem which contains grey number or general model and grey model is called grey decision problem. The combination of grey system theory and classical decision analysis theory has both theoretical significance and practical value. Grey hierarchy evaluation method is the combination of AHP and grey evaluation method (Zhe et al., 2016). The number of grey numbers that only knows the range and doesn't know its exact value is called grey number. In application, the grey number actually refers to the uncertainty of the value in a certain interval or a general number set. By means of a priori information or some means, we can find a white number as the representative of grey number, which is called the whitening number of the corresponding grey number. There is a kind of grey number that changes near a basic value. It is easy to whiten such grey numbers. We can use the basic value as the main whitening value.
The basic idea of grey hierarchy evaluation is as follows. Firstly, the hierarchy structure is established by AHP, and the judgment matrix is constructed. Then, the weights of the evaluation indexes are calculated by the hierarchical single sorting and the total sorting. Finally, the grey model is used to calculate the weight of each alternative to each evaluation index. The flowchart of the grey hierarchy evaluation method is shown in Figure 3.

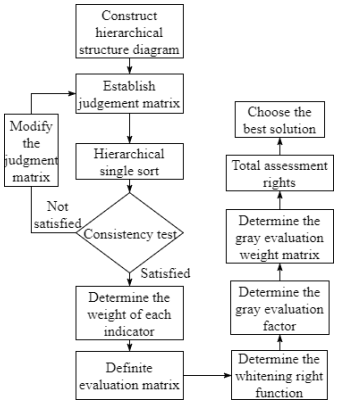

Figure 3: The flowchart of the grey hierarchy evaluation method

3.3 Scheme evaluation method based on grey relational analysis

In urban construction and planning work, the benefits of technology, economy and society should be taken into consideration in many projects. Therefore, it is necessary to put forward a series of indicators to evaluate

and select the best from the alternatives. However, technical and economic indicators are often mutually exclusive and complementary to each other. In addition, there may be non-quantized ash numbers. This will bring difficulties to the evaluation and optimization of the scheme. The location scheme of industrial park belongs to this kind. The method of association analysis can solve the above problems, and can be used as one of the site selection methods of industrial parks.

The correlation analysis scheme evaluation method is the basic nature of the grey system theory correlation analysis. According to the data column of technical and economic evaluation indexes of these schemes, the optimal technical and economic index reference data column is constructed. Through the index data of each scheme, the correlation degree of the optimal reference data column is calculated, and the correlation degree order is obtained, so as to realize the priority of the scheme. The degree of relevance is the degree of association between two things. The basic idea of grey correlation analysis is to judge whether the connection is close according to the similarity degree of geometric shapes of sequence curves. The closer the curve is, the greater the degree of association between the corresponding sequences, and vice versa. The grey relational analysis method is also applicable to the sample size and the law of the sample, and the amount of calculation is small, which is very convenient. The flow chart of the scheme evaluation method based on grey relational analysis is shown in Figure 4.

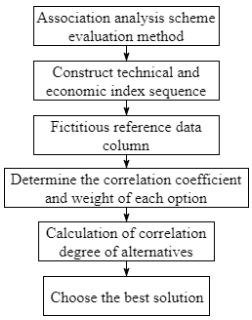

Figure 4: The flow chart of the scheme evaluation method based on grey relational analysis

4. Results analysis

4.1 Determination of evaluation index for site selection of an industrial park

The advantages and disadvantages of industrial park location are related to the main factors, such as construction period, investment cost, economic benefit and social benefit. From the aspects of economic benefit, social benefit, environmental protection and technical evaluation, the evaluation index of industrial park location is taken as the evaluation index. The economic benefit index should be based on the overall interests of the national economy, including the two parts of construction cost and operation cost. Specifically, the total investment, payback period and total construction period are included. The social benefits brought by the industrial park can solve the problem of local employment and promote the progress of education, and it also saves the natural resources because of its unified development. Therefore, the social benefit index includes the employment benefit, the influence on education and the conservation of natural resources. Environmental impact assessment indicators include water environmental impact assessment, atmospheric environmental impact assessment, waste residue pollution assessment and noise environmental impact assessment. According to the general requirements of the construction of the industrial park, the technical evaluation index determines the technical indexes, including the geological and geographical features of the alternative areas, transportation, water supply, power supply conditions and construction conditions. According to the above analysis, the evaluation index system hierarchy diagram of the industrial park site selection can be obtained, as shown in Figure 5.

