

The Analysis of Monitoring Achievement on Key Sewerage Users from 2012 to 2016 in Beijing: a preliminary study

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Abstract. Seven species of key sewerage users in central city zone of Beijing were monitored from 2012 to 2016. The key sewerage users are the main research objects, including hospitals, industrial enterprises, emporiums, universities, comprehensive office buildings, hotels and restaurants. Six main items are monitored including suspended substance, COD_{Cr}, BOD₅, ammonia nitrogen, total phosphorus and total nitrogen. The results of all the analyses shows that COD_{Cr} and ammonia nitrogen are the main pollution items for key sewerage users, and they are the key items to be supervised in the next step of work. Both COD_{Cr} and ammonia nitrogen of emporiums and comprehensive office buildings exceed limit seriously. The ammonia nitrogen concentration of nightsoil station is so high that it will affect the operation of the drainage facility seriously.

1. Introduction

Environmental problems arising from urban areas have become critical issues facing human society.^[1] Globally, 50.5% of the world population was living in cities in 2010. While in China, 45.8% population dwells in urban areas and this number is expected to increase to 70% by 2050.^[1] In many cities wastewater discharge will increase evidently with the increasing population. Both developed and undeveloped countries are facing serious domestic wastewater pollution problems which affect water bodies, groundwater, and the environment.^[2] Besides, on-site greenhouse gases emissions are generated by liquid treatment processes, solids treatment processes.^[3] Wastewater treatment plants are recognized as a significant source of greenhouse gas emissions.^[4] Therefore, we must pay more attention to wastewater discharge in our country.

Treatment of municipal sewage containing relatively high concentrations of organic matter and nutrients has been an enormous problem in many cities.^[5] The pollution discharge of key sewerage users lead to the problems of municipal sewage treatment directly. Therefore, the supervision of key sewerage users is one of the most important work in city water affairs.

In this work, the basic situation of pollution discharge of key sewage users will be analyzed and the direction of pollution control will be proposed based on the analysis.

2. The objects and contents of monitoring

Sewerage users are the ones who discharge the sewage into the urban drainage facilities. Generally, sewerage users are engaged in industrial trades, construction industry, catering industry or medical industry. However, the key sewerage users refer to the enterprises or institutions with concentrated popularity, large discharge of sewage or specific types of sewage. The key sewerage users in central city zone of Beijing are the main research objects in this paper. There are seven species of key sewerage users, including hospitals, industrial enterprises, emporiums, universities, comprehensive



office buildings, hotels and restaurants.

There are 269 key sewerage users were monitored in 2012, 250 in 2013, 271 in 2014, 272 in 2015, 371 in 2016, respectively. The number of different kinds of key sewerage users is shown in table 1.

Table 1 The number of key sewerage users from 2012 to 2016

Year	Hospitals	Industrial enterprises	Emporiums	Universities	Comprehensive office buildings	Hotels	Restaurants	Total
2012	46	33	20	19	51	36	52	269
2013	48	22	15	19	50	35	48	250
2014	48	27	14	27	55	37	49	271
2015	48	27	23	28	46	43	42	272
2016	58	36	35	39	60	40	33	317

Every key sewerage user was monitored once a season, therefore they were monitored four times a year. There are six items monitored in the database. They are suspended substance, COD_{Cr}, BOD₅, ammonia nitrogen, total phosphorus, total nitrogen.

3. Monitoring evaluation standard

The water quality is evaluated according to *Wastewater quality standards for discharge to municipal sewers* (GB/T 31962-2015), and national standard methods are applied to all the detection and analysis. The average value of the four monitoring data is used as the final monitoring result. The sewerage user meets the standard only when all the monitoring items are under the limits of GB/T 31962-2015. The ratio of exceeding limit number of sewerage users and total quantity of sewerage users is called over-limit ratio.

