Research on Landfill Site Evaluation Index Based on Cloud Model

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Abstract. In order to solve the uncertainty, ambiguity and randomness in the closure evaluation of the municipal solid waste landfill in Dagang District of Tianjin, combined with the actual situation of saline-alkali land in the arid area, the cloud model was introduced to evaluate the landfill site closure and determine the filling. The site level of the burial field. The weight of each level of the evaluation index of the landfill and the score of each level of the index are obtained by the reverse cloud generator to obtain the corresponding cloud model, and each level of the index is qualitatively and quantitatively analyzed, and the cloud model is evaluated for the landfill. The evaluation results are presented and an improvement plan is proposed. The cloud model provides a new method for the closure of saline-alkali landfills in arid regions.

Key words: cloud model; qualitative and quantitative analysis; landfill closure evaluation.

1. Introduction
With the development of modern economy and the improvement of people's living standards, more and more domestic garbage is produced. At present, the main ways to solve garbage are incineration, landfill and composting. Although the incineration method is highly efficient, the cost of production is also high. The processing capacity is limited and cannot cope with the increasing speed of garbage production. Therefore, part of the pressure is transferred to the landfill work, but it takes a long time for management and maintenance after the landfill is closed to stabilize the garbage or mine. And safely excavate and recycle[1], in order to make landfills reusable, become bioreactors and transfer stations, rather than final disposal sites, to ensure human health and environmental safety, domestic waste landfills The closure has also received more and more attention. The landfill closure evaluation will enable people to have a clearer understanding of the landfill closure work, thus eliminating concerns about the landfill. Landfill evaluation is usually conducted by professionals to score the indicators of the landfill to determine whether they meet the criteria, but the main examples of the main features of the ”prior art” of the landfill evaluation method that are completely or partially missing It is a statistical description; meaning and uncertainty assessment[2], and the cloud model can solve such problems well[3-7]. The cloud model provides a new method for landfill closure evaluation. The cloud model can realize the uncertainty conversion of qualitative concepts and quantitative values, considering its ambiguity and randomness. Therefore, the cloud model is introduced into the landfill closure evaluation to determine the level of compliance of a landfill.
Dagang District is located in the southeast of Tianjin, bordering on Bohai Bay and Tanggu in the east, Huangqi City in Hebei Province in the south, Jinghai District in the west, and Jinan and Xiqing in the north. The total area is 1113.83 square kilometers. The terrain is flat and average. 3 meters above sea level. It belongs to the northern hemisphere warm temperate semi-humid continental monsoon climate. The soil is more alkaline. Soil fertility is not high, and poor soil conservation is not conducive to the development of the crop industry. The total population is 320,000, of which non-agricultural population is 210,000, accounting for 67% of the total population. There are nearly 20 ethnic minorities including Hui, Manchu, Mongolian and Korean. Due to the impact of heavy industry, the land and air quality pollution in Dagang District is serious. According to the data of the Tianjin Ecological Environment Testing Center, the monitoring data of the Yongming Road National Control Automatic Monitoring Station in Dagang District in December 2018 is 6.06, compared with 2017. The year-on-year decline was -10.1%, pm2.5, pm10, co2, and o3 both declined in 2017, and the data of so2 and no2 increased slightly. According to street interviews, people have many negative emotions about the slow governance of the environment, so we add social factors to the evaluation indicators. In addition, after we thoroughly analyzed the air and geology of Dagang according to local conditions, we redesigned the experts to design weights: (1) Gases such as co2 and ch4 diffused in the sanitary landfill are typical greenhouse gases, and the release will cause serious damage to the atmosphere. Pollution, ch4 is a flammable and explosive gas. When the content in the air exceeds 5%, there is a risk of explosion. H2s, nh3, rsh and other gases will emit malodor and cause odor pollution to the surrounding environment. In 2018, in order to implement the strategic efforts of district committees and district governments to increase environmental air pollution control, accelerate the process of building ecologically-civilized cities, and effectively solve the problem of odor pollution caused by the masses, the District Environmental Bureau insisted on the treatment of odors in Dagang City as a Major tasks are on the agenda, grasping plans, grasping governance, grasping supervision, grasping inspections, grasping propaganda, and grasping the hot and difficult issues of concern to the masses, continuously increasing the efforts of odor management, and striving to reduce the impact of odors on the daily life of the people. Based on this situation, we have increased the weight of public impact and landfill gas collection and treatment. (2) When the landfill anti-seepage engineering measures are taken improperly or without anti-seepage measures, the leachate will penetrate into the soil and destroy the natural dynamic balance of the soil, leading to the imbalance of the normal function of the soil, which will seriously reduce the practical function of the soil. Or lost. A large amount of garbage undergoes corrosion fermentation, which converts a large number of pathogenic microorganisms into acidic and alkaline organic pollutants. In addition, urban domestic garbage is inevitably mixed into waste batteries, waste fluorescent tubes and Green prints when landfilling. The heavy metals contained in them are dissolved in the landfill leachate by chemical reaction with acid-base organic pollutants, so that the domestic waste is filled. The burial field is a comprehensive pollution body in which a variety of pathogenic microorganisms, heavy metals and a large amount of organic matter are mixed together. If it is not treated, leakage will cause serious pollution to the soil and groundwater. In the process of infiltration, the soil leachate containing contaminants will adsorb many heavy metals in the fine particles. As the water deepens, the heavy metals will again Dissolved in groundwater, it will cause more pollution in the long run. The Dagang District itself is a heavy saline-alkali land. In order to cope with the improvement of water conservancy projects and bio-improvement, we have increased the weight of leachate mobile phones and treatment and vegetation coverage.

