

## Prediction and Assessment on the Environmental Impact

### 5.1 Prediction and Assessment on the Environmental Impact

#### 5.1.1 Analysis on the Pollution Metrological Characteristics of the Project Site

##### (1) Analysis on the Characteristics of the Ground Wind

The frequency of the wind direction in the whole year and four seasons of the area is calculated according to the references provided by Xinjian metrological station in recent 5 years and was drawn into the picture of rose of wind (picture 5-1) and the picture of average monthly speed of wind. (Figure 5-2)

##### 1. Wind Direction

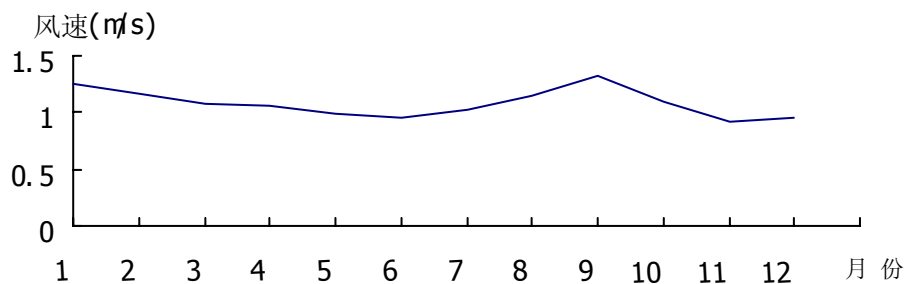
We can see from the picture of rose of wind, the dominant annual wind of the project site is NNE, the frequency of which is 12.3%, followed by NE with the frequency of 11.4%. The wind direction of minimum frequency appears in WNW and NW with the frequency of 0.6%, the frequency of the quiet wind of the whole year is 42.9%.

The dominant wind of the four seasons, spring, summer, autumn and winter, is NE, NE, NNE and NW respectively with the value of 12.0%, 9.7%, 15.2% and 17.2% respectively. In spring, summer, autumn and winter, the wind direction of minimum frequency appears in WNW, NW, NW and WNW respectively, the frequency is 0.6%, 0.5%, 0.4%, 0.3% respectively. The frequency of quite wind appearing in spring, summer, autumn and winter is 46.5%, 41.7%, 40.4% and 42.9% respectively.

##### 2. Wind Speed

The average annual wind speed of the project site is 1.1m/s. The value of the wind speed in the four seasons, spring, summer, autumn and winter is 1.0m/s, 1.0m/s, 1.1m/s and 1.1m/s respectively. Judge from the curve of average monthly wind speed in the whole year which shows in picture 5-2, the average monthly wind speed is between 0.9-1.3m/s, the greatest average wind speed is in September, which is 1.3m/s, and the smallest average wind speed is in November, which is 0.9m/s. The details is shown in the following graph. 5.1-1

Picture 5-2 Average monthly wind speed in the whole year



Picture 5-1 Wind rose in the whole year and in the four seasons at the meteorological station in Xinjian County

**Table 5.1-1 Average wind speed under each wind direction in each season and in the whole year (unit: m/s)**

Direction Season	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Spring	2.3	2.3	1.9	1.8	1.4	1.3	1.7	1.9	2.0	2.0	1.9	1.7	1.3	1.4	1.2	1.9
Summer	2.0	1.7	1.6	1.6	1.5	1.5	1.9	1.8	1.7	2.1	1.8	2.0	1.8	1.5	1.1	1.9
Autumn	2.0	2.0	1.9	1.8	1.5	1.6	1.2	1.5	1.7	1.5	1.4	1.7	1.3	1.0	1.8	2.0
Winter	2.0	2.3	1.8	1.9	1.5	1.2	1.3	1.7	1.5	1.2	1.4	1.5	1.0	1.3	1.6	2.1
The whole year	2.1	2.1	1.8	1.8	1.5	1.4	1.6	1.8	1.8	1.9	1.7	1.9	1.6	1.3	1.4	2.0

(2) Yearly and Seasonal Characteristics of the Stability of Atmosphere

Table 5.1-2 shows the compound frequency of each wind direction, wind speed and stability in the whole year. It indicates that the normal wind speed of the area is smaller or equal to 5.0m/s, the frequency appears as high as 98.4%, in which, the frequency of gentle wind ( $0.5 \leq u < 1.5\text{m/s}$ ) is 25.5%. The frequency of the wind is 19.0% when the wind speed is between  $1.5 \leq v \leq 3.0\text{m/s}$ , the frequency of the wind is 11.0% when the wind speed is between  $3.0 \leq v \leq 5.0\text{m/s}$ . The wind frequency is smaller, that is 1.4% when wind speed is greater than 5.0m/s, while the wind frequency is only 0.2% when wind speed is greater than 7.0m/s.

**Table 5.1-2**

**Compound frequency of each wind direction, wind speed and stability in the whole year**

Wind speed	S	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
v < 1.5	A	0.1	0.1	0.4	0.6	0.6	0.4	0.1	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.0	
	B	0.6	0.8	1.1	0.5	0.5	0.3	0.2	0.1	0.1	0.1	0.2	0.3	0.4	0.0	0.1	0.1	
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	D	2.2	2.6	3.0	0.8	0.3	0.2	0.1	0.1	0.2	0.3	0.3	0.7	0.6	0.2	0.2	0.5	
	E	0.7	0.4	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.0
	F	0.5	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.2
1.5 ≤ v ≤ 3.0	A	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	
	B	0.2	0.4	0.5	0.5	0.5	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	
	C	0.3	0.8	1.0	0.6	0.3	0.1	0.0	0.1	0.2	0.1	0.1	0.3	0.1	0.0	0.0	0.1	
	D	2.0	2.4	1.8	0.7	0.1	0.0	0.1	0.1	0.2	0.2	0.2	0.5	0.4	0.1	0.1	0.4	
	E	0.4	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1
	F	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
3.0 < v ≤ 5.0	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	B	0.2	0.4	0.4	0.4	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.1	
	C	0.3	0.6	0.5	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.3	0.1	0.0	0.0	0.1	
	D	1.8	2.0	1.0	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.3	0.1	0.0	0.0	0.3	
	E	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5.0 < v ≤ 7.0	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	D	0.4	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	
	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
v > 7.0	A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	D	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5.1-3 shows the frequency of the stability at different levels by means of Pasguill, a way of classification of stability, according to the meteorological material obtained by regular observe and survey of cloud, wind and sunshine around where the factory locates in recent years.

**Table 5.1-3 Yearly and Seasonal Frequency of Stability (Unit: % )**

Stability Season	Unstable				Neutral	Stable		
	A	B	C	Σ	D	E	F	Σ
Spring	3.6	16.2	6.2	26.0	56.2	9.8	8.0	17.8
Summer	4.5	14.4	8.5	27.4	53.0	12.5	7.1	19.6
Autumn	6.8	22.3	6.7	35.8	37.8	10.4	15.8	26.2
Winter	5.0	12.2	4.4	21.6	53.3	15.3	9.7	25.0
wholeyear	5.0	16.3	6.5	27.8	50.1	12.0	10.2	22.2

The table indicates the neutral kind (D) of yearly frequency is 50.1% , which is the highest, kind E and F take the second place, and frequency of kind A,B,C is 22.2%, which is the lowest.

The frequency of instability in autumn and summer is higher, the value is 35.8% and 27.4% respectively. The frequency of instability in winter is the lowest, the value is 21.6%. The frequency of neutral stability in spring and winter is higher, the value is 56.2% and 53.3% respectively, the value in autumn is 37.8%, which is the lowest, the value of which in summer is 53.0%, The frequency of stability in autumn is higher, the value is 26.2%, the value in spring is lower, which is 17.8%, the value in summer and winter is 19.65 and 25.0% respectively.

The table also indicates that the law among the four seasons and the year is in common, which is neutral towards steady, that is, the frequency of neutral stability is the highest, the frequency of stability takes the second place and the frequency of instability is the lowest.

(3 ) The height of the mixed layer of the atmosphere

The height of the mixed layer of the atmosphere is one of the important parameters which influence the diffusion of the air contaminant. The height in each season and in the whole year is analyzed and calculated under the condition of different stability with the material obtained by the atmosphere observation from the meteorological station which is close to the factory. The result is shown by table 5.1-4. Kind A shows that the height of the mixed layer in the construction project area under the condition of instability is higher, which normally can arrive at 1000 meter and above, the highest is in summer, which is higher than 1600 meter, the height of kind F under the condition of stability is the lower, normally around 110 meter.