4. Analysis of monitoring results

4.1. Analysis of the situations of all the monitoring objects over the limits

The cases of all the monitoring items that exceed the limits from 2012 to 2016 are shown in Figure 1. Emporiums, universities, comprehensive office buildings, hotels and restaurants exceed the limits seriously among all the kinds of sewerage users. The over-limit ratios of these five kinds of sewerage users are all over 50%, and the highest over-limit ratio appears on emporiums in 2014 with the number of 95.7%.

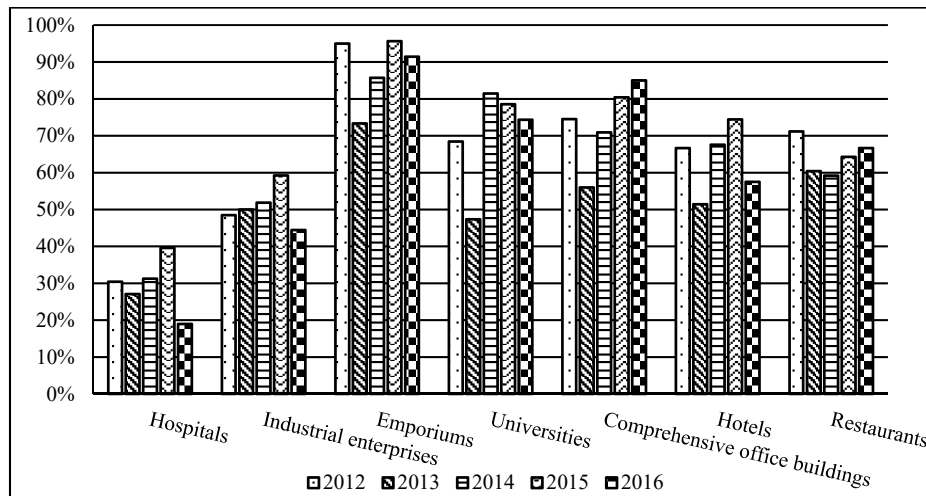


Figure 1 Overall exceeding limits situation of all kinds of key sewerage users from 2012 to 2016.

4.2. Analysis of the situation of single monitoring item exceeding the limits

Figure 2 shows that COD_{Cr} is the most important exceeding item, and total nitrogen takes the second place in 2012 and 2016; COD_{Cr} is the most important exceeding item, and BOD₅ takes the second place in 2013 and 2014; COD_{Cr} is the most important exceeding item, and ammonia nitrogen takes the second place in 2015. So we can draw a conclusion that COD_{Cr} is the most important exceeding item, however, BOD₅, total nitrogen and ammonia nitrogen are also nonnegligible items. However, over-limit ratios of suspended substance and total phosphorus are comparatively low that both of them are under 20% in these five years.

Because of the relativity of COD_{Cr} and BOD₅, ammonia nitrogen and total nitrogen, COD_{Cr} and ammonia nitrogen are analyzed emphatically in this paper.

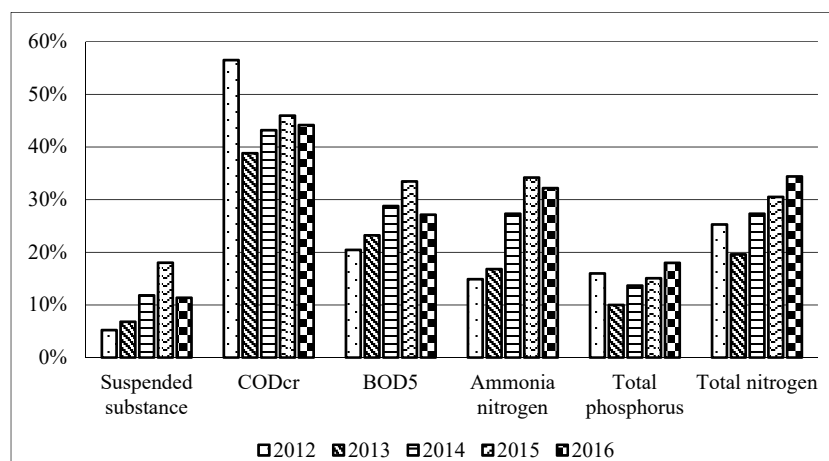


Figure 2 Overall exceeding limits situation of all kinds of key sewerage users from 2012 to 2016.

