SYSTEM DESIGNING ON EMERGENCY METEOROLOGY SERVICE OF HARMFUL GAS LEAK

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INTRODUCTION

This paper will introduce the impact of the weather service in dealing with emergency of harmful gas leak. When dealing with emergency of harmful gas leak, the information of the distribution of contamination density and the extension and speed and direction of this contamination was needed to know quickly. Then according this information government can make emergency planning to ensure retreat extension and retreat direction of the evacuee and how long time is needed doing these. Therefore designing an emergency meteorology service system is necessary to deal with sudden case of harmful gas leaking and its core is polluting disperse model is very necessary.

THE INTRODUCTION OF EMERGENCY METEOROLOGY SERVICE OF TIANYUAN CHEMICAL PLANT CHLORINE GAS LEAK IN CHONGQING

At eleven o'clock 2004/4/16, Chongqing meteorological administration receives the city government inform, was demanded to carry on the spot weather service for Tianyuan chemical plant's chlorine. Chongqing meteorological administration started Emergency Meteorology Service system immediately and observed wind by small ball at ShaPingBa District meteorological administration where is the nearest the Tianyuan chemical plant at twelve o'clock, the first observation report sent to government including the spot wind, weather forecast and the high degree of mixed layer, polluter diffusion condition analysis etc.; In the evening, after consult with national administration expert urgently, put forward a spot air polluter diffusion report that was calculated by the polluting disperse model, the report was sent to the spot commanding department, and it provide a scientific basis for the government's decision work. Afternoon on 17th April, the spot commanding department to decide blowing up the container of the chlorine gas, in order to expel the danger thoroughly, requested the meteorological administration to provide the best blowing up time. The meteorological administration put forward the explicit forecast after pass by consult urgently: before the at twelve o'clock 18th April the direction of wind was southwest, the atmosphere stratification was stable, tainted air diffusion ability is weak, disadvantage in blowing up, polluting the direction after blow up for be partial to the west, main influence the scope was ShaPingBa District ;The direction of wind is partial to the south after twelve o'clock, tainted air diffusion strengthen, was advantageous to blow up. In the evening 17th April and dawn 18th, according to the forecast of the direction of wind, the best time of blowing up was settled at 12:00 18th. At 10:30 18th, the spot weather observation provided to separate 15 minutes each time a time prognosticate, for the convenience of blowing up . This emergency of chlorine gas leakiness indicated that it is necessary to establish this emergency meteorology service system.

SYSTEM DESIGNING ON EMERGENCY METEOROLOGY SERVICE OF HARMFUL GAS LEAK AND THE MAIN CALCULATE METHOD

Idea of the system

System designing on emergency meteorology service of harmful gas leak is based on the emergency meteorology service experience of the chlorine leaking accident happening in Tianyuan chemical plant of Chongqing, and the functions of this system include the following aspects: firstly, polluting disperse model can detailedly react polluting disperse (its scale is 100 meter); secondly, it include operational system that can flexibly change landform data and vegetation data and field of weather factors. For example, if can obtain the information to run this model from GIS rapidly such as landform and vegetation in the harmful gas leaking area, and then adjust quickly to calculate. So this model can be popularized around the country; Thirdly, this system can analyze possible effect from modeling result on accident area so that it can provide advanced technical guarantee and scientific basis for emergency case of harmful gas leaking.

In this paper, chlorine leaking accident happening in Tianyuan chemical plant of Shapingba district in Chongqing at 16th April 2006 was chose as example and the result of analysis and calculate was offered. There is some main calculate method and result in the paper because of hurried time.

The affecting range of leaking Chlorine according upper sounding data

Fig1 is the wind rose figure based on every two minute from 16th to 19th April of automatic station named Shapingba nearer to chlorine leaking locale. It is evident that west winds are the main wind direction on ground from fig1 so that leaking Chlorine diffuses to partial east and south direction.

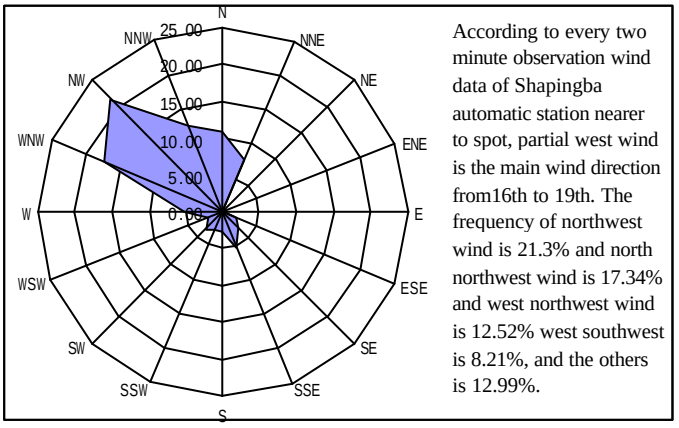

Fig. 1; Observation wind rose figure near Maoershi location from 16th to 19th April.