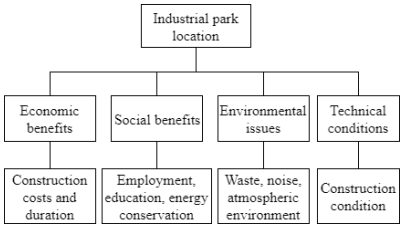

Figure 5: Evaluation index system hierarchy diagram

4.2 Risk assessment of chemical industry

Most of the raw materials and products of petrochemical industry are flammable, explosive and toxic substances, and the production process is mostly under high temperature, high pressure or low temperature, negative pressure and other harsh conditions. The potential risk is great. Chemical leakage accidents can cause explosions and fires. A lot of leakage of toxic chemicals will escape into the atmosphere. The harmfulness of accidents in chemical industry is especially serious. According to the planning project, the functional unit is determined, that is, the storage area of each project is a function unit. The chemical stability of matter is mainly considered in fire and explosion accidents. The risk of installations in chemical projects is far less than the risk of toxic chemicals in the tank area. Therefore, the risk of petroleum tanks and their products and raw material gas tanks should be considered. The main hazardous substances are methanol, carbon monoxide, propylene, ethylene, hydrogen, hydrogen sulfide, diesel, gasoline and liquefied petroleum gas. The leakage concentration distribution of ethylene explosion is shown in Table 1.

Table 1: The leakage concentration distribution of ethylene explosion

Leeward distance	Mass concentration (mg/m^3)		
	20 min	30 min	60 min
5	0.5364	7.1013	26.3546
50	0.5347	7.0897	26.3392
100	0.5290	7.0484	26.2840
200	0.5067	6.8856	26.0646
300	0.4716	6.6235	25.7036
400	0.4267	6.2748	25.2078
500	0.3754	5.8558	24.5865
600	0.3211	5.3850	23.8507
700	0.2672	4.8812	23.0136
800	0.2164	4.3628	22.0894
900	0.1706	3.8466	21.0931
1000	0.1310	3.3466	20.0402

The maximum permissible mass concentration limit for ethylene is 100mg/m3. According to the Table 1, the highest concentration of ethylene is 26.4 mg/m3, which indicates that the risk of ethylene leakage is within acceptable range. Based on the concentration distribution after leakage and material toxicity, it can be seen that the toxic material pollution caused by material leakage has little influence on the surrounding environment, which can be accepted. The risk of ethylene fire explosion is shown in Table 2.

Table 2: The risk of ethylene fire explosion

Types	Frequency
Accident probability	8.7×10^{-5}
Static wind probability	0.25
E-F stability frequency	0.50
The probability of an accident occurring under static wind conditions	1.09×10^{-5}
Death toll	0
Accident risk under different wind directions	0
Maximum accident risk	0
FAFR	6.75×10^{-5}

When the poison enters the atmosphere, the concentration is very small and basically does not cause poisoning. Moreover, the risk of fire and explosion accidents in the chemical area is negligible, and it is acceptable.

4.3 Risk prevention measures

Flammable and explosive containers should be provided with instructions and warning labels, so that employees understand the dangers and correct handling methods. Flammable and explosive containers shall not be made of combustible materials. Glass containers can only be used to store corrosive articles. When flammable liquids are not needed, the containers should be sealed to prevent ignition or to produce toxic and harmful gases and coexist in appropriate cabinets or buildings. All flammable and explosive goods storage

points should be identified and attached to "prohibited pyrotechnics" logo, management should ensure that all staff comply with safety warning regulations. All warehouses that store flammable and combustible liquids should be equipped with natural or mechanical exhaust systems. The number of exhaust air per hour should meet the requirements of the regulations to prevent the formation of explosive space.
All wires shall be properly sized, adequately insulated, properly connected and free from harmful substances. All the wires should be installed correctly and with sufficient support and protection to prevent tripping. All electrical equipment should be grounded or reliable insulation measures. Worn or exposed cords are not to be used. Electrical equipment should be regularly checked and maintained and recorded. A qualified electrician should be used to check and maintain the power system. Grounding and reliable insulation measures can ensure the normal operation of the protective facilities. The electrical facilities, switches and lines in the warehouse of all inflammable and explosive materials shall be suitable for operation in dangerous places.

5. Conclusions

Based on the study of the risk sources in chemical industry area, the risk assessment method and the risk management system of chemical industry zone are established by using the method of risk grading evaluation. The organic combination of environmental risk assessment and risk management in chemical industry area is realized. Starting from material identification, the environmental risk discrimination system including mortality, health damage and health impact was constructed, which expanded the scope of environmental risk assessment. Based on the basic model of poison diffusion and energy transfer, the effect of atmospheric diffusion on atmospheric environmental risk is fully considered in the risk prediction. There are some accident risks in the process of production and operation in chemical industry area, and the risk of this accident will bring serious consequences. The value of environmental risk depends on the surrounding environment of the enterprise. Therefore, in the process of urban planning and chemical enterprise siting, the accident influence factors must be fully considered. Taking the lethal radius as the safety distance, the location and layout planning of the enterprise can be carried out rationally.

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