Trends in national emissions of dioxins on a Crematory in the Republic of Korea

Byung-Hoon Lee*, Tea-Seon Choi, Young-Rok, Jeon, Yong-Ho Cha
Dept. of Living Environment Safety, Korea Environmental Corporation, Hwankung-ro 42, Seogu, Incheon, Republic of Korea, 22689, lbh4732@keco.or.kr

Introduction

Persistent organic pollutants are not easy to decompose chemically, biologically and chemically in the environment, so they can be concentrated in the body of animal, plants through the food chain, long-distance mobility that can travel far from the source, And Bioaccumulation that causes harmful damage. Accordingly, the Stockholm Protocol which mandates emission reduction, prohibition or restriction of POPs substances was adopted. Korea has made great efforts to identify POPs emissions after the signing of the Stockholm Convention in October 2001, and to enact relevant laws. In particular, in October 2005, the Ministry of Environment issued the first list of dioxin emission sources in 2001

In Korea, Emissions of non-incineration facilities account for 74.1% of total emissions. Among them, the ratio of dioxin emission from the crematorium was 2.5%. However, as of 2015, the number of crematories nationwide has increased to 57 compared to the previous year, the number of cremated body was 217,782 in 2014, 225,964 in 2015 and The cremation ratio was steadily increasing from 76.9% in 2013 to 79.2% in 2014 and 80.5% in 2015 Therefore, in order to achieve the goal of eliminating dioxins and reducing them in the future, it is necessary to calculate the emission amount for the rate of cremation which is increased along with the existing emission sources, and accordingly, a management plan is required.

Materials and methods

Sampling is the industry (steel, non-ferrous metals, non-metallic minerals, energy, chemicals, crematorium, etc.) samples of about 600 evenly on POPs emission facility (non-incineration plants) of approximately 1,200 in the country from 2011 to 2015. The crematoriums ware included as etc. and ware measured at 22 out of 57 places in the country.

Dioxin measurement and analysis was performed according to the standard test POPs process, the standard of oxygen concentration is not corrected emission concentration was calculated in terms of the concentration factor (TEF-I) in terms of the international toxicity equivalent. Sample tablets hydrochloric acid treatment, was a ulti-layer silica gel column, an alumina column, the final concentrate is then injected jicheom available internal standard syringe, HRGC / HRMS (Aotospec Premier, Waters, USA), (JMS-8000, JEOL, JAPAN) It was analyzed using the mass selective ion detection method in the above resolution of 10,000 using. The calculation method is the bottom-up approach and the top-down approach (Table 1.)

In the case of actual measured cremation sites, each emission factor is calculated by using the bottom-up approach method. In this process, the cumulative average of the last five years is used for the emission factor. For the non-measured cremation sites, the average emission factor is calculated using the measured data using the top-down approach.

Table 1. 『Bottom-Up Approach』 and 『Top-Down Approach』 Emissions calculation procedure

Item	Bottom-Up Approach	Top-Down Approach
Characteristic	Measurement of all facilities	If some facilities measure or not to measure data
Statistics	Production of individual facilities	Production of each category
Measurement data	Emission factor of individual facilities	Emission factor of each category
Calculation	Calculate emissions for each Facilities	Emission factor × Production of each category
Calculate emissions	· emissions for each Facilities · Total emissions	Total emissions

Results and discussion

In the case of Korea cremation rate, Table 3 shows an increase of about 10% and the number of cremated body increased by more than 40,000 compared to 2011. As a result, the dioxin emission was increased to 1.86 g I-TEQ / yr, 1.92 g I-TEQ / yr and 2.49 g I-TEQ / yr according to the number of cremation in 2011, 2012, 2013 in Table 2. However, in Fig3, the amount of emissions in 2014 decreased by about 1.26 g I-TEQ / yr compared with 2013. The reason is not only a decrease in the number of cremation but also a decrease in the emission factor in 2014 shown in Fig3.

Dioxin emissions are calculated using the cumulative analysis data of the last five years, and thus the average emission factor is calculated. As a result, Outlier data in 2009 are included in the calculation of the emission.