According to upper sounding data of eight o'clock 16th April and numerical prediction method, affecting range and diffusing direction of leaking Chlorine from Tianyuan chemical plant are calculated and predicted three days latter. The following are the results of prediction. From 16th to 19th, leaking Chlorine in atmosphere mainly diffuse to partial east and south. Leaking Chlorine subsiding range (fig2) on ground is near to leaking location (about 100km in

circumference) from eight o'clock 16th to eight o'clock 17th, and there is about 50km from the subsiding center to leaking location; Leaking Chlorine subsiding range (fig3) on ground is extending towards southeast from eight o'clock 16th to eight o'clock 18th, and there is about 300km from the subsiding center to leaking location. Subsiding range (fig4) on ground is extending also mainly towards southeast from 16th to 19th, and farthest subsiding location is about 600km from leaking location. At the same time, the affecting range is extending towards west.

From fig2 to fig4, it is seen that the prediction results is reasonable and the result is coincident with observation wind of automatic station.

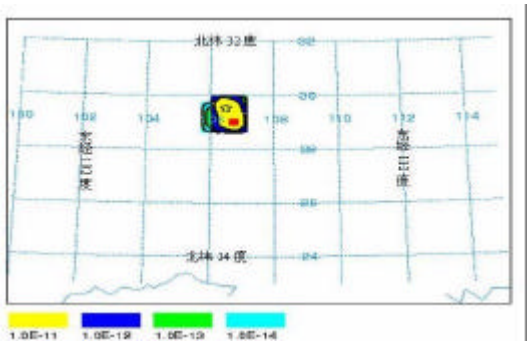

Fig. 2; Prediction of subsidence on ground from 8 o'clock 16th to 8 o'clock 17th.

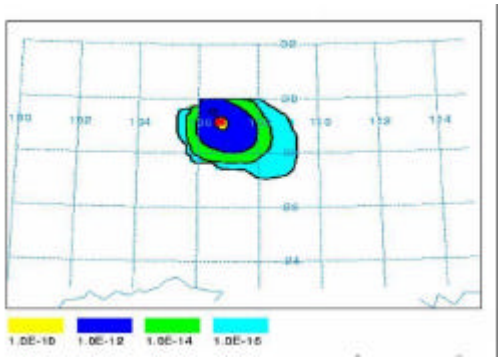

Fig. 3; Prediction of subsidence on ground from 8 o'clock 16th to 8 o'clock 18th.

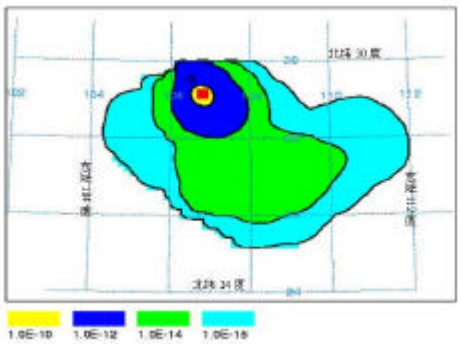

Fig. 4; Prediction of subsidence on ground from 8 o'clock 16th to 8 o'clock 19th.

Chlorine diffusion result calculated by observation wind on ground

The distribution of Chlorine thickness on the high 1 to 1.5 meter from ground is cared in the emergency project so this method calculates distribution and diffusion of two dimensions point pollution. From 16th to 19th is cloudy and partial Northwest wind is the main wind direction on the ground and contamination diffuses towards partial east and south. The short time max wind speed, minimum wind speed and average wind speed respectively are 2.2m/s, 0m/s and 1.6m/s. As a whole, wind speed is weak and difficult to diffuse. Environmental temperature is 13.8℃ and average air pressure is 989.61hpa.

