21. THE ARGUMENT STUDY ABOUT THE LOCATION OF A SEWAGE OUTLET ON MIN RIVER

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With Jinhua Town being a planned functional industry area of new materials, it brought corresponding increase in the sewage flow. But nowadays, there are no sewage treatment plants. If the untreated sewage directly discharged into the Min River, it would not only destroy the Min River and the surrounding water environment, but also drop the life quality of residents. After the sewage treatment system and the location of sewage outlet have been decided, this research report have to determine whether the location of sewage outlet, emissions intensity and total amount of pollutant is reasonable or not. Certainly, the result will be stated through the pollutant model simulations, the determination of corresponding parameter, and the analysis of simulation results, etc..

Key Words : *sewage outlet,COD,NH_3-N,two-dimensional steady-state mixed-decay mode,impact analysis of water quality, reasonableness evaluation*

1. INTRODUCE

(1) Background

The researched water function area named Jinhua Town belongs to the drainage of Min River, southwest of the Chengdu Plain. As the **Fig.1**. According to the hydrological observation data statistics for many years, the average annual discharge in the area is 336 m^3 / s, average flow velocity is 0.96 m/s, average gradient is 1.44‰ ; annual ordinary water level（July-Aug.）is 445.89 m, the flood stage once 50 years is 449.91 m, average depth is 1.51 m.

Fig.1 Min River-Jinhua Town Section

(2) The sewage outlet

The designed discharge way of the sewage outlet is open channel and continuous emission. The designed effluent quality of the local sewage treatment plant as the **Table 1.**

Table 1 The outlet water quality of sewage treatment plant

No.	Essential control project	Primary A-level standard
1	chemical oxygen demand (COD)	≤ 50mg/L
2	biochemical oxygen demand (BOD_5)	≤ l0mg/L
3	suspended solids (SS)	≤ l0mg/L
4	plant and animal oils	≤ lmg/L
5	petroleum	≤ lmg/L
6	anionic surfactant	≤ 0.5mg/L
7	TN（count on N）	≤ 15mg/L
8	ammonia（count on N）	≤ 5 (8) mg/L
9	TP（count on P）	≤ 0.5mg/L
10	mmonia nitrogen（dilution ratio）	≤ 30
11	PH	≤ 6～9
12	Fecal Coliform	≤ 103

Table 2 the total main pollution discharges of sewage outlet unit:kg/day

ORT	Year of 2013	Year of 2020
BOD_5	≤100	≤500
CODCr	≤500	≤2500
NH_3-N	≤50（80）	≤250（400）
pH	≤60（90）	≤300（450）
SS	≤100	≤500
anionic surfactant(LAS)	≤5	≤25
TN	≤25	≤75
TP	≤5	≤25
Fecal Coliform（per L）	≤10000	≤50000

Notes: The values of outside the brackets is the index which water temperature> 12 ℃, and the value in brackets is the control index which water temperature≤ 12℃.

(3) Pollution discharges

The total main pollution discharges of sewage outlet as the **Table 2**.

2. CURRENT WATER QUALITY

Using the planned EIA (Environmental Impact Assessment) monitoring data of this project, and taking the data of upper outlet of 1 km range of monitoring area, then, the current water quality can use the single factor index method, according to the 「standard of surface water environment」 (GB3838-2002). The computation formula is as follows:

$$S = C/C_S \qquad (1)$$

S： Standard index;

C： The concentration of evaluation factors, mg/L;

C_S： Evaluation Criteria,mg/L.

The monitoring and evaluation results of the indicators are shown in **Table 3**.

According to the analysis of monitoring data, Seven water quality indexes of project in this river reach can reach the standard of GB3838-2002 「Surface Water Environment Quality Standard」. This phenomenon is accord with the requirement of water function regionalization, so the background concentrations of the indicators do not affect the project emission.

3. WATER QUALITY ANALYSIS

(1) The analysis of assimilative capacity of water bodies

Because the pollutant is mixed evenly at the cross-section dimensional water quality model to calculate of assimilative capacity of water bodies. And the analysis result of assimilative capacity of water bodies is shown in **Table 4**.

Table 3 Current water quality monitoring results unit：mg/L

SORT	I section（upper river apart from 1km）		
	concentration range	Over standard rate(%)	average (S)
pH	7.56～7.63	0	7.60
BOD_5	1.5～1.8	0	1.63
CORCr	9.3～9.5	0	9.4
DO	7.3～7.6	0	7.5
ammonia	0.352~0.416	0	0.39
sulfide	non-detectabl	0	/
Petroleum	non-detectabl	0	/
SORT	IIsection (down river apart from 1km)		
	Concentration range	Over standard rate(%)	average(S)
pH	7.43—7.57	0	7.49
BOD_5	1.3～1.7	0	1.53
CORCr	9.3～9.8	0	9.52
DO	7.1～7.4	0	7.23
ammonia	0.0480~0.480	0	0.334
sulfide	non-detectabl	0	/
Petroleum	non-detectabl	0	/

Table 4 The analysis result of assimilative capacity of water bodies unit: ton/annually

SORT	Assimilative capacity of water bodies	Actual emissions
COD	372.12	182.5
NH_3-N	37.27	29.18

$$W = 86.4 \times 0.365 \times \left[C_S - C_o \times \exp\left(-K_1 \times \frac{L}{u}\right)\right] \times \exp\left(-K_1 \times \frac{L}{2u}\right) \times Q_r \qquad (2)$$

W: maximum waste load allocation, t/a;

C_s: The water quality goals, mg/L;

C_0: The background density, mg/L;

K_1: Pollutant degradation coefficient, 1/s;

L: Length of the function area, m;

Q_r: The cross-section design discharge, m^3/s;

u: Average flow velocity at a cross-section, m/s.