4.2.1. Analysis of the situation of COD_{Cr} exceeding limit

As shown in Figure 3, the over-limit ratios of emporiums and restaurants are 95.0% and 71.2% respectively and they are the highest two in 2012; the over-limit ratios of emporiums and restaurants are 73.3% and 56.3% respectively and they are the highest two in 2013; the over-limit ratios of emporiums and hotels are 78.6% and 62.2% respectively and they are the highest two in 2014; the over-limit ratios of emporiums and restaurants are 87.0% and 64.3% respectively and they are the

highest two in 2015; the over-limit ratios of emporiums and restaurants are 74.3% and 63.6% respectively and they are the highest two in 2016. The five-year average over-limit ratios of emporiums, restaurants, comprehensive office buildings and hotels are 81.6%, 61.7%, 57.8% and 57.0% respectively and they are the highest four.

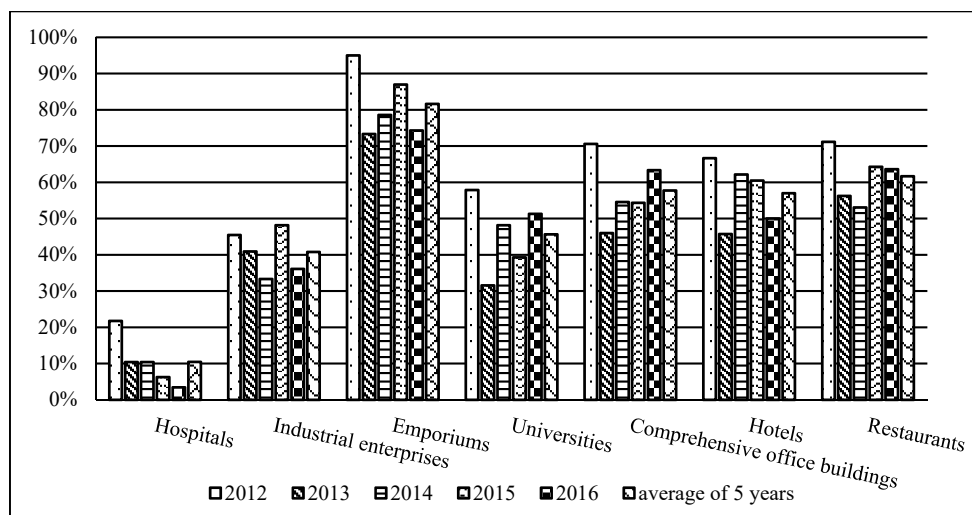


Figure 3 CODcr exceeding limit situation of all kinds of key sewerage users from 2012 to 2016.

According to the result of Figure 3, emporiums, restaurants, comprehensive office buildings and hotels are regarded as the key research objects in this paragraph. We can obtain the CODcr average concentration by analyzing all the data. The emporiums' CODcr average concentration are 791mg/L, 757mg/L, 1058mg/L, 1102mg/L and 860mg/L respectively from 2012 to 2016, and it is higher than any other sewerage users in the same year. The average concentrations that are higher than standard are shown in Figure 4.

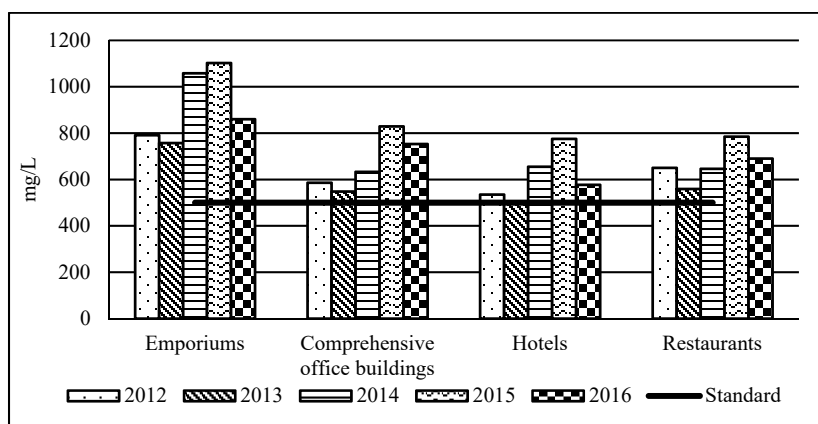


Figure 4 CODcr average concentration of all kinds of key sewerage users.