On the basis of meeting relevant national norms and standards, the following principles must also be observed:

(1) Coordinating and coordinating: Pursuing the principle of “adapting the implementation of the closure project and adapting the target of land reuse after the closure”. Considering the requirements of ecological restoration and green space landscape design, the overall indicator evaluation idea should cover the closure project itself.
(2) Adapt to local conditions: Fully analyze the status quo of landfills, consider the principles conducive to soil and water conservation, formulate feasible engineering programs, and reduce investment capital.

(3) Site safety: Effective construction measures should be taken to ensure the adverse impact on the environment by ensuring the safe and stable behavior of the landfill.

(4) Aesthetic and harmonious: Pursuing the principle of equal emphasis on the design of the closure and landscape planning, the closure work should fully consider the later garden planning. The vegetation landscape should conform to the local natural conditions, and there should be a leisure space for the citizens.

(5) From the actual situation, it meets the requirements and actual requirements of the landfill site and surrounding environment of Dagang District, Tianjin.

2. Research methods and data

2.1 Cloud Model

2.1.1 The concept of the cloud model. The cloud model introduces the three characteristics of expectation Ex, entropy En and super entropy He on the basis of fuzzy mathematics theory and probability theory. Ex can best describe the characteristics of qualitative concept, namely the qualitative concept center value; En can explain the qualitative concept. Uncertainty, that is, the degree of dispersion of data; He can explain the degree of association between randomness and ambiguity, and is the measure of uncertainty of entropy, that is, the entropy of entropy.

Through the specific algorithm, the two-way transformation between qualitative concepts and quantitative data is realized, which reveals the randomness, ambiguity and relevance of objective objects. The figure below shows a schematic diagram of a cloud model with Ex being 0, En being 5, and He being 0.1.

![Figure 1. Schematic diagram of the cloud model](image-url)
2.1.2. Basic algorithm of the cloud. This paper uses the forward cloud generator and the reverse cloud generator of the cloud model. The forward cloud generator is used to obtain the data distribution range and distribution law when Ex, En, He are known, and the reverse cloud generator refers to the digital features obtained from the already implemented cloud drop samples, and then the sample data is characterized. Evaluation.