In this paper, Gauss diffusion formula is used and origin superposes with pollution point or origin is the pollution point's projection on ground. When the ground is flat and origin superposes with pollution point, diffusion formula is written as following:

$$c(x,y,z)=\frac{Q}{2pus_y s_z}\exp\left(\frac{-y^2}{2s_y^2}+\frac{-z^2}{2s_z^2}\right)$$

In the formula, c - thickness of contamination, mg/m^3; Q - release speed of contamination, mg/s; s_y - parameter of diffusion on the level, m; s_z parameter of diffusion on the vertical direction, m; u - average wind speed, m/s. Because Chlorine will obtrude some distance, affection of ground must be considered. Origin is the pollution point's projection on ground under this condition so Gauss diffusion formula is written as following:

$$c(x,y,z,H)=\frac{Q}{2pus_y s_z}\exp\left(\frac{-y^2}{2s_y^2}\right)\left\{\exp\left[\frac{-(z-H)^2}{2s_z^2}\right]+\exp\left[\frac{-(z+H)^2}{2s_z^2}\right]\right\}$$

In the formula, H is effective high of smoke. If ground thickness is calculated Gauss diffusion formula is as the following:

$$c(x,y,0,H)=\frac{Q}{2pus_y s_z}\exp\left(\frac{-y^2}{2s_y^2}\right)\exp\left(\frac{-H^2}{2s_z^2}\right)$$

Using Gauss diffusion formula and considering the affection of ground, the ground Chlorine thickness at 16^{th} is calculated. In the formula degree of stability is c and the high of smoke is 5meter and air pressure 1000hpa, environmental temperature 286.8K. X axes is southeast direction and Y axes is vertical with southeast. To show contamination diffusing mainly towards south and east, the distance from leaking point in X axes increases bigger than in Y axes.

The results show when west wind is main wind direction and the distance does not change down west wind, Chlorine thickness decreases by exponential form at the wind direction. And at the direction vertical to main wind direction, Chlorine thickness decreases by linear.

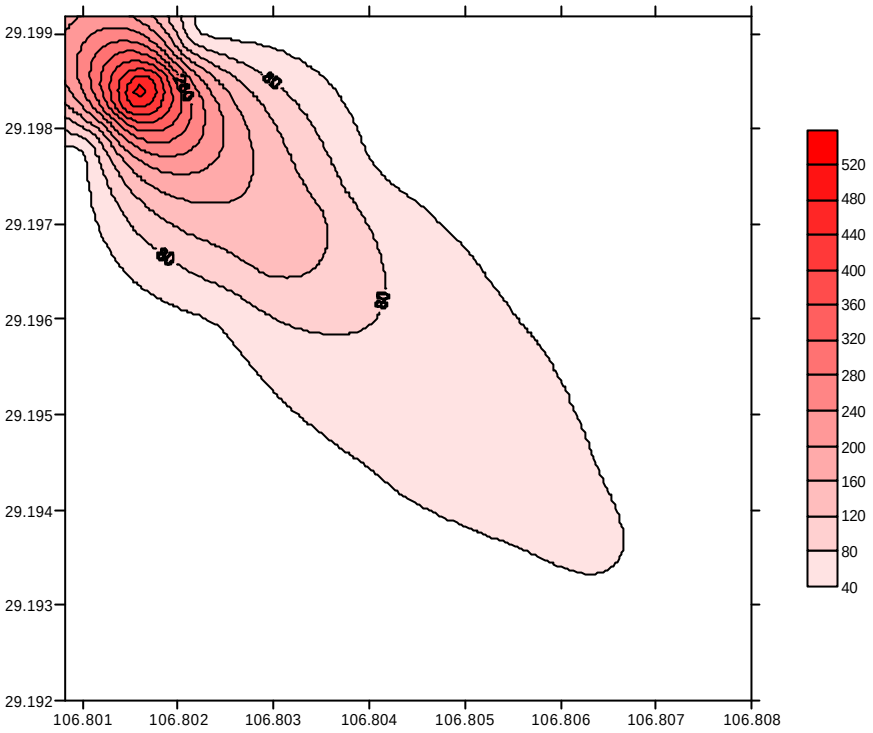

Fig. 5; Contamination thickness distribution downwind from chlorine leaking spot

Fig 5 is Chlorine thickness distribution on the ground calculated by Gauss formula. Affected by northwest wind, Chlorine mainly diffuses to south and east, and the farthest distance is 10km or so in the southeast. The max thickness on the ground is 0.52g/m^3 (this is leaking location's thickness) and the minimum thickness is 0.04 g/m^3.

CONCLUSION

According to the experience of dealing with the Tianyuan chemical plant chlorine gas leakiness in Chongqing, reveals the methodology on designing Emergency Meteorology Service System of Harmful Gas Leakiness, and the key problem need to be resolved of.

The numerical model that uses the Gauss equation computing the small scope diffusion of the harmful gas, have the certain leading meaning in actual application.

This calculation methods still need to be improved in the further: at first, in order to embody the change of harmful gas, we should join the time variable. The second, the location of the emergency take place and its influence factor of the gas diffusion should be considered. At last, should carry on the fast adjustment for the occasional location, give result.

REFERENCES

References were omitted.