The study on the atmospheric pollutants, which are from urban residents' life in Guilin

Huihong Luo[1,a],Lei Liao[1,b];Wei Diao[2,c]

College of Environmental Science and Engineering, Guilin University of Technology ,Guilin 541004,Republic of China;

Foreign Language and Culture Institute of South China Normal University;Guangzhou 510631,People's Republic of China

[a]541939312@qq.com,[b]fangqiu2001@163.com,[c]583026878@qq.com

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Abstract. By investigating the statistical data of the fuel consumption of urban residents' life in Guilin area from 2012 to 2013, the emission factors were determined after referenced literatures from home and abroad. Through the methods above, the author finally calculates the annual atmospheric pollutant emissions from urban residents' life in Guilin area. The data shows that SO_2 is 4514.67t, NO_x is 455.72t, TSP is 829.78t, PM_{10} is 975.50t, and $PM_{2.5}$ is 1515.71t. Xiangshan District, Qixing District, Diecai District, Xiufeng District and Quanzhou County discharge most pollutants in Guilin area. However, there is a tendency that particulate pollutants become tinier. Compared with other areas in our country, domestic pollution from urban residents' life is relatively serious in Guilin area. It mainly results from the fact that high sulfur and high ash coal are widely used in this area.

1.Introduction

Domestic pollution is regarded as one of the most important pollution sources in the world. With various kinds of forms.[1]However, among the domestic pollution in lodging industry, catering industry and service industry, the atmospheric pollutants from the residents' life becomes more serious.

As a major city for urban conservation and a national environmental protection model city, Guilin's air quality needs to improve compared with other developed countries. The air pollution index of major pollutants, such as SO_2、PM_{10} is 2～5 times compared with developed countries. Meanwhile, according to the new air quality standard, the data from Guilin's Environmental Monitor Station at the end of 2013，showed that the rate of Guilin's good environment in 2013 decreases to 64.1%.

Based on *Urban Domestic Pollution and Emission Data in China* (No. (2014) 4, national confirmed), which are co-published by State Bureau of Environmental Protection and National Bureau of Statistics, the researcher studies and calculates the atmospheric pollutants of TSP、SO_2、NO_x、PM_{10}、$PM_{2.5}$ ect. from urban domestic pollution in Guilin area. This research will provide theoretical basis for the prevention of atmospheric pollution in Guilin area.

2. Research methods

2.1 Obtaining the data of TSP, SO_2 and NO_x

There is a systematic statistics and data about TSP, SO_2 and NO_x in the *Urban Domestic Pollution and Emission Data in China* (No. (2014) 4, national confirmed). The data of these pollutants in this research all comes from the data basis.

2.2 Obtaining the data of PM_{10} and $PM_{2.5}$

2.2.1 The method of calculation

Firstly, according to the fuel consumption (the second classification of the sources), different

kinds of burning (the third classification of the sources) and the applied ratio of control techniques for particulate matter (the fourth classification of the sources), the research gets the fourth activity level of emission resources. Then according to the burning situation, the researcher confirms the production index of PM_{10} and $PM_{2.5}$ from the emission sources. Based on the production index, the researcher confirms the emission factors of PM_{10} and $PM_{2.5}$ according to the removal efficiency of different classification of control techniques.[2] At last, the researcher calculates the emission of PM_{10} and $PM_{2.5}$. The calculation formula is:

$$E_i = A \times EF_i(1-\eta) \quad (1)$$

E_i stands for the emission of PM_{10} and $PM_{2.5}$, t/a. A stands for the corresponding activity level of the fourth emission sources. Generally, it refers to the fuel consumption. Coal and natural gas are the main fuel in urban residents' life in Guilin. The unit of A is t/a. As for the non-point source pollution, A stands for the activity level of the smallest district. EF_i stands for the production index of PM_{10} and $PM_{2.5}$ in the one-time process, g/kg. η stands for the removal efficiency for PM_{10} and $PM_{2.5}$ by pollution control techniques, %. Because the exhausted gas in Guilin's residents' life is discharged directly, the value of η is zero in this research.

2.2.2 Emission factors

Emission factors have a significant influence on the accurate calculation of pollutants from the emission sources. Referenced by the data in AP-42[3], which is recommended by Environmental Protection Agency, and combined with recently researches by scholars of zhang J, Chen Y and Lei, Y[4-11], the researcher confirms the emission factors --PM_{10} and $PM_{2.5}$, which are mainly produced in the main fuels from residents' life in Guilin area. The data is shown in table 1

Tab.1 Emission factors of fine particulate matter from domestic fuels of Guilin's urban residents [g/kg]

Fuel for Life	PM_{10}	$PM_{2.5}$
Coal	4.41	6.86
Natural gas	0.00	0.03

*The unit of emission index of natural gas is g/m^3.