**5.1-4 The height of the mixed layer in the season and in the whole year under different stability around the factory site area ( unit: meter)**

Stability Season	A	B	C	D	E	F

Spring	1315	801	801	431	270	113
Summer	1625	801	857	381	262	107
Autumn	1160	921	829	414	283	110
Winter	1160	962	857	431	276	110
Whole year	1315	881	829	414	276	110

5.1.2 The emission quantity and density allowed for the contaminant to discharge in environmental air

The assessment on the atmosphere environmental impact this time mainly refers to the assessment on the two boilers with 240t/h (one for use and one for substitution). According to the document issued by the State “ Emission standard on air contaminant in thermal power station” (GB13223-1996), emission quantity of air contaminant (SO<sub>2</sub>) allowed and the emission density of air contaminant (SO<sub>2</sub> and smoke and dust) allowed should be calculated first.

(1) Calculation of the emission quantity of SO<sub>2</sub> allowed

The emission quantity of SO<sub>2</sub> allowed is calculated according to the following formula

$$Q_{so_2} = P \bar{U} H_g^m \times 10^{-6}$$

$$\bar{U} = \frac{1}{N} \sum_{i=1}^N U_i$$

$$U_i = \bar{U}_{10} \left( \frac{Hs_i}{10} \right)^{0.15}$$

$$H_g = \sqrt{\frac{1}{N} \sum_{i=1}^N He_i^2}$$

in the formula,

Q<sub>so<sub>2</sub></sub>: the emission quantity of sulfur dioxide allowed in the whole factory, t/h;

N: number of chimney in the whole factory

I: serial number of the chimney ( I=1,2,.....N)

$\bar{U}$ : the average value of the exit for each chimney, m/s;

U<sub>i</sub>: environmental wind speed of the chimney No.i at the exit, m/s;

$\bar{U}_{10}$ : average wind speed at the height of 10m above the ground, m/s;

H<sub>g</sub>: equivalent unit height of the chimney in the whole factory, m;

H<sub>s<sub>i</sub></sub>: geometry height of the chimney No.i, m;

H<sub>e<sub>i</sub></sub>: effective height of the chimney No.i, m

$\Delta H_i$ : smoke uprising height of the chimney No.i, m, calculated by the rule mentioned in

Appendix A attached to the document GB13223-1996;

P: coefficient of emission controlling, which is 5.802, according to the specific form;

m: diffusion condition index in the area, which is 1.893, according to the specific form;

(2) Calculation on the emission density allowed for SO<sub>2</sub> and the smoke dust

The emission density allowed for SO<sub>2</sub> and the smoke dust is calculated according to the following formula:

$$C_i = C_i' \frac{\alpha'}{\alpha}$$

In the formula:

C<sub>i</sub>: the emission density of the contaminant No.i under the excessive standard of air coefficient, mg/m<sup>3</sup>

a: Excessive air coefficient corresponding to the standard value, this is a newly-built project in the third period when a=1.4;

a' real excessive air coefficient;

i=1,2 representing SO<sub>2</sub> and smoke dust;

(3) The selection of the parameter

Table 5.1-5 shows the parameter for the calculation on the emission quantity allowed for SO<sub>2</sub> and the emission density allowed for SO<sub>2</sub> and smoke dust

**Table 5.1-5 Table for parameter selection**

		Symbol	Unit	Actual parameter for boiler
Parameter for chimney	Number of the chimney	N	ge	1
	Geometrical height	Hs	m	120
	Internal diameter	D	m	3.2
Parameter of smoke emission	Quantity of smoke	V <sub>0</sub>	Nm <sup>3</sup> /h	275771
			Nm <sup>3</sup> /s	76.6
	Coefficient of air surplus	α		1.39
	Smoke temperature	Ts	°C	132
	Annual working hour 工	T		8160
Parameter of coal-burning	salpher amount	Sy	%	1.6
	Lime powder	Aar	%	36
Parameter of environment	Environment temperature	Ta	°C	17.5
	Wind speed of 10m	U <sub>10</sub>	m/s	1.1
	Index for area diffusion condition	m		1.893
Other parameters	Coefficient of emission-control	P		5.802
	Heat releasing rate	Qh	KJ/s	11470
	Height of efficient source	Hg	m	306.2

### 5.1.3 Prediction Model and Parameter for the Impact of the Environment on Atmosphere

#### (1) Introduction to the model on diffusion prediction

The assessment on atmosphere environmental impact this time would adopt the model (ISCST3) on atmosphere diffusion for compound industrial source. The model is developed by environment protection bureau in America for the purpose of providing support to environment management. The model includes overall model parameter, there is much room for the selection as to the impact of simulated contaminant source on environment quality. The function of the model is as follows:

To deal with the process for the uprising and diffusion of different kinds of smoke, e.g. Quiet wind condition, index for the wide line of wind, urban / rural diffusion, the transformation deposit and subsidence of contaminant etc.;

To deal with the flow from the top end of the chimney, the flow function of the architecture in urban area on the discharge point with consideration of the initial diffusion dimension of Area, and Line in the city;

To conduct simulation to many kinds of contaminant sources, including Point, Area, Line, Volume and Open pit;

To choose and calculate many sets of regular and/or irregular net square of accepting or dispersion points, distance of net square and simulation ranges are variable;

To print out the density of many kinds of contaminant, the deposition of small particles and the result of calculations for dry and wet subsiding amount;

The contaminant, such as SO<sub>2</sub>, TSP, PM<sub>10</sub>, NO<sub>x</sub>, CO and the kinds, can be chosen;

It is possible to choose many kinds of average period e.g. by hour, by hours, by day, by month and by year;

To Deal with the complicated topographical condition;

To calculate with the routine meteorological observation data obtained by hour;

To analyze the contribution of individual or group of pollution source to the density or subsiding amounts of the accepting point;

#### (2) The main equation and parameter of the model

The model ISCST3 is based on statistical theory of positive smoke flow pattern, namely the formula used in Gauss equation is Gauss diffusion formula in the state of sealing-up with flat straight, stable state which is used extensively at present. In the model, the corresponding diffusion equation which is used in urban dimension has undergone necessary revision based on the result from experience. The model defines influence of meteorological condition on the uprising,

transportation, diffusion and subsidence based on meteorological data and averages the time period according to the requirement.

### 1. Gauss equation on Point

Point model includes the basic Gauss equation, smoke feather uprising formula and formula of calculating diffusions parameter.

$$C_{(x,y,0)} = \frac{QKVD}{2\pi U_s \sigma_y \sigma_z} \exp \left[ -0.5 \left( \frac{Y}{\sigma_y} \right)^2 \right]$$

$C_{(x,y,0)}$  = density of the contaminant when the distance of wind direction (downwards) from the pollution sources is x, the distance of wind direction (side) is y

Q= the emission intensity of the contaminant (g/s)

K = the coefficient for dimension transfer when Q is g/s and density is  $\mu\text{g}/\text{m}^3$ ,  $K = 10^6$

V = perpendicular items

D = attenuation items

$\sigma_y, \sigma_z$  = the coefficient of level and perpendicular diffusion

$U_s$  = the average wind speed in the high place for emission (m/s)

Perpendicular items include the topographical height, source accept topographical height for the accepting point, smoke feather uprising, the limit of mix layers in perpendicular direction and the gravity subsidence and dry subsidence of small particles etc.

### 2. The distance of downward wind direction and side wind direction

If the coordinate of pollution sources is X (S) and Y (S) respectively, the coordinate of accepting point is X (R) and Y (R) respectively, then the distance of the accepting point along the smoke feathers for downward wind (WD) x and the distance for side wind y is respectively

$$X = -(X(R) - X(S)) \sin(WD) - (Y(R) - Y(S)) \cos(WD)$$

$$Y = (X(R) - X(S)) \cos(WD) - (Y(R) - Y(S)) \sin(WD)$$

### 3. The wide line of wind speed

The formula of index law of wide line of wind speed is as follows. Table 5.1-7 shows the indexes in different steady degree of wind wide line.

$$u_s = u_{\text{ref}} \left( \frac{h_s}{z_{\text{ref}}} \right)^p$$

$U_s$  = the wind speed of the mouth of chimney for emission (m/s)

$U_{\text{ref}}$  = The wind speed of the observes height at the meteorological station (m/s)

$h_s$  = The height of the mouth of chimney for emission (m)

$z_{\text{ref}}$  = The height for the observation of wind speed at meteorological station, it is generally 10 m

$P_s$  = The index of wide line of wind (the defaulting value of the model can be seen in the following form, reality can be adjusted)

**Table 5.1-6 The Indexes in Different Steady Degree of Wind Wide Line**

Level of steady degree	Index in rural area	Index in urban area
A	0.07	0.10
B	0.07	0.15
C	0.10	0.20
D	0.15	0.25
E	0.25	0.30
F	0.25	0.30

#### 4. The smoke feather uprising

Have revised on the basis of Briggs uprising formula, adopting a set of uprising formula that correlated with steady degrees. Among them:  $H_s$  is the geometrical height for the chimney;  $V_s$  is the speed for smoke emission (m/s);  $d_s$  is the diameter of the mouth of the chimney;  $h_s'$  is the height of smoke feathers after revising, when the tail flow is not considered,  $h_s' = h$

