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Study on Environmental Impact Evaluation of Ecotoxicity

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Abstract

An environmental problem is in a serious situation. In order to suppress and advance environmental discharge, the measure which grasps the quantity of the substance of the environmental impact which affects various kinds of environment is advanced. The PRTR system was enacted in order to grasp the quantity of discharge and transfers in industry. The unification evaluation which grasps the environment impact of category, and the technique of evaluating influence using the quantity of discharge of an environmental impact are proposed. Moreover, this study has grasped it as various kinds of transfers and the tendency of the quantity of discharge by PRTR system, and clarified the quantity of discharge using the characterization factor to the carcinogen which is the environmental impact in PRTR.
Keyword: Environmental impact, Environmental load

1 Introduction

In recent years, the problem to environment is raised. Since the Industrial Revolution, the human race with the development of technology has achieved economic development by consuming large amounts of fossil resources such as oil, coal and natural gas. And it is expected to world energy consumption will continue increasing gradually as has been predicted, also environmental load in the atmosphere accordingly. The industry which responds to social problems such as environmental pollution, energy conservation and greenhouse gas emissions from conventional, by improving the latest technology is expected to contribute to society by improving product environmental performance. Regional and global environment problems are taken up, and a measure and a regulation have been carried out. The environment systems such as SGDs, EGS investments, and environmental labels are widespread in the world. Since there are multiple environment problems, methods for uniformly evaluating multiple environment problems have been proposed.

Global warming, ecotoxicity, and depletion of ozone layer, etc. can be cited as a representative environment problem on global scale. In response to these problems, carcinogenic substances which affects a human body and the hazardous chemical substance which affects a plant etc. are focused on and emission of target substances is required to be reduced.

Then, there is PRTR system (Pollutant Release and Transfer Register) as a system of issuing a notification about the quantity of discharge and the quantity of transfers of a chemical substance. After the system begins, several years pass, and a tendency of the quantity of discharge of a substance, transition, etc. which are the targets of PRTR are called for as a numerical value.

This study clarifies transition at a given year of the substance which is the target of a PRTR system. And, this study aims at clarifying the quantity of ecotoxicity and discharge of the carcinogen which is one of the environmental impact items.

2 Environmental Impact Evaluation of Ecotoxicity

The substance which is the target of PRTR totals about 462 descriptions and asks for transition. Therefore, about the target substance, it asks at a given year from the viewpoint of a transfer from discharge and a place of business in a place of business. The quantity of discharge by a PRTR system clarifies a tendency from each viewpoint.

And, PRTR system classifies of discharge about the air, a water area, and soil, classify into waste and sewerage about a transfer, and clarify a tendency. This study calculates the quantity of discharge about the Ecotoxicity (air, water, land) which is one of the environmental impact items in the substance which is the target of PRTR. Therefore, when an environmental impact evaluates, this study uses a conversion coefficient for plural substances used as an object called a characterization factor, and it compares it while converting into a single substance and computing.

Figure 1 shows an example of the use of global warming for the assessment of environmental impacts. The environmental impact of global warming is 3kg. However, the assessment of environmental load is not based on the impact of global warming, i.e., the warming effect. Therefore, the evaluation based on the impact of global warming can be done by using the coefficient of warming effect based on carbon dioxide for substances related to global warming.

The environmental impact in terms of ecotoxicity is shown in Figure 2. The assessment of ecotoxicity is divided into aquatic and terrestrial ecology. The data obtained from the PRTR system (air, water, and soil) are also used to evaluate the aquatic and terrestrial ecology. After the evaluation, the sum of aquatic and terrestrial ecology is calculated. In addition, the effects on humans (carcinogenicity) as well as ecotoxicity will be assessed. The standard substance for ecotoxicity and carcinogenicity is benzene.This study calculates the quantity of discharge about the carcinogen (air, water, soil) which is one of the environmental impact items in the substance which is the target of PRTR. Therefore, when an environmental impact evaluates, this study uses a conversion coefficient for plural substances used as an object called a characterization factor, and it compares it while converting into a single substance and computing. The substances subject to ecotoxicity are 60, and carcinogens are 95.