Since then, in 2014 and 2015, the amount of I-TEQ / yr emissions has increased by about 0.73 g due to the increase in the number of cremation. Dioxin emissions are calculated using the cumulative analysis data of the last five years, and thus the average emission factor is calculated. As a result, Outlier emission data in 2009 are not included, resulting in a decrease in emission factor and emission. In 2014 and 2015, the amount of I-Teq / yr emissions increased by about 0.73 g due to the increase in the number of cremation.

Table 2. Annual changes in national emissions (Unit : g I-TEQ/yr)

Division	Steel	Non-ferrous sector	Non-metallic	Chemical	Energy	Crematorium	Total
2011	44.5	12.2	6.7	0.7	12.2	1.86	78.1
2012	41.5	9.9	5.5	1.6	12.2	1.92	72.5
2013	40.6	7.5	5.4	1.9	13.4	2.49	71.2
2014	41.9	6.5	6.9	1.2	12.3	1.23	70.0
2015	43.1	8.5	4.9	1.1	9.9	1.80	69.3

Fig 1. Annual chanes in non-incineration facility emissions

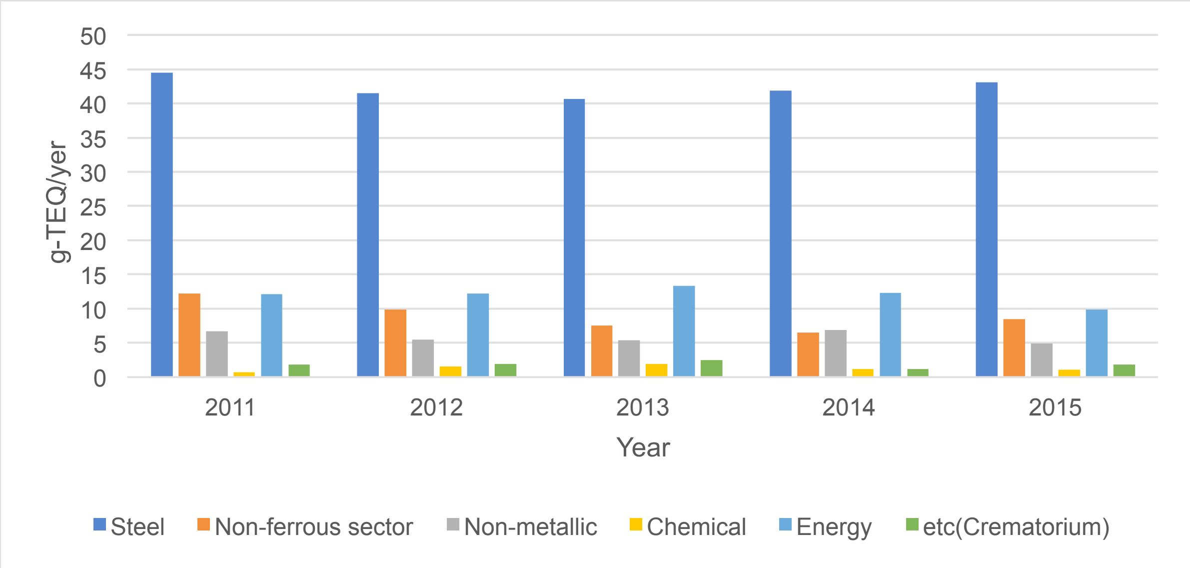

Fig 2 Annual emission factor for non-incineration facilities

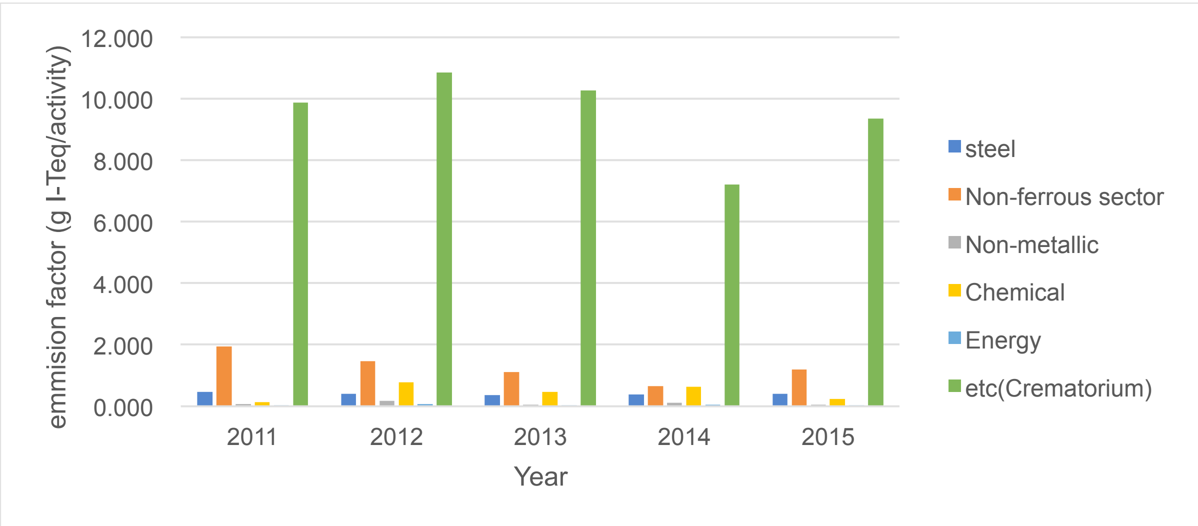