Coal stoves are widely used in Guilin's residents' life. Therefore, the researcher selects the corresponding emission index of coal stoves.

3. Results and discussion

3.1 The emission list of atmospheric pollutants from urban residents' life in Guilin

According to data of main fuel consumption and emission factors in 2012 and 2013, the researcher gets PM_{10} and $PM_{2.5}$'s emission quantity from Guilin's urban residents' life through formula (1). Combined with the statistics of TSP, SO_2 and NO_x, the researcher final draws the emission list of atmospheric pollutants from urban residents' life in Guilin, which is demonstrated in tab.2.

Tab.2 The emission list of atmospheric pollutants from urban residents' life in Guilin area in the year of 2012 and 2013 [t/a]

Area	Years	Coal$PM_{2.5}$	CoalPM_{10}	Natural gas$PM_{2.5}$	$S0_2$	NOx	TSP
Xiufeng	2012	111.42	71.84	0.03	309.40	31.23	100.59
	2013	153.18	98.48	0.05	309.40	31.23	22.33
Diecai	2012	166.96	107.65	0.05	464.47	46.88	151.05
	2013	115.25	74.09	0.04	464.47	46.88	16.81
Xiangshan	2012	282.83	182.35	0.09	786.00	79.34	256.06
	2013	274.47	176.44	0.09	786.00	79.34	40.02
Qixing	2012	197.74	127.49	0.06	548.80	55.40	179.82
	2013	168.62	108.4	0.06	548.80	55.40	24.54
Yanshan	2012	10.12	6.53	0.003	27.80	2.81	8.63
	2013	24.42	15.7	0.01	27.80	2.81	3.54
Yangshuo	2012	73.87	47.63	0.03	175.20	17.69	94.95
	2013	90.96	58.48	0.03	175.20	17.69	13.27
Lingui	2012	76.13	49.08	0.03	270.10	27.27	84.87
	2013	93.98	60.42	0.03	270.10	27.27	13.71
Lingchuan	2012	77.09	49.7	0.03	270.60	27.32	73.37
	2013	80.33	51.64	0.03	270.60	27.32	11.72
Quanzhou	2012	111.70	72.02	0.04	362.90	36.63	105.01
	2013	110.72	71.18	0.04	362.90	36.63	16.14
Xingan	2012	74.56	48.07	0.02	206.00	20.79	71.93
	2013	77.31	49.7	0.03	206.00	20.79	11.28
Yongfu	2012	44.12	28.44	0.01	173.50	17.51	38.84
	2013	40.95	26.33	0.01	173.50	17.51	5.97
Guanyang	2012	34.54	22.27	0.01	113.00	11.41	34.53
	2013	36.36	23.37	0.01	113.00	11.41	5.31
Longsheng	2012	32.35	20.86	0.01	74.70	7.54	30.21
	2013	31.83	20.46	0.01	74.70	7.54	4.64
Ziyuan	2012	31.74	20.46	0.01	58.60	5.91	26.61
	2013	28.81	18.52	0.01	58.60	5.91	4.20
Pingle	2012	56.16	36.21	0.02	260.60	26.31	51.79
	2013	56.11	36.07	0.02	260.60	26.31	8.18
Lipu	2012	91.11	58.74	0.03	296.30	29.91	84.88
	2013	89.45	57.51	0.03	296.30	29.91	13.05
Gongcheng	2012	41.25	26.59	0.02	116.70	11.77	45.31
	2013	43.97	28.27	0.01	116.70	11.77	6.41
Guilin	2012	1513.69	975.93	0.49	4514.67	455.72	1438.45
	2013	1516.72	975.06	0.51	4514.67	455.72	221.12
	Mean	1515.21	975.50	0.50	4514.67	455.72	829.78

According to tab.2, in the year of 2012 and 2013, the emission quantity of these atmospheric pollutants from urban residents' life in Guilin area is close. However, the emission quantity of suspended particulate matter changes a lot. The emission quantities in 2012 and 2013 are 1438.45t and 221.12t, falling 84.63%. We can draw the conclusion that fine particulate matters pollution becomes less severe. Sulfur dioxide and fine particulate matters are the main atmospheric pollutants from urban residents' life in Guilin. The average emission quantities of these two pollutants are 4514.67t and 1515.21t, reaching 54.45% and 18.27% in contribution rate. Many scholars like Zhang Xuehong point out that 80% of energy in Guilin comes from coal. Besides, the coal in Guilin is with high sulfur because it contains high degree of sulfur and ash.

According to table 2, the researcher draws the line graph of different atmospheric pollutants

in 2012 and 2013 according to districts and counties in Guilin, which is illustrated in Fig.1 and Fig.2.

