Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(5):1469-1472

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Coral Reef Lenticular Freshwater Assessment Based on Fuzzy Mathematical Method

Yuzheng Lv[1], Jiafu Yang[2], Kun Liu [3], Jie Shi[4]

[123]Building Design and Research Academy of Canbao, Beijing, China
[4]Logistical Engineering University of PLA, Chongqing, China

---

ABSTRACT

This thesis analyzes the lenticle quality of fresh water by choosing chroma, turbidity, chloride, COD and calcium ion as assessing indexes and assesses the lenticle quality of fresh water using single factor method and Fuzzy Mathematical Method separately. The result shows that single factor assessing method is not compatible with the situation of the actual fuzzy margins of water resources and that the comprehensive assessing grade of the quality of lenticular freshwater is category V. The compatibility of Fuzzy Mathematical Method with the situation of the actual fuzzy margins of water resources is good with category I lenticular freshwater quality taking up 18.8%, category II 6.2%, category III 32.2%, category IV 2.8% and category V 40%. These data could provide technical reference for the practical utilization of lenticular freshwater.

Key words: Fuzzy Mathematical Method; Lenticular Freshwater; Water Quality

---

INTRODUCTION

Fuzzy Mathematical Method is a fundamental method for the assessment of water environment quality. It is based on the theory of Fuzzy Mathematical Method and draws on the advantages of human brain's identification and judgment of fuzzy phenomena. By using accurate math method to process fuzzy phenomena, it could quantify some water environment factors that concrete point value cannot demonstrate to conduct a comprehensive assessment of water environment [1-3].

Lenticular freshwater is precious underground water resource whose formation is related to the geologic structure of Island. Usually the time when the limestone on the coral reef was formed is late so that the permeability of holes is poor. In this case the sea water cannot infiltrate into the stone and the rain water is apt to be retained, forming the lenticular freshwater. At present, the exploitation of large amounts of lenticular freshwater and the incomplete sewage system on the island cause the quality of a part of freshwater to deteriorate, influencing the normal exploitation and utilization of freshwater resources[4].

SELECTION OF WATER QUALITY INDEX

Factors that influence the freshwater quality are large in number and accordingly the assessing indexes vary. In the Sanitation Standard for Domestic Drinking Water (GB5749-2006) there are as many as 106 water quality assessing indexes. To simplify the process, researchers choose chroma, turbidity, chloride, COD and calcium ion as assessing indexes after taking into account the actual status of lenticular freshwater.

Turbidity, as a comprehensive index, could reflect the content of suspended solids. Viruses, bacteria and other toxical substances are likely to attach themselves to the surface of suspended solids that could generate turbidity [5]. Calcium is a usual index for the Assessment of underground water. Because of the pollution of deadwood and rotte leaves on the ground, lenticular freshwater is rich in such organic matters as humus. Research demonstrates that chroma of freshwater is out of limits. Therefore, chroma and COD are chose as two indexes to assess the content of organic matters. Geometrical boundary of lenticular freshwater is generally marked by the concentration of chloride ion. When the concentration of chloride ion surpasses 600mg/L, water resources in question are turned into salty water whose use value is greatly discounted.

QUALITY ASSESSMENT OF LENTICULAR FRESHWATER

Water of the large open well in Yongxing Island of Xisha Isles is chosen as the water source. The status of water quality is shown in the table below [6-7].

Tab.1: Quality Status of Well Water

Water Quality Index	Turbidity/NTU	Chroma/Grade	Chloride/mg/L	COD/mg/L	Calcium Ion/mg/L
Value	4	40	225	95	159.2

Tab. 2: Assessment Table of Water Environment Quality

Index	Category I	Category II	Category III	Category IV	Category V
Chroma	≤5	≤5	≤15	≤25	＞25
Turbidity	≤3	≤3	≤3	≤10	＞10
Chloride	≤50	≤150	≤250	≤350	＞350
COD	≤15	≤15	≤20	≤30	≤40
Calcium Ion	≤150	≤300	≤450	≤550	＞550

The assessing standard of this water source is chosen from Quality Standards for Underground Water Environment （GB/T14848-93）. In this system of standards, no regulation is established on the COD because the content of COD in the underground water is limited and will normally be up to standards. However, considering the peculiarity of lenticular freshwater, the indirect assessment of the content of COD will be conducted using Standards for Underground Water Environment. Results are displayed in the table below.

Single factor assessment

Single factor assessing method is a commonly-used method for the disposal of water which compares the actual value of the concentration of water quality index with the standard concentration of water quality to estimate the category to which each index belongs. At last, the lowest category is selected as the comprehensive grade of this water resource with which whether the quality of this water resource is up to standard can be determined.

A comparison between actual value of lenticular freshwater index and water environment quality assessment standard reveals that chroma and COD belong to category V and that turbidity, chloride and calcium belongs to respectively category IV, III and II. The analysis above demonstrates that the quality of the lenticular freshwater in question belongs to poor V category. The results are as follows.