Fig 3 Annual emissions and activity of the creator

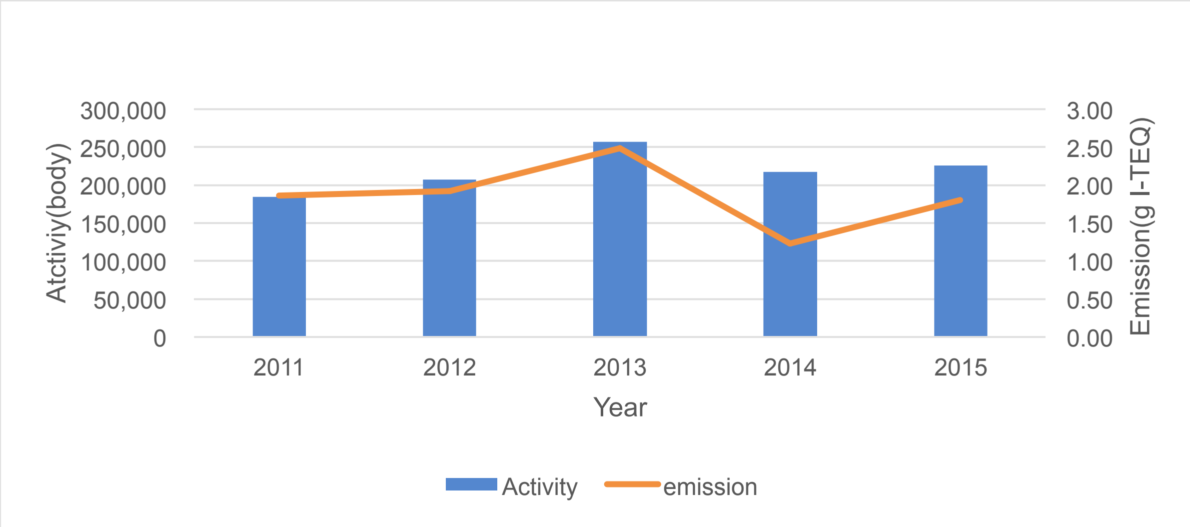

Table 3. Annual number of cremation and rate

	Number of cremated body	cremation rate
2011	184,823	71.1%
2012	206,938	74%
2013	257,092	76.9%
2014	217,782	79.2%
2015	225,964	80.8%

Compared to the total dioxin emission of non-incineration facilities, the emission amount of crematory is about 2.5%. It is low compared to national total emissions. However, the number of cremation and cremation rate are increasing each year, and the emission factor is also higher than other industries. As a result, the amount of crematory emmision is also increasing in Table 3. Therefore, continuous management and supervision are needed, and it is necessary to review the criteria for permitting emission of dioxin from the crematorium.

Acknowledgements

Thanks for the Ministry of Environment and the National Academy of Sciences created a classification system and guidelines for source emission estimation techniques.

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