A) Buoyancy and motive force flux parameter

Flux of buoyancy parameter  $F_b$  ( $m^4/s^3$ ):

$$F_b = g v_s d_s^2 \left( \frac{\Delta T}{4 T_s} \right)$$

Flux of motive force parameter  $F_m$  ( $m^4/s^2$ ):

$$F_m = v_s^2 d_s^2 \frac{T_a}{4 T_s}$$

B) Unstable or neutral condition

The dominant function whether with motive force or buoyancy is judged by  $\Delta T$

When  $F_b < 55$

$$(\Delta T)_c = 0.0297 T_s \frac{v_s^{1/3}}{d_s^{2/3}}$$

when  $F_b \geq 55$ ,

$$(\Delta T)_c = 0.00575 T_s \frac{v_s^{2/3}}{d_s^{1/3}}$$

when  $\Delta T \geq (\Delta T)_c$ , buoyancy dominants, otherwise, motive force dominants

Buoyancy uprising dominants

When  $F_b < 55$ ,

$$h_e = h_s' + 21.425 \frac{F_b^{3/4}}{u_s}$$

When  $F_b \geq 55$ ,

$$h_e = h_s' + 38.71 \frac{F_b^{3/5}}{u_s}$$

Motive force uprising dominants

$$h_e = h_s' + 3 d_s \frac{V_s}{u_s}$$

when  $V_s/U_s$  is greater than 4, the formula is suitable.

c) The condition for stability

The parameter for steady degree

Under the condition for stability, the parameter for steady degree can be calculated by the following formula

$$s = g \frac{\partial \theta / \partial z}{T_a}$$

the steady degree of kind E,  $\partial \theta / \partial z$  is 0.02 K/m, the steady degree of kind F  $\partial \theta / \partial z$  is 0.035k/m

### The judgment of motive force and buoyancy

$$(\Delta T)_c = 0.019582 T_s V_s \sqrt{s}$$

when  $\Delta T$  is greater or equal to  $(\Delta T)_c$ , buoyancy dominants, otherwise motive force dominants.

#### Buoyancy uprising dominants

when  $\Delta T$  is greater or equal to  $(\Delta T)_c$ , buoyancy uprising dominants. The final distance of downward wind being upraised is:

$$x_f = 2.0715 \frac{u_s}{\sqrt{s}}$$

The height of the smoke feather being raised is:

$$h_e = h_s' + 2.6 \left( \frac{F_b}{u_s s} \right)^{1/3}$$

#### Motive force uprising dominants.

When the temperature of smoke is lower or equal to the temperature of the environment, or when  $\Delta T$  is lower than  $(\Delta T)_c$ , suppose motive force uprising dominants, the height of smoke uprising is:

$$h_e = h_s' + 1.5 \left( \frac{F_m}{u_s \sqrt{s}} \right)^{1/3}$$

D) The uprising before the distance of final uprising

#### Buoyancy uprising dominants

$$h_e = h_s' + 1.60 \left( \frac{F_b^{1/3} x^{2/3}}{u_s} \right)$$

The formula is suitable only for the condition that buoyancy uprising dominants, when it exceeds the final uprising, it should be substituted by final uprising.

#### Motive uprising dominants

a) Unstable condition

$$h_e = h_s' + \left( \frac{3F_m x}{\beta_j^2 u_s^2} \right)^{1/3}$$

$$x_{\max} = \frac{4d_s(v_s + 3u_s)^2}{v_s u_s} \quad \text{for } F_b = 0$$

$$= 49F_b^{5/8} \quad \text{for } 0 < F_b \leq 55m^4/s^3$$

$$= 119F_b^{2/5} \quad \text{for } F_b > 55m^4/s^3$$

b) Stable condition

$$h_e = h_s' + \left[ 3F_m \frac{\sin(x\sqrt{s}/u_s)}{\beta_j^2 u_s \sqrt{s}} \right]^{1/3}$$

$$x_{\max} = 0.5 \frac{\pi u_s}{\sqrt{s}}$$

$$\beta_j = \frac{1}{3} + \frac{u_s}{v_s}$$

With graduate uprising caused by buoyancy, when the motive uprising which changes in accordance with the distance exceeds final uprising, It should be substituted by the height of the final uprising.

#### 5. Diffusion Parameter

Table 5.1-7 shows the formula for the calculation of the diffusion parameter  $\sigma_y$  and  $\sigma_z$  for the Point in urban area, the unit for +and + is m, the unit for x is m.

**Table 5.1-7 Briggs' Diffusion Parameter Formula**

Rank of steady degree	$\sigma_y$ (m)	$\sigma_z$ (m)
A	$0.32 \times (1.0 + 0.0004 x)^{-1/2}$	$0.24 \times (1.0 + 0.001 x)^{1/2}$
B	$0.32 \times (1.0 + 0.0004 x)^{-1/2}$	$0.24 \times (1.0 + 0.001 x)^{1/2}$
C	$0.22 \times (1.0 + 0.0004 x)^{-1/2}$	$0.20 \times x$
D	$0.16 \times (1.0 + 0.0004 x)^{-1/2}$	$0.14 \times (1.0 + 0.0003 x)^{-1/2}$
E	$0.11 \times (1.0 + 0.0004 x)^{-1/2}$	$0.08 \times (1.0 + 0.0015 x)^{-1/2}$
F	$0.11 \times (1.0 + 0.0004 x)^{-1/2}$	$0.08 \times (1.0 + 0.0015 x)^{-1/2}$

#### 6. Vertical item

The vertical item (V) in the equations indicates the distribution of Gauss smoke feather in the perpendicular direction. Gravity subsidence and dry subsidence can be neglected to gas contaminant and small particles. The perpendicular item without the function of subsidence is as follows:

$$V = \exp \left[ -0.5 \left( \frac{z_r - h_e}{\sigma_z} \right)^2 \right] + \exp \left[ -0.5 \left( \frac{z_r + h_e}{\sigma_z} \right)^2 \right]$$

$$+ \sum_{i=1}^{\infty} \left\{ \exp \left[ -0.5 \left( \frac{H_1}{\sigma_z} \right)^2 \right] + \exp \left[ -0.5 \left( \frac{H_2}{\sigma_z} \right)^2 \right] \right.$$

$$\left. + \exp \left[ -0.5 \left( \frac{H_3}{\sigma_z} \right)^2 \right] + \exp \left[ -0.5 \left( \frac{H_4}{\sigma_z} \right)^2 \right] \right\}$$

$$h_e = h_s + \Delta h$$

$$H_1 = z_r - (2iz_i - h_e)$$

$$H_2 = z_r + (2iz_i - h_e)$$

$$H_3 = z_r - (2iz_i + h_e)$$

$$H_4 = z_r + (2iz_i + h_e)$$

$z_r$  = the height of the accepting point to the ground (m)

$z_i$  = the height of mixed layer (m)

When the height of effective uprising is greater than the height of mixed layers, it is considered

that the smoke feather pierces through the inversion layer completely. Density is set as 0 on the ground at this moment.

When the distance of the downward wind direction reaches relatively far, the density distribution of perpendicular item is change from Gauss distribution to rectangle distribution.( if density distribution is in the mixed layer on the earth's surface). So in order to save the time of calculating, and keep the precision, when  $\sigma_z/z_i$  is greater than or equals to 1. 6, table (5. 1 - 22) changes to

$$V = \frac{\sqrt{2\pi} \sigma_z}{z_i}$$

$$h_{ed} = h_e - h_v = h_e - \frac{x}{u_s} v_g$$

Considering the impact of dry subsidence

$$V_d (x, z, h_{ed}) = V (x, z, h_{ed}) F_Q(x) P(x, z)$$

$V(x, z, h_{ed})$  is the perpendicular item with no consideration of subsiding ,  $F_Q(x)$  is the contaminant which is kept in smoke feather at point X along downward wind direction,  $P(x, z)$  is the adjust factor of the perpendicular wide line.

## 7. Decay item ( D )

Decay item indicates physical or chemical removal process to the contaminant.

$$D = \exp\left(-\psi \frac{x}{u_s}\right) \quad \text{当 } \psi > 0$$

或

$$D = 1 \quad \text{当 } \psi = 0$$

Among them:

$\psi$  = decay coefficient( $s^{-1}$ )( equal to 0 means without consideration of decay)

$x$  = distance of downward wind direction

However, if the half-life decay period of the contaminant is  $T_{1/2}$ , then  $\psi$  can be obtained by the following equation:

$$\psi = \frac{0.693}{T_{1/2}}$$

To  $SO_2$ , half-life decay period is 4 hours, then  $\psi=0.0000481 s^{-1}$

#### 4. The input-control file of the model and the set-up of meteorological file

SCST3 model offered a set of standard form of the inventories for data-input. Set up model input and control file with the form, it can not only input the acquiescence parameter of the emission source of the contaminant, but also can revise the acquiescence parameter of the model according to the reality

The input-control file of the model includes the following 5 kinds of information:

Operation-control parameter: Define types of simulated contaminant, average time periods, type-selection for diffusion parameter etc;

Source-input parameter: Including source type, coordinate, height, discharge intensity, discharge uneven coefficients, etc.