According to the result of Figure 4 we can draw the conclusion that CODcr is the main pollution item for emporiums, restaurants, comprehensive office buildings and hotels. Therefore CODcr should be the key item to be supervised.

4.2.2. Analysis of situation of ammonia nitrogen exceeding limit

As shown in Figure 5, for ammonia nitrogen item, the over-limit ratios of universities and

comprehensive office buildings are 52.6% and 23.5% respectively and they are the highest two in 2012; the over-limit ratios of industrial enterprises and universities are 40.9% and 31.6% respectively and they are the highest two in 2013; the over-limit ratios of universities and industrial enterprises are 70.4% and 37.0% respectively and they are the highest two in 2014; the over-limit ratios of industrial enterprises and emporiums and comprehensive office buildings are 75.0% 52.2% and 52.2% respectively and they are the highest three in 2015; the over-limit ratios of emporiums and universities are 57.1% and 56.4% respectively and they are the highest two in 2016; The five-year average over-limit ratios of universities, comprehensive office buildings, emporiums and industrial enterprises are 57.2%, 36.1%, 34.2% and 31.8% respectively and they are the highest four.

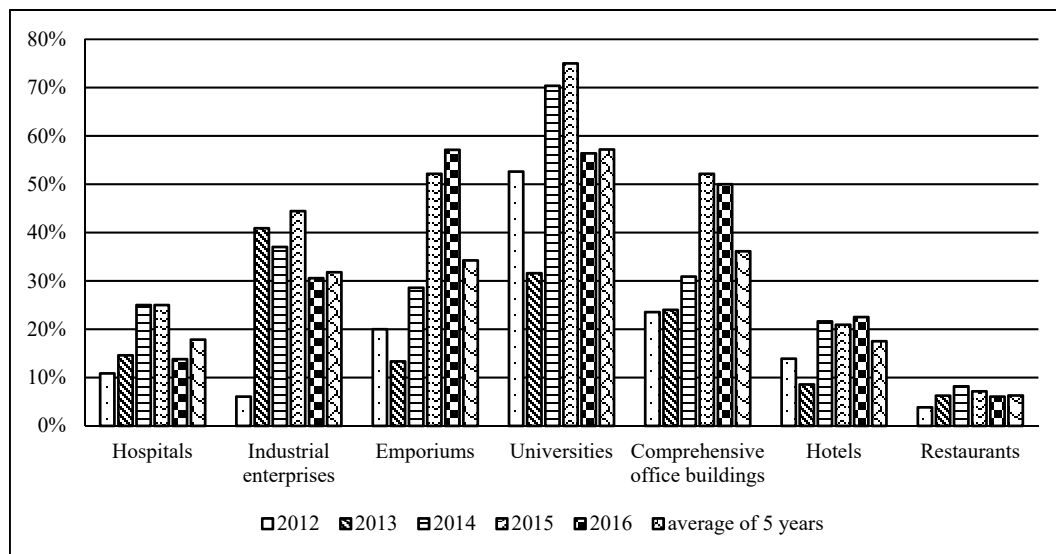


Figure 5 ammonia nitrogen exceeding limit situation of all kinds of key sewerage users from 2012 to 2016.

According to the results of Figure 5, universities, comprehensive office buildings, emporiums and industrial enterprises are regarded as the key research objects in this paragraph. We can obtain the ammonia nitrogen average concentration by analyzing all the data. The industrial enterprises' ammonia nitrogen average concentration are 63.8mg/L, 75.9mg/L, 91.7mg/L, 70.9mg/L and 81.4mg/L respectively from 2012 to 2016, and they are higher than any other sewerage users in the same year. The average concentrations of industrial enterprises that are higher than the standard are shown in Figure 6.