Tab. 3: Assessment Table of Single Factor

Index	Actual Measurement	Grade	Comprehensive Grade
Chroma	40	Poor Category V	
Turbidity	4	IV	
Chloride	225	III	Poor Category V
COD	95	Poor Category V	
Calcium Ion	159.2	II	

Assessment of Fuzzy Mathematical Method

The degree of the pollution of water quality is a fuzzy concept. A simple math index is set as the boundary which is flanked by disparate grades. The judgment hereby made of the status of water quality does not conform to the actual status. So the description of the classifying boundary of water quality with subordinate concept is more reasonable. Subordinate concept refers to the degree to which a certain object is subordinate to a certain standard.
Its equation is

$$Y = \frac{X - X_0}{X_1 - X_0} \tag{1}$$

In the equation, Y is the subordination degree of the water category regulated by X1; X is the actual measurement of a certain water quality index; X0 and X1 are the standard measurements of two water quality categories neighboring a certain water quality index.

In accordance with the equation above, the subordination degree of each single index could be calculated. The relationship between a single index and categories is the fuzzy relation. It can be demonstrated by fuzzy matrix:

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{pmatrix} \tag{2}$$

This matrix shows that lenticular freshwater has m controlling indexes and n assessing categories in total. rij refers to the chance that the j-th index of the assessed water quality could be graded as Vi, namely the degree of subordination.

Because the influences of assessment indexes in each grade standard are the same, the weighted value of each assessing index is identical, totaling 1 and demonstrated in the matrix as A= (a,a,···,a). Supposing that the index matrix of the assessed water quality is B, then B=A ·R.

Fuzzy Mathematical Method is utilized to assess the quality of lenticular freshwater. In accordance with the actual measurement of table 1, the fuzzy matrix is established. Fuzzy matrix R of m×n＝5×5 is

$$R = \begin{pmatrix} \mathrm{I} & \mathrm{II} & \mathrm{III} & \mathrm{IV} & \mathrm{V} \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0.86 & 0.14 & 0 \\ 0 & 0.25 & 0.75 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0.94 & 0.06 & 0 & 0 & 0 \end{pmatrix} \tag{3}$$

According to the actual number of water quality controlling indexes and fuzzy matrix, the index matrix of the assessed water quality is B, which is

$$B=(0.2，0.2，0.2，0.2，0.2) \cdot \begin{pmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0.86 & 0.14 & 0 \\ 0 & 0.25 & 0.75 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0.94 & 0.06 & 0 & 0 & 0 \end{pmatrix} \tag{4}$$

=(0.188，0.12，0.222，0.178，0.4)

Matrix B could assess the category of the water quality comprehensively. The assessment made hereby could well reflect the status of the lenticular freshwater quality. It can be known from matrix B that the lenticular freshwater quality belonging to category I takes up 18.8% with category II taking up 6.2%, category III 32.2%, category IV 2.8% and category V 40%. The lenticular freshwater quality does not simply belong to a certain category, which is in conformity to the actual situation.

CONCLUSION

Single factor assessing method assesses the comprehensive grade of the lenticular freshwater quality as poor V category. In reality, only chroma and COD fall within the category of poor V with others belonging to respectively category II, III and IV. Thus it can be seen that single factor assessment method is relatively stricter but its results are to some extent one-sided and don't conform to the situation of the actual fuzzy margin of water resources. Fuzzy Mathematical Method combines the principle of subordination degree and weighted mean method to evade the irrationality of the ambiguity of the comprehensive index method. Its assessing results are more close to actual situation. The calculation shows that the lenticular freshwater quality belonging to category I takes up 18.8% with category II taking up 6.2%, category III 32.2%, category IV 2.8% and category V 40%. Therefore, we can say that in the practical use of lenticular freshwater the emphasis should be put on reducing the content of organic matters reflected by chroma and COD in the freshwater.

REFERENCES

[1] Shi Taotao, Guo Shu, Zhang Xinyu, etc. *West Technology of China*, **2009**, 8(27): 38-39.
[2] Zhang Huaqiao, Dou Ming, Zhao Hui, etc. *Protection of Water Resources*, **2010**,26(6): 42-45.
[3] Sun Xiaomei, Liu Hong, Bao Siqi, etc. *Academic Journal of Changchun University of Technology*(Version of Natural Science), **2012**,35(3): 172-174.
[4] Liang Hengguo, Zhou Conzhi, Fang Zhengdong. *Water Supply and Drainage of Southwest*, **2006**,28(5): 23-24.
[5] Yan Xunshi, Fan Jinchu. *Architecture and Industry Publishing House of China*, **1999**.
[6] Zhang Jingcheng, Fan Qixiong. *Environment Engineering*,**2008**, 26(4):23-24.
[7] Liang Heng-guo, Fang Xiaojun, Fang Zhendong, etc. *Water Supply and Drainage of Southwest*, **2002**,18(1):23-24.