Algorithm 1: One-dimensional forward cloud generator algorithm

Input: The three digital features Ex, En and He of the qualitative concept, and the number N of cloud drops.

Output: The distribution of n cloud drops in the data space, and the consistency of the qualitative concepts expressed in the cloud map.

(1) generating a normal random number Em and taking Ex as an expectation, and He being a standard deviation;
(2) generating a random number sequence with Ex as the expectation and Em as the standard deviation;
(3) Using x as a quantitative value of the qualitative concept, namely cloud drop;
(4) Calculation \( y = e^{-\frac{(x - Ex)^2}{2He}} \)
(5) Calculate y as the membership of x on the qualitative concept;
(6) Repeat the above steps to obtain n cloud droplets.

Algorithm 2: One-dimensional inverse cloud generator algorithm

Input: n cloud drops \( x_i \) (0 ≤ i ≤ 1);

Output: Cloud’s expected Ex, Entropy En and Super Entropy He.

The calculation process is as follows:

(1) The mean of the sample data is calculated by Xi.

\[ Ex = \bar{X} = \frac{1}{n} \sum_{i=1}^{n} x_i \]

(2) Calculate the variance of the sample data.

\[ S^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{X})^2 \]

(3) Calculate the entropy and super-entropy of cloud droplets.

\[ En = \frac{\pi}{2} \times \frac{1}{n} \sum_{i=1}^{n} |x_i - Ex| \]
\[ He = \sqrt{S^2 - En^2} \]

2.2. Data source

2.2.1. Calculation of weights. A hierarchical structure model [8-10] suitable for landfill closure evaluation is established by using analytic hierarchy process. The b-level criterion layer includes three indicators of maintenance management, engineering construction and ecological construction, and specific evaluation indicators of c-level program layer, including equipment. 12 indicators including maintenance, environmental and safety testing, system establishment and routine inspection.
Figure 2. Evaluation index system for the closure of domestic landfills

According to the above-mentioned indicators of various levels, experts are invited to use the analytic hierarchy process to obtain the weight of each level of indicators in the comprehensive assessment.

Table 1. Weights of the evaluation index of the landfill site

| Dimension          | Index                                      | Total weight | Weights |
|--------------------|--------------------------------------------|--------------|---------|
| Maintenance        | Equipment maintenance                      |              | 0.0671  |
|                    | Environmental and safety monitoring        |              | 0.0798  |
|                    | Establishment and implementation of the system | 0.2684       |         |
|                    | Routine inspection                         | 0.0949       |         |
|                    | Leachate collection and treatment          |              |         |
|                    | Stack shaping                              | 0.0266       |         |
| Construction       | Landfill gas collection and treatment      | 0.1576       |         |
|                    | Final coverage                             | 0.0525       |         |
| OK                 | Landscape coordination                     | 0.1576       |         |
| social factors     | Vegetation coverage                        | 0.0525       |         |
|                    | Public influence                           | 0.0303       |         |
|                    | Urban coordination                         | 0.0949       |         |
2.2.2. Calculating Cloud Parameters of Each Indicator. In the way of questionnaires, experts are required to give a good score of 5 points, preferably 4 points, generally 3 points, a poor score of 2 points, and a poor score of 1 point to give the evaluation value of each indicator and according to the reverse cloud. The generator calculates the characteristic value of the indicator cloud model.