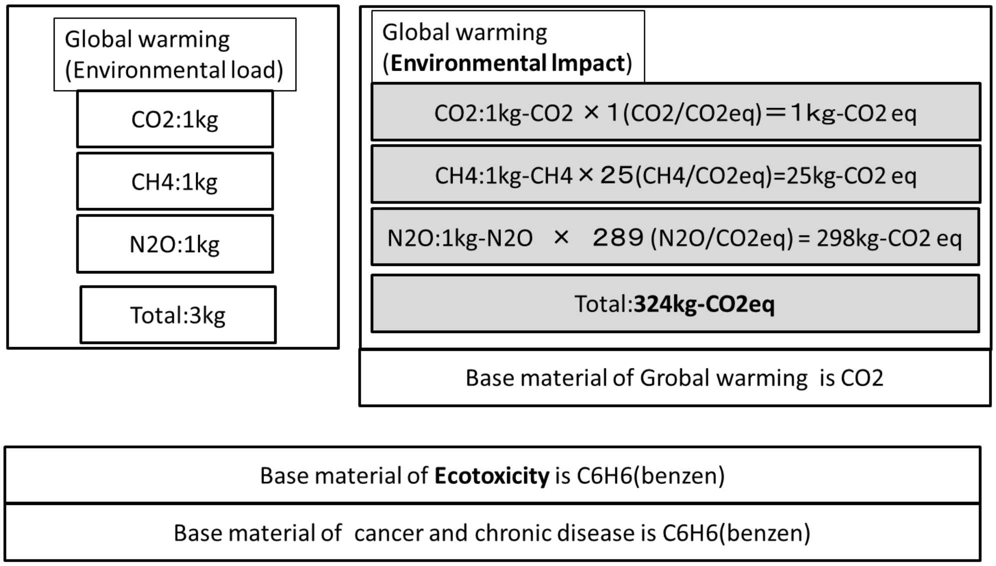

Figure 1 : Environmental Impact of global warming

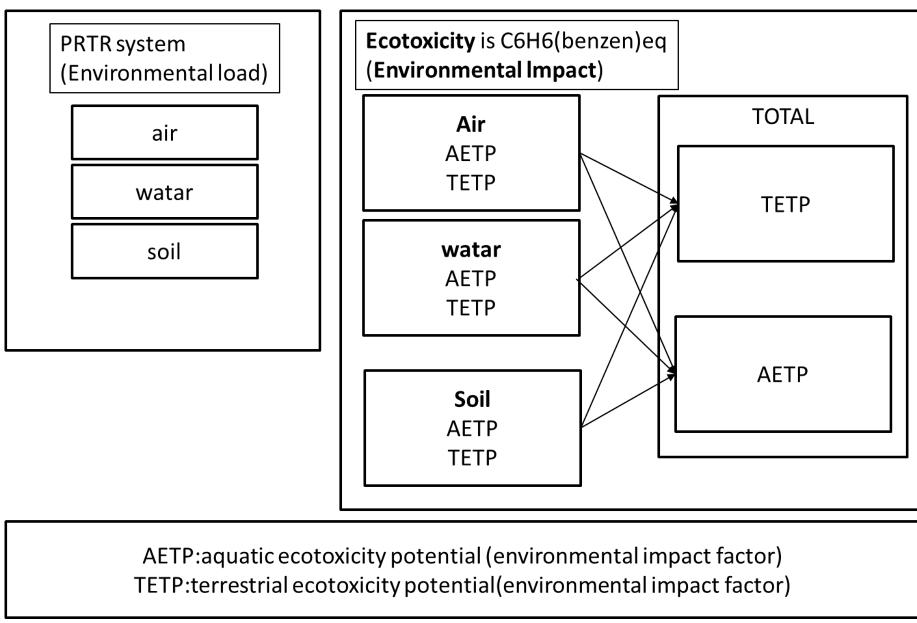

Figure 2 : Environmental impact of Ecotoxicity

3 Result of environmental evaluation

The total emissions in ecotoxicity of environmental load are shown in figure 3.
Figure 3 shows the sum of substances involved in ecotoxicity from 2015 to 2019.

Although there was an increase or decrease, it was found that in 2019 it was lower than in 2015, when the emission was the highest.

The list of substance emissions in ecotoxicity is shown in Table 1. The emissions of trichlorfon and permethrin were high.