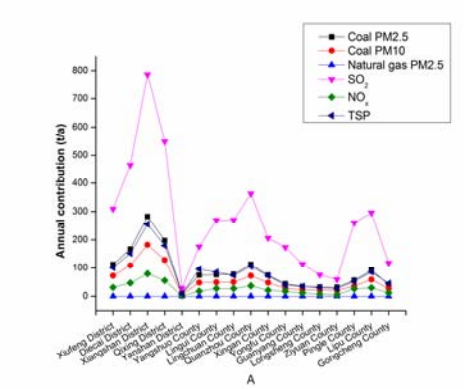

Fig.1 The comparison of atmospheric pollutants from urban residents' life in different districts and counties of Guilin in 2012

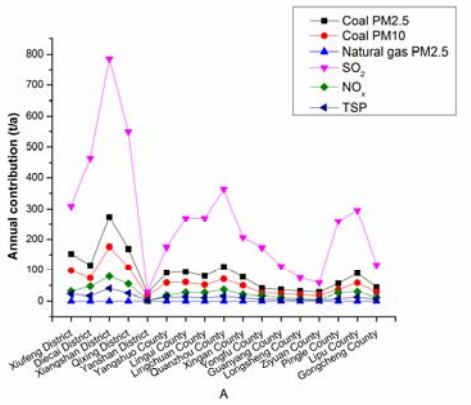

Fig.2 The comparison of atmospheric pollutants from urban residents' life in different districts and counties of Guilin in 2013

As a whole, the population in different districts and counties has a direct proportion with emission quantity of atmospheric pollutants. The population in Xiangshan District is 2,904,000 with all kinds of emission quantity ranking first. The population in Qixing District, Diexiu District, Xiufeng District, Quanzhou County, Lingchuan County, Lingui County, Xingan County, Pingle County and Lipu County is over 1000 thousand; meanwhile their contribution rate of atmospheric pollutants lists top in Guilin. It is obvious that atmospheric pollution in Guilin is severe in the developed cities or areas. It is a regional phenomenon.

3.2 The comparison of atmospheric pollutants from urban residents' life in Guilin and other parts of China

Ma Xiaolu, Zhao Bing[13、14] and other scholars made a research about the emission lists of east and north part of China, which is demonstrated in tab.3. It has a detailed statistics of SO_2 and NO_x, but it lacks the data of particulate matter pollution.

Tab.3 The comparison of atmospheric pollutants from urban residents' life in Guilin and other parts of China [t/a]

Area	$S0_2$	NO_x	$PM_{2.5}$	PM_{10}	TSP	Data Sources
Guilin	4514.67	455.72	1515.71	975.5	829.78	This research
Shanghai	93.7	13701.62		2.03		MaXL,2009[13]
Changzhou	20.55	695.28		0.35		
Nanjing	34.56	1958.64		0.66		
Sunzhou	23.31	834.3		0.39		

Hangzhou	42.92	1076.57		0.7		
Taizhou	30.97	465.52		0.48		
Tianjing	60.8	19.8	5.3	11.2	---	Zhan B,2008[14]

According to tab. 3, the emission quantity of pollutants in Guilin is higher than other parts of China. Moreover, all kinds of emission quantity are higher except the emission quantity of nitrogen oxides. It is because gas, natural gas and LPG are widely used in urban residents' life in other parts of China. There produces little sulfur dioxide and particulate matters during the process of burning natural gas [13]. The urban population in Guilin is 215,460,000. The population is relatively small compared with other cities in China: for instance, Shanghai's urban population is 1,366,280,000[14] in 2009. However, the emission quantity of atmospheric pollutants does not decline because of the smaller urban population. We can draw the conclusion that clean energy is seldom used in Guilin and the average ratio of using clean energy is lower than other parts of China.

4. Conclusion

The emission quantities of SO_2, NO_x, TSP, PM_{10} and $PM_{2.5}$ from domestic pollution in Guilin are respectively 4514.67t, 455.72t, 829.78t, 975.50t and 1515.21t each year. Among these atmospheric pollutants, sulfur dioxide's contribution rate is the highest, reaching 54.45%. $PM_{2.5}$'s contribution rate tops second, reaching 18.27%.There is a tendency that fine particulate matter pollution in Guilin from domestic pollution decreases. The pollution occupation rate of $PM_{2.5}$ increases from 38.54% to 55.91% in 2012 and 2013.From the perspective of administrative districts, Xiangshan District is the main pollution contribution district. It discharges 1471.52t pollution each year,pollution emission quantity has a positive relation with population.Compared with emission quantity from domestic pollution in other parts of China, the atmospheric pollution is more sever in Guilin.

Acknowledgments

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