| Dimension index | Expectation (Ex) | Entropy (En) | Super entropy (He) |
|-----------------|------------------|--------------|-------------------|
| Equipment maintenance | 3.63 | 0.81 | 0.17 |
| Environmental and safety testing | 4.12 | 0.93 | 0.03 |
| Establishment and implementation of the system | 4.52 | 0.81 | 0.16 |
| Routine inspection | 3.56 | 1.03 | 0.07 |
| Leachate collection and treatment | 4.13 | 0.81 | 0.09 |
| Stack shaping | 3.61 | 0.73 | 0.12 |
| Leachate gas collection and treatment | 4.16 | 0.86 | 0.12 |
| Final coverage | 3.83 | 0.91 | 0.07 |
| Landscape coordination | 3.84 | 1.13 | 0.32 |
| Vegetation coverage | 3.78 | 1.09 | 0.03 |
| Public influence | 3.31 | 1.21 | 0.07 |
| Urban coordination | 3.76 | 0.76 | 0.32 |

2.2.3. Building an evaluation ruler cloud. According to the results of the comprehensive evaluation of the cloud model, the level of landfill closure is divided into five grades using the Likert scale, which are I (very poor) II (poor) III (general) IV (better) V (very good) corresponds to five evaluation intervals [0, 1], [1, 2], [2, 3], [3, 4], [4, 5].Ex is expected to select the intermediate value of each interval, and calculate the entropy value according to the data obtained by questionnaire and expert scoring. The cloud parameter results are as follows.

| Evaluation level | Expect Ex | Entropy En | Super entropy He |
|------------------|-----------|------------|------------------|
| I                | 0.5       | 0.19       | 0.1              |
| II               | 1.5       | 0.19       | 0.1              |
| III              | 2.5       | 0.19       | 0.1              |
| IV               | 3.5       | 0.19       | 0.1              |
| V                | 4.5       | 0.19       | 0.1              |

According to the forward cloud generator algorithm, matlab is used to generate a standard cloud map of the landfill closure level.
3. Results and analysis

The operation of the integrated cloud is not to add each indicator to the synthesis, but to consider the weighted average of the dishes based on the weight of each indicator. The algorithm is as follows:

\[
Ex = \frac{\sum_{i=0}^{m} \omega_i E_{x_i}}{\sum_{i=0}^{m} \omega_i}
\]

\[
En = \sqrt{\sum_{i=1}^{m} \omega_i E_{n_i}^2}
\]

\[
He = \sum_{i=1}^{m} \omega_i H_e_i
\]

According to the above algorithm, the comprehensive evaluation cloud parameters of the three dimensions of the landfill closure are calculated.

| Dimension             | Ex     | En     | He     |
|-----------------------|--------|--------|--------|
| Maintenance management| 4.0834 | 0.4511 | 0.0308 |
| Construction          | 4.0388 | 0.5360 | 0.0430 |
| OK                    | 3.8100 | 0.4836 | 0.0332 |
| social factors        | 3.6475 | 0.3112 | 0.0312 |
Similarly, the three-dimensional comprehensive evaluation cloud parameters are combined, and the cloud parameters of the total indicators are as follows:

**Table 5. Cloud parameters of the closure of Tianjin Dagang Landfill Site**

| Overall indicator | Ex     | En    | He    |
|-------------------|--------|-------|-------|
| Evaluation of Closing Index of Domestic Waste Landfill Site | 3.9586 | 0.4810 | 0.0364 |

According to the cloud parameters obtained above, the positive cloud generator algorithm is used to obtain the normal cloud of the evaluation result, and then the comparative evaluation ruler cloud is used for comparative observation, and then the evaluation level of the evaluation result can be roughly judged.

![Figure 4. Cloud map of the closure of Tianjin Dagang Landfill Site](image)