Accepting point parameter: accepting point can be defined as the accepting point in rectangle coordinate (equal distance net square, unequal net square and dispersed a bit) and accepting point in pole coordinates( regular or irregular net square, dispersed point);

Meteorological parameter: Including the route of the file name for meteorological data, height of the wind-observing point etc. Give out the data of wind direction by hour, wind speed, temperature, stability degree, height of mixed layer in the meteorological data file;

Output control: Define the form for date out-put, after-treatment file name and its route, etc.

This assessment adopts rectangle coordinate, distance of the net square is 500 m X 500 m, predict range is 13 km X 15 km. Set up meteorology input file by the data obtained by the three-times-a-day daily observation in 2000 from meteorological station in Xinjian county. Calculate the density of the contaminant by hour and get the daily average density and yearly average density with the result of the calculation.

#### 5.1.4 Analyze and Appraisalment on the Predict Result of Environmental Impact of Air

##### (1) Prediction and appraisalment on the average annual density

Using ISCST3 model, carry out simulation prediction on SO<sub>2</sub>, contribution value of average annual density of PM<sub>10</sub>, the density distribution is shown in picture 5-3 and 5-4

Picture 5-3 shows maximum value of the average annual density is 4.02  $\mu\text{g}/\text{m}^3$  with the calculate range SO<sub>2</sub> which is far lower than mentioned in second standard of air quality, accounting for only 6.7%. of the second standard and lies in about 2.6 meter from the boiler chimney southwest of heat and power station. The areas being mainly influenced are located in 1.3 kms to the west of Ganjiang River and within 6 km to the south of the site of a factory being built. The density contribution value of SO<sub>2</sub> in this region reached more than 2  $\mu\text{g}/\text{m}^3$ . The density contribution value of SO<sub>2</sub> in some area of Xihe factory of brick and tile which is located in the east of the factory site is 1.5-2  $\mu\text{g}/\text{m}^3$ . The density contribution value of SO<sub>2</sub> in Nanchang City which is located in the east of Gan River and south of the factory site is less than 1  $\mu\text{g}/\text{m}^3$ , The density contribution value of SO<sub>2</sub> in Fenghuang Zhou which is located in the west of Gan River and south of the factory site is 2-3  $\mu\text{g}/\text{m}^3$ , the density contribution value of SO<sub>2</sub> in East China University of Transportation and Jiangxi University of Finance and Economics is less than 1. 5-2  $\mu\text{g}/\text{m}^3$

Picture 5-4 shows the maximum value of the average annual density is 0.76  $\mu\text{g}/\text{m}^3$ , with the calculation range PM<sub>10</sub>, which is far lower than mentioned in second standard of air quality,

accounting for only 0.76% of the second standard and lies in about 2.6 meter from the boiler chimney south to southwest of heat and power station. It can be seen that the emission of smoke from boiler of this project being built has little impact on the environment and air quality in Nanchang City because the dust removal device of sack has been set up. The area in which the density contribution value exceeds  $0.5 \mu\text{g}/\text{m}^3$  is mainly located 1-2km to the west of Gan River and within 5km south of the factory site being built. The density contribution value of  $\text{PM}_{10}$  is below  $0.3 \mu\text{g}/\text{m}^3$  in the east of Gan river and Nanchang City which is located in the south of the factory site being built. The density contribution value of  $\text{PM}_{10}$  is  $0.4\text{-}0.6 \mu\text{g}/\text{m}^3$  in Fenghuang Zhou, which is located in the west of Gan River. The density contribution value of  $\text{PM}_{10}$  is  $0.3\text{-}0.4 \mu\text{g}/\text{m}^3$  in East China University of Transportation and Jiangxi University of Finance and Economics.

(2) The Assessment of average daily concentration.

According to the average daily concentration simulation result for the whole year, we analysed five maximum concentration value days' meteorological conditions and the positions of maximum daily concentration value. The result are illustrated in the tables 5.1-8 and 5.1-9. The tables indicate that, in these five days, the atmosphere is formed mainly by the facts that are steady and neutral, the average wind speed is low, and the maximum surface concentration generally appears in the area which is 2-6 km southeast far away from the project location. In maximum daily concentration values, concentration of  $\text{SO}_2$  accounts for 20 %-25% of certified value and  $\text{PM}_{10}$  concentration value is about 5% of certified value. The maximum daily concentration of  $\text{SO}_2$  and  $\text{PM}_{10}$  during the whole year are  $37.4 \mu\text{g}/\text{m}^3$  and  $8.4 \mu\text{g}/\text{m}^3$  which are 25% and 6% of the certified numerical value respectively. It is obvious that, under certain meteorological conditions,  $\text{SO}_2$  average daily concentration discharged in the new project accounts 25% of the second bend standard value in some parts of leeward area, but  $\text{PM}_{10}$ 's largest average daily concentration is only 6% of the certified value.

**Table 5.1-8 The statistical form for the maximum  $\text{SO}_2$  average daily concentration**

Date	Meteorological condition			The maximum surface concentration			
	Leading wind direction	Average wind speed m/s	Main stability	Distance m	Direction	$\text{SO}_2$ concentration $\mu\text{g}/\text{m}^3$	Proportion of certified value %
11-23	C	0	E, A, F	4450	Southwest	37.44	25.0
1-03	C	0	E, B, F	4879	Southwest	36.93	24.6
1-12	NNE	1.3	D	2191	Southwest	35.89	23.9
7-12	WSW, C	1	D, B, F	3653	Northeast	31.53	21.0
10-27	N, C	0.7	D, D, E	4478	South	31.32	20.9
8-27	NNE	2.3	D	2191	Southwest	30.69	20.5

**Table 5.1-9 The statistical form for  $\text{PM}_{10}$  maximum daily concentration**

Date	Meteorological condition	The maximum surface concentration
------	--------------------------	-----------------------------------

	Main wind direction	Average wind speed m/s	Main steady degree	Distance m	Direction	PM <sub>10</sub> concentration $\mu\text{g}/\text{m}^3$	Proportion of certified value %
1-03	C	0	E, B, F	5996	Southwest	8.41	5.6
11-23	C	0	E, A, F	5568	Southwest	8.38	5.6
1-12	NNE	1.3	D	2191	Southwest	6.59	4.4
10-27	N, C	0.7	D, D, E	4975	South	6.51	4.3
7-12	WSW, C	1	D, B, F	4136	Northeast	6.36	4.2
5-19	C, W	0.3	B, B, E	3543	East	6.07	4.0

(3) The effect analysis of concentration per hour

According to the average concentration per hour simulation result in the whole year, the maximum concentration appears at the position 4.7km far away from the source of discharging in the thermal station. It is  $61.93 \mu\text{g}/\text{m}^3$ , which is 12.4% of secondary certified value. The value appears in case of quiet wind and F type steady degree (July 4th .20 PM). Table 5. 1-10 show the comparison between the largest concentration value per hour and environmental quality certified value. The largest concentration value per hour is  $38.83-61.93 \mu\text{g}/\text{m}^3$ , which is 7.8% to 12.4% of the second bend air quality standard. It always appears in steady floors and in the condition of no wind, especially in the accumulative condition of quiet wind in a succession of several days. In the major area we paid close attention to, the largest density value per hour contributes about 10% to certified value. As a consequence, this project will have some effect to concentration of SO<sub>2</sub> in appraised area.

**Table 5.1-10 The statistical form for the maximum SO<sub>2</sub> concentration value per hour in the focal point**

Distance m	Date 2002 year	Meteorological condition			The maximum surface concentration	
		Main wind direction	Average wind speed m/s	Steady degree	SO <sub>2</sub> density $\mu\text{g}/\text{m}^3$	Proportion of certified value %
1485	6.28	SW	1	D	38.83	7.8
2550	8.5	C	0	F	42.93	8.6
3010	7.15	C	0	E	47.46	9.5
3503	9.3	C	0	F	57.05	11.4
4021	12.26	C	0	F	58.10	11.6
4691	7.4	C	0	F	61.93	12.4
6157	9.22	C	0	F	57.12	11.4
6331	8.5	C	0	F	55.25	11.0
8125	4.16	C	0	F	47.43	9.5

8636	1.3	C	0	F	45.18	9.0
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(4) Abnormal productive situation forecast analysis:

Abnormal production, which is, when there is parts of purify equipment or completely invalid, accident sluice. Considering about the situation of casualty, when this simulation predict accident occurred, ash separator completely invalid, efficient of the desulfurizing equipments are zero (cycle fluid bed furnace run without lime or smoke desulfurizing equipments are not in motion.). Input the data resource of accident to the ISC3 mode, calculate maximum & minimum average concentration of each topic points under accident. When the distance between Sensitivity point to the source is about 1000 -- 8000 meters, the maximum concentration per hour of SO<sub>2</sub> is around 200 -- 400 μg/m<sup>3</sup> and the proportion of certified value are 40%--80%; the maximum concentration per hour of PM<sub>10</sub> is around 210 -- 410 μg/m<sup>3</sup>, the proportion of certified value are 47%--91%; (PM<sub>10</sub>'s average standard density value per hour should base on triple of daily average standard concentration value.) Obviously, in abnormal production of the new project, maximum concentration per hour of SO<sub>2</sub> is up to 80% of the certified value. PM<sub>10</sub>'s average standard concentration per hour value is up to 91% of the certified value. Therefore, abnormal production discharging bring more effect to the quality of atmosphere around circumstance. After the project setting up, it will stop this occurring.