(2) Diffusion analysis

In order to build the model visually, based on the fact, the deviation between the concentration of any point at cross-sections and average concentration is less than 5% of average concentration, then it can be regarded as evenly distributed. After that, it can be make the following assumptions simulated conditions.

a) Continuous point pollution, side discharge

b) In normal circumstances, processed sewage

concentration is regular, constant.

c) Basically, the river flow is stable, and the sewage concentration and flow is also stable.

d) In the water function area, the average concentrations of pollutants do not change with time in anywhere.

So, there can choose Two-Dimensional Steady-State Mixed-Decay Model.

$$C(x,y) = exp(-K_1 \frac{x}{86400\ u}) \times \left\{ C_h + \frac{C_p Q_P}{H(\pi(\ _y xu)^{1/2}} \left[exp(-\frac{uy^2}{4M_y x}) + exp(-\frac{u(2B-y)^2}{4M_y x}) \right] \right\} \quad (3)$$

$C(x,y)$: The average pollutants concentrations of point (x,y), mg/L;

x,y : Coordinate, m;

u : The average flow velocity of a river cross-section, m/s;

C_h : The pollutants concentrations of upstream, mg/L;

C_p : The emission concentration of pollutants, mg/L;

Q_p : Effluent volume, m^3/s;

K : Synthetic attenuation coefficient, l/d;

H : Mean depth, m;

M_y : Transverse mixing coefficient, m^3/s;

B : The width of the river, m.

By the analysis of actuality, and match the coefficient, the pollutant diffusion can be visualized as following 3-D distribution **Fig.2-5**.

4. DISCUSSION AND CONCLUSION

As listed above **Fig.2-5**, the horizontal diffusion of sewage discharge, both COD and NH_3-N, is very tiny. Besides, the outleted sewage extend linearly to the downstream closed to left bank, and the concentrations fall sharply.

In addition, based on the analyzed data and the **Fig.2-5**, there is a scale chart can show the contrast between assimilative capacity of Min River and quality of sewage as **Fig.6**.

In conclusion, the location of sewage outlet is reasonable, and benefits to improve the assimilative capacity of water bodies.

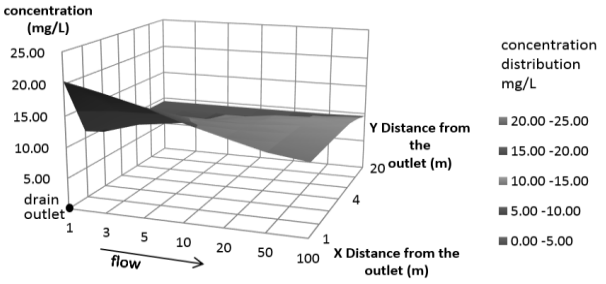

Fig.2 the COD concentration in normal discharge

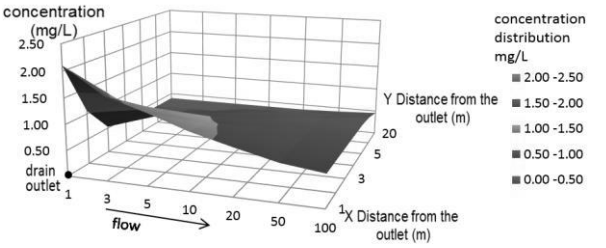

Fig.3 the NH_3-N concentration in normal discharge

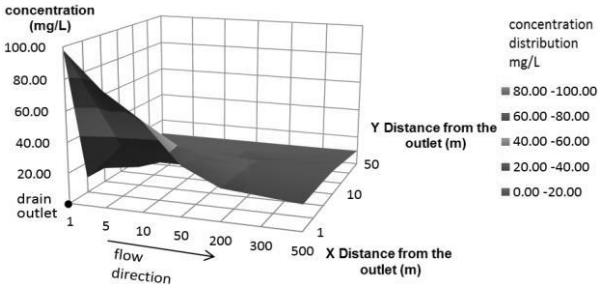

Fig.4 the COD concentration in accident discharge

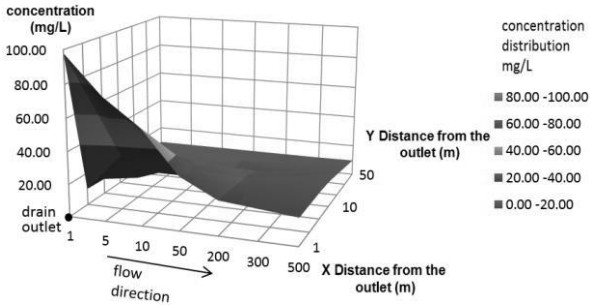

Fig.5 the NH_3-N concentration in accident discharge

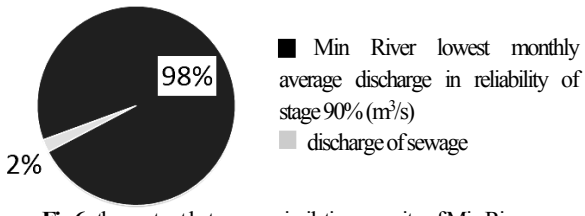

Fig.6 the contrast between assimilative capacity of Min River and quality of sewage

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