On the whole, the results of the landfill evaluation in Dagang District are slightly better than the cloud drops falling in a good interval, so the results are better and better. According to the data obtained from the survey, the establishment and implementation of the Dagang District landfill system, the collection and treatment of leachate and the collection and treatment of landfill gas have obvious advantages, while the weights of the latter two account for there are many, so the investment in these three aspects can effectively improve the evaluation results. The En of the scale cloud is 0.19 and the En of the result cloud is 0.4810. The cloud drops are not concentrated, and some clouds fall in the generally poor position. The results show that the degree of dispersion of the cloud is relatively large, reviewing the weight and scoring, and analyzing the main part of the impact En is public influence, landscape coordination and vegetation coverage. It is recommended to improve in these three aspects, and the result is that the cloud has a small super-entropy, indicating that the overall results are relatively stable, and can provide a feasible solution for further research. Suggestions for improvement are as follows:
1. The public influence is closely related to the people's livelihood reaction. At present, the Internet era is developing rapidly. We should actively and quickly understand the public's demands, and the public can also freely and timely feedback or put forward their wishes through the Internet. We can build a communication platform or communication channel to collect this information, which has great guidance and reference value for the development of landfill closure.

2. In terms of landscape coordination, although the construction cost is high and the operation is difficult, it is necessary to strengthen the investment in this aspect. After the salt is discharged, the salt is washed, the soil salt content is lowered, and some salt-tolerant plants are planted, for example. Ash, Amorpha, etc., with the improvement of saline-alkali land, some plants that are more salt-tolerant or more economical forests are added later to achieve the coordination and aesthetic indicators. To lay a good foundation for the improvement of saline-alkali land in Dagang District in the future, and to make important reference cases for other research on improvement of saline-alkali landfills.

3. Vegetation coverage is based on the improvement of saline-alkali land, and complements the landscape coordination. It is recommended to add organic fertilizer. After decomposition of organic fertilizer, humus will be formed, which not only enhances soil buffer capacity, but also reacts with sodium carbonate. Sodium humate to reduce soil alkalinity. Sodium humate also stimulates crop growth and enhances salt tolerance. Humus can promote the formation of agglomerate structure, which increases the porosity and enhances the water permeability, which is beneficial to salt leaching and inhibits salt return.

4. Discussion

This paper conducts a questionnaire survey on experts, screens the data of the survey, and processes the data according to the relevant theories of the cloud model. It fully considers the true feelings of the experts and the public on the closure of the Dagang District landfill. Scientific and reliable.

Using the cloud model to evaluate the landfill closure, not only can the evaluation cloud of each dimension be obtained, but also the comprehensive evaluation cloud of the landfill closure, so it can meet different analysis needs.

Based on the cloud model, it makes up for the loopholes and gaps in the landfill site closure evaluation, which greatly improves its accuracy and credibility.

Although this paper solves the ambiguity and uncertainty of various factors in the landfill closure, the method is not rigorous, and five evaluation grades are set, so the grade division is too general. Although the questionnaire survey was used, the willingness of the interviewees and the consistency of the filling were also different. Nor did it take into account the difference in the level of people for the understanding of the landfill closure and the judgment of the pros and cons.

This article only makes a corresponding weight analysis on the actual situation of Dagang District, but the actual situation of landfill evaluation in each region is different. In the process of evaluation, it is still necessary to follow the local actual situation, for three The weight of the dimension can be re-allocated when the indicator is evaluated for cloud consolidation.

5. Conclusion

According to the above figure, the evaluation level cloud map of Tianjin Dagang Landfill Site is between good and good, and it is better. The past evaluation method is very subjective and often ignores the evaluation subject. Deterministic, but using the cloud model to quantify the expert's semantic evaluation information, from the evaluation of the language ambiguity and the randomness of the membership degree to better characterize the uncertainty of the evaluation process, so the evaluation results are also objective and accurate. Sex. Moreover, using a small number of samples to test the method can also reasonably evaluate the quality of the landfill wind field. Landfill closure evaluation is affected by many factors, with uncertainty, randomness and ambiguity.

The research proves that the cloud model can be introduced into the landfill closure evaluation and combined with AHP to propose a more scientific landfill closure evaluation method. In addition, the cloud model can combine the qualitative and quantitative analysis of landfill closure evaluation to provide a
new evaluation method for landfill closure. Although further practical tests are needed, the method is landfill closure. Field evaluation studies provide meaningful reference values.

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