**5.1.5 summary**

- New project produce the annual average maximum concentration of SO<sub>2</sub> and PM<sub>10</sub> are 4.02 & 0.76 μg/m<sup>3</sup>, far less then the second certified value of atmospheric quality, which is 6.7% & 0.76% of the second certified value. Main area is affected around 1-3km in the west of Ganjiang river, the area around 6km which in the south of factory, which will be no effect to the east of Ganjiang river, and Nanchang city, which is located in the south of the factory.
- With in the estimated range, under low diffuse condition, draining SO<sub>2</sub> off in the new project, cause SO<sub>2</sub> average daily value is 25% of the second standard value in some parts of leeward, but PM<sub>10</sub> average daily concentration is 6% of the certified value.
- The five maximum concentration day appear in the day, when the atmospheric layer is stable and medium, average main wind speed is low, the maximum surface concentration is appear around 2-6 km in southeastern area of the project location. The maximum concentration of daily value of SO<sub>2</sub> & PM<sub>10</sub> during the whole year are 37.4 μg/m<sup>3</sup> and 8.4 μg/m<sup>3</sup> and are 25% and 6% of the certified value respectively.

The maximum concentration per hour of SO<sub>2</sub> appear about 4.7km southeast far away from the heating and power plant sluice point, the maximum concentration value is 61.93 μg/m<sup>3</sup>, which is 12.4% of the standard value.

The abnormal production of the new project, cause the maximum density value per hour of SO<sub>2</sub> is up to 80% of the standard value, the maximum density value per hour of PM<sub>10</sub> is 410 μg/m<sup>3</sup>.

Concluding the forecast result above: the atmospheric pollution discharged of this project will not affect atmospheric quality, exceeding the standard, around circumstance. The soot discharged of the thermoelectric station's furnace after use electric dust will less affect the concentration of PM<sub>10</sub>, but if there is low diffuse condition, it will should carry on seriously control policy, meanwhile, will stop the accident sluice caused by no parts of purify equipment or completely invalid.

## **5.2 Effect and analysis of odor**

### **5.2.1 Odor pollution traits**

- (1) Odor is a kind of sentience social effects of pollution, which mainly will make human beings feel uncomfortable, subjective factor. Nevertheless, distinguish of olfaction of human is much more strong than other sentience, the subjective feeling of affected person is the main source of estimate.
- (2) Odor is composed of plenty of gas, the threshold value or minimum concentration of various of gas is different, at the low concentration, often not easy to realize, but once the odor is up to threshold value, almost gas will have violent odor reaction.
- (3) People relate to nature, intensity and concentration of the gas composition of odor to the sense of detesting of odor, and include the factor inclusived, such as surrounding environment, meteorological condition and individual condition (which includes the health condition and spirit state, etc.), etc. After most of composition of odor being gotten rid of, people will not feel the reduction of the corresponding degree or it will be lightened in people's sense of smell. However, for preventing and curing odor pollution, person who suffers effect doesn't require lighten or reduce stench smell, but require that there is no odor.

### **5. 2. 2 The odor pollution sources of sewage treatment plant**

Odor is produced by every treatment units of factory such as water grille, sink sand pool, aerated lagoon, sludge concentrated pan and storage sludge pool, but the odor from the water entrance (entering water grille) and the parts of dealing with sludge is particularly serious. The sewage is degenerated in the course of sending. Odor, such as hydrogen sulfide and methyl hydrosulfide, will be released out in a large amount from the grille. In addition, there is up to 85% organic matter in the dregs of the grille. After some grille dregs even corrupting a little, it can produce strong odor in the relatively big space. Parts of dealing with sludge are units with bad smell too, odor anaerobic ferment and bad smell materials in a large amount, because the period of water staying is too long. This is also a common problem occurred in the sewage disposal plants of China.

The concentration of odor and distributed amount are closely related to the quality and quantity of water, technology, meteorological condition, sludge quantity, degree of stabilization and the time of sewage staying. Still, we are not sure about the source intensity. Odor spreads generally in two kinds of decayed forms: One kind is physical decay in the space; another is chemical decay under the function of sunlight and ultraviolet ray. Because of its complication, it is very difficult to quantify the intensity of discharging from the odor pollution sources and the quantity of decay. We

will comment on the discharging intensity of the odor pollution sources of sewage disposal plant in the way of analogy investigating.

According to previous data, in this report, we made a survey of odor pollution of Handan EastSuburb Sewage Disposal Plant whose disposal capacity is designed at 100,000 m<sup>3</sup>/ds, Gaobeidian Sewage Disposal Plant which adopts AB process whose disposal capacity is designed at 100,000 m<sup>3</sup>/ds, Tianjin Jizhuangzi Sewage Disposal Plant which adopts ordinary aeration technology whose disposal capacity is designed at 100,000 m<sup>3</sup>/ds.

The result can be showed respectively in the table 5.2-1; 5.2-2; 5.2.3 ( **Reference from the pollution analysis and comment at state sewage treatment plants stenches VOL18 NO. 2).**

**Table 5. 2-1 The survey result of Handan East Suburb Sewage Disposal Plant**

The source	The entry to the Oxidize ditch	Exportation of the Oxidize ditch	The grille	Sediment pan	Concentrated pool	The boundary of grille pool	The place 10m far away from the factory boundary
The concentration of odor	760	110	760	1200	1100	2. 8	1. 5

**Table 5. 2-2: The survey result of Gaobeidian Sewage Disposal Plant**

The source	The sludge concentrated pool	Sludge dehydration room	50m away from Dehydration room	100m away from dehydration room	The place 10m far away from the factory boundary
The concentration of odor	43	173	6. 5	1. 5	<1. 5

**Table 5. 2-3: The survey result of Tianjin Jizhuangzi Sewage Disposal Plant**

Items \ Location	H <sub>2</sub> S (mg/m <sup>3</sup> )	NH <sub>3</sub> (mg/m <sup>3</sup> )	Methyl hydrosulfide (mg/m <sup>3</sup> )	The Concentration of odor
Aerated lagoon	0. 222	0. 479	0. 084	570
Sludge storage pool	30. 95	0. 312	0. 347	6500
Dehydration workshop	52. 72	0. 475	0. 495	20000
Primary sediment pan	0. 45	4. 7		

Leeward 50m	0.30	4.1		
Leeward 10m	0.07	3.5		
Leeward 150m	0.05	2.6		
GB14554-93 Second bend standard	0.06	1.5	0.007	20

According to the survey result of some domestic sewage disposal plant, the circumstance of pollution is indicated in the table 5.2-4.

**Table 5.2-4 The survey result of odor in the side of Aerated lagoon**

location pollution	Aerated lagoon	Leeward 50m	Leeward 100m	Leeward 150m	GB14554-93 Second standard
H <sub>2</sub> S	0.05	0.03	0.005	0.007	0.06
NH <sub>3</sub>	0.45	0.18	0.14	0.10	1.5
Methyl hydrosulfide (mg/m <sup>3</sup> )	<0.002	<0.002	<0.002	<0.002	<0.002

The analogy investigation result shows that: (1) The main sources of odor in sewage disposal plant are sludge storage pool, the sludge concentrated pool, dehydration workshop, aerated lagoon and the grille; (2) The main elements of the odor from sewage disposal plant are sulfide, methyl hydrosulfide and ammonia; (3) The concentration of odor is decayed with the increase of the distance from the source. The degree of odor is characterized by such a state, with obvious reduction 100 meters away, no effect 300 meters away. The degree of odor pollution is up to The Second Stage Standard of the “Boundary Standard Value of Odor Pollute”, which has been regulated by GB 14554 – 93 Discharging Limitation of Odor Pollution; (4) Different kinds of process will create various concentrations of odor, the process of dealing with sludge in long time (such as oxidizing ditch) creates lower odor concentration than the one which deal with sludge in short time (such as Aerated lagoon).