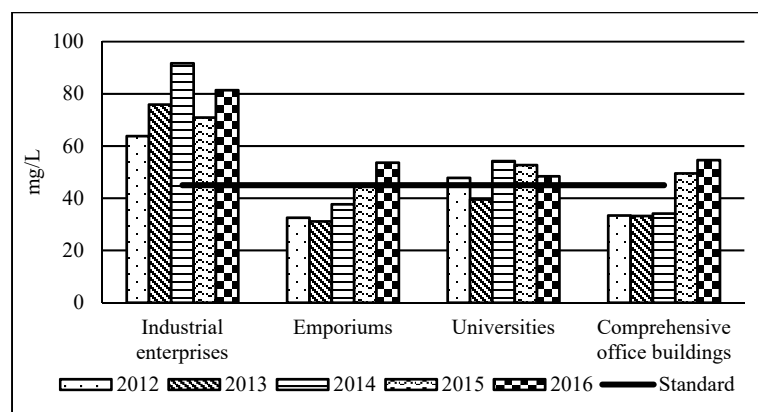


Figure 6 ammonia nitrogen average concentration of all kinds of key sewerage users.

Based on Figure 5 and Figure 6, we can see that among these four kinds of sewerage users the over-limit ratios of industrial enterprises is not the highest while its average concentration is the highest. The main reason is that nightsoil station make a great contribution to it. The ammonia nitrogen average concentration of nightsoil station is an order of magnitude higher than other industrial enterprises. If nightsoil station's effect can be deducted, the ammonia nitrogen average concentration of industrial enterprises will be under standard (Figure 7).

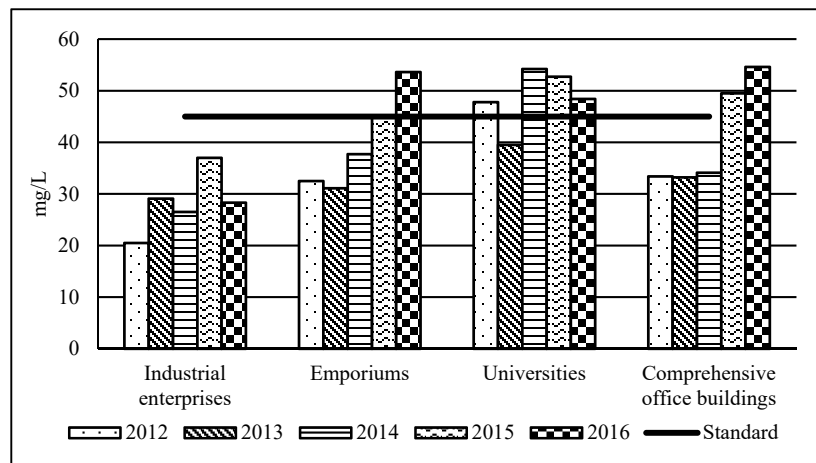


Figure 7 ammonia nitrogen average concentrations of all kinds of key sewerage users with the deduction of nightsoil station.

According to the analysis of Figure 7 we can draw the conclusion that ammonia nitrogen is the main pollution item for universities, comprehensive office buildings, emporiums and industrial enterprises. Therefore ammonia nitrogen is the key item to be supervised especially for nightsoil station.

5. Conclusion

The wastewater discharge of key sewerage users in central city zone of Beijing were monitored from 2012 to 2016. Based on the five-year data and the situation of exceeding limits, COD_{Cr} and ammonia nitrogen are the main pollution items for key sewerage users, and they are the key items to be supervised in the next step of work. Both COD_{Cr} and ammonia nitrogen of emporiums and comprehensive office buildings exceed limits seriously. The reasons are probably large population density and bad management of septic or oilseparating tank. The ammonia nitrogen concentration of nightsoil station is so high that it will affect the operation of the drainage facility seriously. Therefore emporiums, comprehensive office buildings and nightsoil station need to be supervised more in the future.

Acknowledgements

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