### 5.2.3 Odor's effect and analysis

According to the investigation, in order to find out about the degree of odor's impact on environment and air of sewage disposal plant, some concerned departments of Shanghai have specially hold a scene test to smell the flavor of ordinary sewage disposal plant using aeration process. 10 single men and women under the age of 30 years old, without the habit of smoking and drinking, smell the stench respectively in 5m, 30m, 50m, 70m, 100m, 200m, 300m point away from

the project. Based on statistics record, during 5m range the surveyors feeling strong stench (about 3-4 stage), and during the range of 300m-100m, easy to feel the existence of odor (about 2-3 stage). The stench is weak (about 1-2 stage) outside 200m. Outside around 300m, they have not smelt any odor.

The strength of odor refers to table5.2-5

**Table5. 2-5 The strength of odor divides form**

The classified concentration	The feeling degree of odor smell
0	Have not smelt any smell, has not reflected
1	Feel the smell reluctantly, examine and know the density of threshold value
2	Can define the relatively weak smell of odor, confirming the density of threshold value
3	Easy to smell odor.
4	There is very strong smell and very repugnant. Want to leave
5	There is extremely strong smell. Unable to stand, leave immediately

With increasing of distance, odor concentration drops rapidly. Comparing with pervious record, it indicates that at 100m point far from the odor source, odor can be sharply decreased, at 120m point far from the odor source, the odor concentration is around 11, which is close to the top standard, it is 4.4 in 200m point, the distance increases by 1 time, odor concentration drops to half, It is about 1 in 300m point, the distance increases by 3 times, odor concentration drops to below one tenth.

The sewage disposal plant is in the Nanchang National Investing and Developing District. The direction of leading wind in this district is N-NNE in the whole year. And in summer it is NE and WWS. From floor and rose graph of wind we can know that the administrative building and professor office is 300m far away from the sewage disposal plant, hence the odor will impact little about the factory environment. But the odor will definitely have impact to the Construction Ave. of Investing and Developing District in summer.

In accordance with the scheme of Nanchang National Investing and Developing District and the floor plan of Chenming Co.'s plant, the position of sensitive point and the sewage disposal plant and the distance between them refer to the tbale5.2-6.

**Table5.2-6 position of sewage disposal plant and sensitive point surrounding environment**

Sensitive point	position (base on Sewage treatment plant)	Distance with The border of sewage treatment plant; m	comment

The north mountain village	WS	1000	Removing in the planning residence block
The Jiaotong university of East China	WS	4000	
The Mechanical Institution of Railway	WWS	3800	
The Metallurgical institute of south China	WSS	3800	
The international container Dock of Nanchang	S	300	

From form 5.2-6 we can know that, the nearest distance from sensitive points to the boundary of sewage treatment plant is about 300m. According to the above analysis, the odor of the sewage treatment factory is relatively lighter than it is in sensitive position of environment

#### 5.2.4 Odor protection distance and the allowable limitations of pollution discharge

The most effective way to protect people from the odor of sewage treatment plant is setting up the hygiene protection distance. Generally, the protection distance of the ordinarily aeration method is between 200 - 400m and of the oxidizes ditch is between 100 m-300m. It affects of the scale, quality of water (BOD load) and mud stable state mainly. Pernicious gases have and organize shelter distance that discharge allowed the relations of emission adopt stench. The pernicious gases has not organized the shelter distance discharged to allow the relation of the emission to adopt GB/T with the pollutant in odor 13201-91 **The Technological Method to Make Pollutant Discharge Standard for Local Atmosphere** relates with no controlled discharging and protect and define from standard formulation the calculation formulae of method with industrial enterprise hygiene about pernicious gases.

(1) The Calculate method:

The formula is:

$$\frac{Q_c}{C_m} = \frac{1}{A} (BL^C + 0.25r^2)^{0.5} L^D$$

In the formula:

C<sub>m</sub>----Standard density limitation value; mg/m<sup>3</sup>;

L---- Necessary sanitation protection distance of industrial enterprise; m ;

Q<sub>c</sub>----The quantity of pernicious gases discharging ; kg/h

r--- effective radius of pernicious gases discharging; m;

$$r = \left( \frac{S}{\pi} \right)^{0.5}$$

A.B.C.D --Sanitation protection distance calculate coefficient, consult GB/T 13201-91 form NO.5

(2) The result of calculation and analysis

L value respectively is: 100m, 200m, 300m and 400m, 100m is the distance form center to the south boundary of factory, 300m is the distance to the international container terminal of Nanchang.

The result of calculation is in graph 5.2.7.

**Table5.2—7 The allowable discharge limitations of stench pollution**

The unit: kg/h

pollution distance	NH <sub>3</sub>	H <sub>2</sub> S	Methyl hydrosulfide
100	0.47	0.023	0.00166
200	0.89	0.044	0.00311
300	1.36	0.068	0.00477
400	1.92	0.096	0.00672
Highest Permit density limit value in once	0.20 mg/m <sup>3</sup> , The quality level of indoor air (GB/T18883— 2002)	0.01 mg/m <sup>3</sup> , The sanitary standard of the industrial enterprise design (TJ36-79) based on “The highest allowable harmful gas concentration in the atmosphere of residential block” limit value	0.0007 mg/m <sup>3</sup> , Concentration of Methyl hydrosulfide in the atmosphere of inhabited region Standard (GB18056— 2000)

According to the result of calculations and planning in form5. 2-7. Binjiang Rd. is on the southern side of this project. In order to protect the surrounding environment, the sewage treatment factory's protection distance is 100m, and the limitation of discharging odor pollutants as: NH3 0.47kg/h; H2S : 0.023 kg/h, Methyl hydrosulfide : 0.00166kg/h.

### 5.2.5. Countermeasures for avoidance of stench

For decreasing the impact on environment and resident's life, domestic sewage factories adopt the methods, which is adding a cover on the units producing stench and dealing with the collected gas at the same time. Most stench materials produced in the sewage disposal course are organic molecular compound, which mainly are consist of carbon, nitrogen and sulphur elements, such as: Low molecular fatty acid, amine type, ether type, hydrocarbon and nitrogen and sulfide of fatty group, aromatic group, etc. These materials all have active gene and are easy to take place chemical reaction, especially oxidation. After the active gene is oxidized, the smell disappears. A lot of stench pollution control technologies are based on this principle. The following is the commonly used deodor methods by sewage treatment plant.

1 Chemical treatment deodorizing method: Add chemical drugs to stink materials react, such as

adopting  $\text{Ca}(\text{OH})_2$  or ozone;

2 Physical treatment deodorizing method: For instance, active charcoal absorption method. The aldehyde ethanal, sip, 3 - methyl sip are exorcized by physical absorption, and yet some other stench composition (such as  $\text{H}_2\text{S}$  and methyl hydrosulfide, etc.) are oxidized on the active charcoal surface and then advanced aborted;

3 Biologic treatment deodorizing method: It mainly utilizes microorganism for deodorization, transforming the stench materials through the physiological metabolism;

4 Masking agent treatment deodorizing method: This method spray chemical material around some processing pool (such as primary Sediment pan, secondary Sediment pan, aerated lagoon) to deal with the stench. However, masking agent treatment deodorizing method is not reliable because the odor concentration and atmosphere condition are constantly changeable.

### **5.3 Predicting and appraising the environmental impact to the surface water**

#### **5.3.1 Prediction factor and the mode**

##### **5.3.1.1 Prediction factor**

Based on the analysis result of project's pollution,  $\text{COD}_{\text{Cr}}$  and  $\text{BOD}_5$  are the prediction factors of this evaluation.

##### **5.3.1.2 Prediction content**

This predicting adopts two-dimensional stable states decaying mode. predicting project having gone into operation, the influences of quality of receiving dirty river after normal and abnormal production emission swage, estimating water in the range and degree which influenced.

##### **5.3.2 Prediction range**

According to the content of surface water investigation and project's analysis, the prediction range is from waterspout to the 1000m downstream ( $\text{SW}_5$  fracture surface), required by the guild rule of surveying.

#### **5.3.3 Time interval of Prediction and hydrology state**

##### **5.3.3.1 Time interval of Prediction**

Time interval of Prediction is in the dry season for the north branch of Ganjiang River (the average maximum dry value per month is 90% guaranteeing rates).

##### **5.3.3.2 Hydrology state**

The Ganjiang river is the largest earth's surface water of Nanchang city, according to river's hydrologic date of recently 40 years of Waizhou stream gauging station, the average rate of discharge is  $2110.3 \text{ m}^3/\text{s}$ , average velocity is  $0.65\text{m/s}$ . After flowing through the Nanchang city, Gan River is divided into south part, middle part and north part by Qiujahe river and Yangzizou. Construction project lie in north of the Gan River, based on the previous years record of Yelou, Dakouhu, Changyi, Jiangbu stream gauging station, comparing with the Waizhou stream gauging

station's same period data, it can be worked out the disciplinarian of each part of Ganjiang river. It determines taht the predict parameter of this appraised technology of north river of Ganjiag river is: the rate of discharge: 202 m<sup>3</sup>/s, average velocity: 0.40 m/s. And the river is 389m wide on average. The average depth of water is 4m. The drop height is 0.0008.

### 5.3.4 Predicting mode and the parameter

#### 5.3.4.1The predicting mode of water's quality

COD<sub>cr</sub>, BOD<sub>5</sub> are using the two-dimensional stable state decaying mode.

$$c_{(x,y)} = \exp\left(-K_1 \frac{x}{86400 u}\right) \times \frac{c_p Q_p}{H \sqrt{\pi M_y x u}} \left[ \exp\left(-\frac{u y^2}{4 M_y x}\right) + \exp\left(-\frac{u(2B - y)^2}{4 M_y x}\right) \right]$$

$$K_1 = \left(\frac{86400 u}{\Delta x}\right) \ln \frac{c_A}{c_B}$$

In these two formulas above:

C (x, y)---- The added density-value of the pollutant on predicting point, mg/L

C<sub>p</sub>---- The density of predicting pollution, mg/L;

QP---- The emission of sewage, m<sup>3</sup>/s

M<sub>y</sub>---- The spread coefficient horizontally, m<sup>2</sup>/s

X ---- The distance from the predicting point to the draining exit, m;

y--- Distances from the predicting point to bank, m;

B---- The width of the river, m;

H--- The average depth of the water, m;

u---- The average velocity of the water, m/s

#### 5.3.4.2The assurance of the predicted parameter

(1) On the basis of Appraise for Environmental Impacts Lead as At Technology (HJ/T2.3- 93), the defining of K1 adopts the Two-point method.

(2) On the basis of Appraise at Environmental Impacts ( 2 HJ/T. 3 - 93), the defining of the spread coefficient horizontally adopts the Taylor Principle.

$$M_y = (0.058BH + 0.0065B)(gHI)^{1/2}$$

In the formula,

g--- The gravitational acceleration, m/s<sup>2</sup>

I --- Hydraulic quantity 0. 0008m/m..

During this environmentally surveying process, 5 monitoring sections are set up along the low and up reaches of river in the discharging mouth. The simulation region of the 3 monitoring points is set up on each section. All these are for the discerning, adjusting and defining of the predicted parameter of quality of water. By calculating, we can get  $K1=0.38d^{-1}$ ,  $M_y=0.49m^2/s$ .

### 5.3.5. The discharging parameters of polluting fountainhead

According to the analysis of this project, the condition of the pollutant discharging from the construction project sees form 5. 3-1

**Table5.3-1 The condition of the pollutant discharging from the construction project**

Effluent volume	Program	Unit	Normal discharging volume	Abnormal discharging
19965m <sup>3</sup> /d	COD <sub>Cr</sub>	mg/L	332	3128
	BOD <sub>5</sub>	mg/L	68	1463

### 5.3.6 The Prediction and appraise in environmental impact of surface water.

#### 5.3.6.1 The Prediction of environmental impact of surface water

In the situation of normal and abnormal emissions, the predicting result of north Ganjiang Rive is indicated in table5. 3-2-5. 3-7.

**Table 5.3-2 The net additional COD<sub>Cr</sub> value of north branch of the Ganjiang River In normal discharging situation (mg/L)**

X(m) \ Y(m)	5	10	15	50	100	150
100	2.32	1.99	1.54	0.01	0.00	0.00
200	1.68	1.56	1.37	0.13	0.00	0.00
500	1.08	1.05	0.99	0.39	0.02	0.00
1000	0.76	0.75	0.73	0.46	0.10	0.01
1500	0.62	0.62	0.60	0.44	0.16	0.03
2000	0.54	0.53	0.53	0.42	0.19	0.05
2500	0.48	0.47	0.47	0.39	0.21	0.08
3000	0.43	0.43	0.43	0.37	0.22	0.09

3500	0.40	0.40	0.40	0.35	0.22	0.11
4000	0.37	0.37	0.37	0.33	0.22	0.12
5000	0.33	0.33	0.33	0.30	0.22	0.13

**Table 5.3-3 Net additional BOD<sub>5</sub> value of north branch of the Ganjiang River In normal discharging situation (mg/L)**

X(m)\Y(m)	5	10	15	50	100	150
100	0.48	0.41	0.32	0.00	0.00	0.00
200	0.34	0.32	0.28	0.03	0.00	0.00
500	0.22	0.21	0.20	0.08	0.00	0.00
1000	0.16	0.15	0.15	0.09	0.02	0.00
1500	0.13	0.13	0.12	0.09	0.03	0.00
2000	0.11	0.11	0.11	0.09	0.04	0.01
2500	0.10	0.10	0.10	0.08	0.04	0.01
3000	0.09	0.09	0.09	0.07	0.04	0.02
3500	0.08	0.08	0.08	0.07	0.05	0.02
4000	0.08	0.08	0.08	0.07	0.05	0.02
5000	0.07	0.07	0.07	0.06	0.04	0.03

**Graph 5.3-4 Net additional COD<sub>Cr</sub> value of north branch of Ganjiang River in abnormal**

**discharging condition (mg/L)**

X(m)\Y(m)	5	10	15	50	100	150
100	24.14	20.71	16.03	0.15	0.00	0.00
200	17.50	16.20	14.26	1.39	0.00	0.00
500	11.21	10.87	10.33	4.07	0.19	0.00
1000	7.93	7.81	7.61	4.78	1.03	0.08
1500	6.46	6.39	6.28	4.61	1.66	0.30
2000	5.57	5.53	5.46	4.33	2.00	0.56
2500	4.97	4.93	4.88	4.05	2.20	0.79
3000	4.51	4.49	4.45	3.81	2.29	0.98
3500	4.16	4.14	4.11	3.60	2.32	1.12
4000	3.88	3.86	3.84	3.42	2.33	1.23
5000	3.44	3.43	3.41	3.11	2.29	1.37

**Graph 5.3-5 Net additional BOD<sub>5</sub> value of north branch of Ganjiang River in abnormal**

**discharging condition (mg/L)**

X(m)\Y(m)	5	10	15	50	100	150
100	11.26	9.66	7.48	0.07	0.00	0.00
200	8.16	7.56	6.65	0.65	0.00	0.00
500	5.23	5.07	4.82	1.90	0.09	0.00
1000	3.70	3.64	3.55	2.23	0.48	0.04
1500	3.01	2.98	2.93	2.15	0.77	0.14

2000	2.59	2.57	2.54	2.01	0.94	0.26
2500	2.31	2.30	2.27	1.89	1.02	0.37
3000	2.10	2.09	2.07	1.77	1.06	0.45
3500	1.93	1.93	1.91	1.67	1.08	0.52
4000	1.80	1.79	1.78	1.59	1.08	0.57
5000	1.60	1.59	1.58	1.44	1.06	0.64

**Graph5.3-6 The COD<sub>cr</sub> concentration stat of north branch of Ganjiang river in the situation of normal and abnormal discharging (mg/L)**

Lateral simulation district	5m			50m			150m						
	Background value	Normal discharging		Background value	Normal discharging		Background value	Normal discharging					
		Net additional value	Superimposing value		Net additional value	Superimposing value		Net additional value	Superimposing value				
Concentration Superimposing Fracture surface													
1000m	13.70	0.76	14.46	7.93	21.63	14.90	0.46	15.36	4.78	19.68	13.70	0.01	13.71
3000m	16.00	0.43	16.43	4.51	20.51	16.00	0.37	16.37	3.81	19.81	14.80	0.09	14.89
5000m	14.30	0.33	14.63	3.44	17.74	16.00	0.30	16.30	3.11	16.30	15.40	0.13	15.53

表 5.3-7 The BOD<sub>5</sub> concentration stat of north branch of Ganjiang river in the situation of normal and abnormal discharging (mg/L)

Lateral simulation district	5m				50m					
	Background value	Normal discharging		Accident discharging		Background value	Normal discharging		Accident discharging	
Concentration Superimposing Fracture surface		Net additional value	Superimposing value	Net additional value	Superimposing value		Net additional value	Superimposing value	Net additional value	Superimposing value
1000m	1.15	0.16	1.31	3.70	4.85	1.03	0.09	1.12	2.23	3.26
3000m	1.19	0.09	1.28	2.10	3.29	1.05	0.07	1.12	1.77	2.82
5000m	1.1	0.07	1.17	1.60	2.70	1.11	0.06	1.17	1.44	2.55

### 5.3.6.2 Environmental impact of surface water predicts analysis

#### (1) Discharging under the normal situation

From graph 5.3 – 2& graph 5.3-3 we know that, discharging under the normal situation, the COD<sub>CR</sub> maximum additional value is 2.32mg/L, the maximum additional value of BOD<sub>5</sub> is 0.48 mg/L , because the water yield propped up in north of the Ganjiang river is compared larger than the emission of sewage of the project. From graph 5.3.6- graph 5.3.7 we know, after adding with the additional value and forthcoming one, the predict value of both COD<sub>CR</sub> and BOD<sub>5</sub> are all satisfied with **Environmental quality level of surface water** (GB 3838 - 2002) III standard type. So in normally discharge situation, the construction project will affect a little to the north of the Ganjiang river.

#### (2) Situation of accident discharging.

From form 5.3-4- forms 5.3-5 we find out that, in the accident-discharging situation, the maximum additional value of the pollutant COD<sub>CR</sub> and BOD<sub>5</sub> are 24.14 mg/Ls and 11.26mg/L. From graph 5.3-6- graph5.3-7 we can also find out that, after added the additional value with the status monitoring superimposed value, the concentration of the lower reaches of sewage discharging exit is 3000m for COD<sub>CR</sub>, which exceed **Environmental quality level of surface water** (GB3838–2002) IIItype standard. Predicted accumulate value satisfies the IVstandard type of **Environmental quality level of surface water** (GB3838–2002) . According to the **Reporting of Defining Jiangxi Chenming Co. Ltd. Produce 200,000 ton of Coating Paper Project’s quality of Environment** by Environmental Protection Agency of Nanchang [2003]NO.120, the surveying of the environmental quality of surface water temporarily follows **Environmental quality level of surface water** (GB3838–2002) IVtype. After new function region is defined, it will be carried out to the new regulation. So for protecting the quality of water in north Gan River part in Jiangxi province, constructors should reinforce their management, make sure the disposal processing of the sewage running healthily. Outlet wastewater should have been up to the discharging standard. They should forbid the discharging of the substandard wastewater or the accident discharging.

## 5.4 Prediction and appraising of the environmental impact on noise

### 5.4.1 Choice of Predicting mode

#### (1) Predictive formula

Basis on the trait of industry noise source, this appraise uses the geometrical attenuation formula of no directivity point voice source

$$L_A(r) = L_A(r_0) - 20 \lg(r/r_0) - \Delta L$$

In the formula

r、r<sub>0</sub>— The distance from the noise source , m;

L<sub>A</sub>(r)、L<sub>A</sub>(r<sub>0</sub>)---- The A acoustical grade at a distance of r and r<sub>0</sub> from the noise source, dB( A);

ΔL----- The sound absorption results of comprehensive considering the sound insulation in the factory building synthetically, air and trees, set values 20 dBs ( A);

Superimposing noise formula of different grade sound pressure:

$$L = 10 \lg \sum_{i=1}^n 10^{0.1L_i}$$

In the formulae:

L—— The total sound pressure grade, dB( A)

n——Count in the noise source

#### (2)Prediction content

Superimposing intensity value of the place 1m away factory boundary and temporary background value, we compared the superimposing value to the noise standard value and analyzed the situation up or exceeds standard

### 5.4.2 The result of Predicting and analysis

#### (1)The noise of the boiler exhaust

Thermal station is needed to exhaust no matter at the starting or restarting time. And when vale exhaust, it produces special high noise. The effect range can be seen in table 5. 4-1

**Table 5.4-1 The noise coverage of boiler exhaust**

distance (m)	1	5	15	100	150	200	500	1000	2000	3000	4000
Noise grade dB(A)	125.0	101.0	91.5	75.0	71.5	69.0	61.0	59.0	49.0	45.5	43.0
Cut down 20 dB(A)	105.0	81.0	71.5	55.0	51.5	49.0	41.0				
Cut down 30dB(A)	95.0	71.0	61.5	45.0	41.5						

From form 5.4-1 we can know, when the accident discharging value is 125 dB(A) and the distance is 4000m, the project have a certain effect on surrounding environment. After taking the measure to cut down to 105dB(A), the coverage drops to 500m, after cut down to 95dB(A), the coverage drops as 150m. It shows that coverage can be controlled in the factory. Therefore, noise should be strictly implement by the construction unit, in order to reduce effect to surround environment.

Only considering noise reduction is under the inefficiency situation, relative effect range is can be seen in the diagram of curves. 5.4-1

(2) The prediction of the noise in the sensitive point and boundary of project.

Table 5.4-2 shows how far the main noise source of the project (after reduced by the equipment), predictably contributed to the sound environment of factory boundary and sensitive point. Form 5.4-2

After project is over, the change of environment around the factory and sensitive point can be seen in form 5. 4-3

**Table 5.4-2 Effect of the equipment noise on the environment around the factory**  
unit: dB(A)

The location of monitoring point		East of factory circle N <sub>1</sub>		Southeast of factory N <sub>2</sub>		Southwest of factory circle N <sub>3</sub>		West of factory circle N <sub>4</sub>		North of factory N <sub>5</sub>	
		D (m)	PV dB(A)	D (m)	PV dB(A)	D (m)	PV dB(A)	D (m)	PV dB(A)	D (m)	PV dB(A)
workshop	Inv.	310	36.6	510	32.2	930	27.0	1400	23.5	300	36.9
	Rub the thick liquid	680	26.7	640	27.3	570	28.3	1030	23.1	290	34.2
papermaking workshop		1060	22.5	990	23.1	410	30.7	650	26.7	280	34.1
Thermoelectric station		680	18.1	460	21.5	320	24.7	1090	14.1	510	20.6
sewage disposal plant		370	27.8	180	34.1	370	27.8	1470	15.9	700	22.3
Water disposal plant		880	14.1	750	15.5	380	21.4	850	14.4	390	21.2
Accumulate contributing value			37.8		37.1		35.2		29.8		40.2

D: distance; PV: predict value

Table 5. 4-3 The Values and Changes about the surrounding sound environment after completion of the project unit: db (A)

Measuring periods	Measuring points	Environmental original values	Machinery contributing values	Add-up values	Increased values
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The whole night	Easter side N1	46.4	37.8	46.9	0.5
	South east side N2	56.6	37.1	56.6	0.0
	South West N5	56.5	35.2	56.6	0.0
	West side N1	41.3	29.8	41.6	0.3
	North side N2	42.2	40.2	44.3	2.1
The night	Easter side N1	38.0	37.8	40.8	2.8
	South east side N2	49.1	37.1	50.2	0.3
	South West N2	49.1	35.2	49.2	0.1
	West side N1	34.8	29.8	36.0	1.2
	North side N5	25.8	40.2	40.3	0.1

It can be inferred from the above table 5. 4-2 that the accumulated contributing values are 29.8---40.2 db (A), which indicates the degree of the sound environment in the surroundings of the plant impacted by the noise created by the machines. The accumulated contributing values measured at the checkpoints in the north side (N6) are 40.2 db (A). The major reason is the noise sources are very close to the north side (N6).

It can also be found from the above table 5. 4-2 that the noise level around the plant has increased slightly after the project has been finished and into production. With increased value of 0.0db (A)----40.2dB (A) at day time, the value of 0.1dB (A)—2.8dB (A) during night. The noise level around the plant at daytime is of between (A) while 36.0 dB (A)—49.2 dB during night, all these figures can be in accord with the prevail standard: during daytime 60 dB (A) while at night 50 dB (A).

### (3) Analysis of Noise Contamination caused by Traffic and Transportation

The total amount to be transported for this plant is estimated as 1.1954 million tones, 0.36 million tones of which shall be transported by road. In considering the barging in side of the plant, it is estimated that the traffic rate will be increased to 20 lorry /h after the normal operation of the plant. In accordance with the formula in the appendix of <The Standard of Assessment for the Environmental Influence by the Road Construction Projects>, given the speed of vehicles is 40 km/h, the noise level  $L_w$  for heavy-duty lorries is 84.4 dB (A). The vehicle can be regarded as a moving noise source when there is a light traffic. Therefore the following formula can be used to calculate the noise level at the point somewhere close to the central line of the road:

$L=20lg1-8$ , where L is the noise level dB (A) at the point one meter away from the central line of the road. The calculated noise level of the point measured 20 meters away from the central line of the road is 50 dB (A), and that measured 30 meters away from the central line of the road is 46.8 dB (A).

Normally the checking points for measurement of the road within the plant and the major ways are appointed a certain distance away from them. In this circumstance there is slight noise influence to the surrounding environment.

The locomotive is another noise source. According to the calculation the total amount to be transported by road for this project is 840,000 tones per year. There will be only two trains coming into the plant per day. The time is not long when the environment is exposed to the noise influence. The noise level checked at the point 30 meter in front of the locomotive will be 105 dB (A) when it is whistling. And the noise level checked at points in front of the locomotive by the two sides of railway is 90—100 dB (A). The whistling will cause a certain of influence to the surrounding environment. Therefore the whistling with in the plant shall be forbidden, especially during the nights.