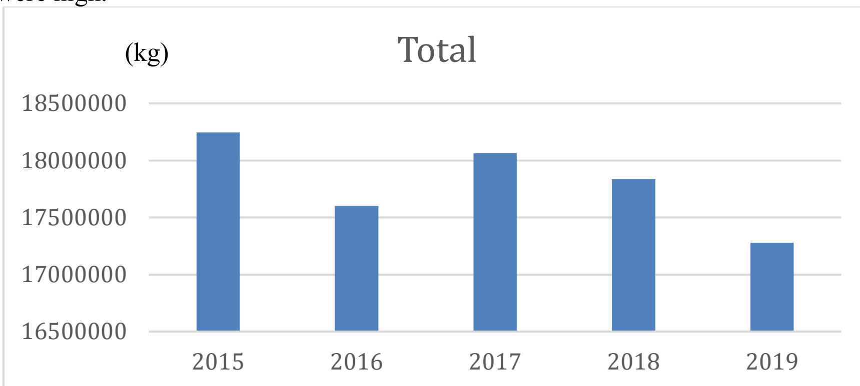

Figure 3 : Emissions of Total

material	emission(kg)	Amount of emissions (%)
trichlorfon	212,605,162	54.4%
permethrin	117,494,338	30.0%
Cadmium	31,215,306	8.0%
Chromium (+6)	19,453,840	5.0%
benomyl	8,928,246	2.3%

Table1 : Environmental load of Ecotoxicity

Figure 4 shows the emission of substances that affect the atmosphere. The emissions affecting the atmosphere shown in figure 4 were calculated based on benzene. Emissions in 2019 were significantly lower than in 2015, when they had the highest emissions.

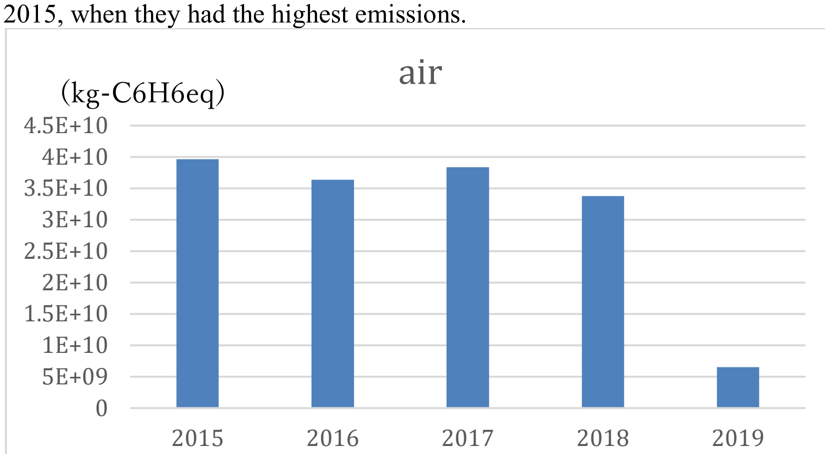

Figure 4: Emissions of air

Figure 5 shows the emissions of substances that affect water bodies. The emissions affecting water bodies shown in figure 3 were calculated based on benzene as well as their impact on the atmosphere. Emissions in 2019 were significantly lower than in 2015, when they had the highest emissions.

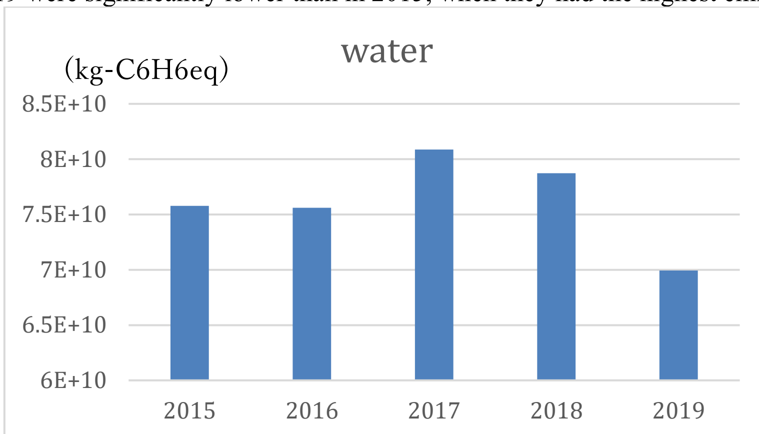

Figure 5 : emissions of water

Figure 6 shows the emissions of substances that affect the soil. The emissions affecting the soil shown in figure 4 were calculated based on benzene as well as the impact on the atmosphere. Emissions in 2019 were found to have been higher than in 2017, when they were the most emitted.

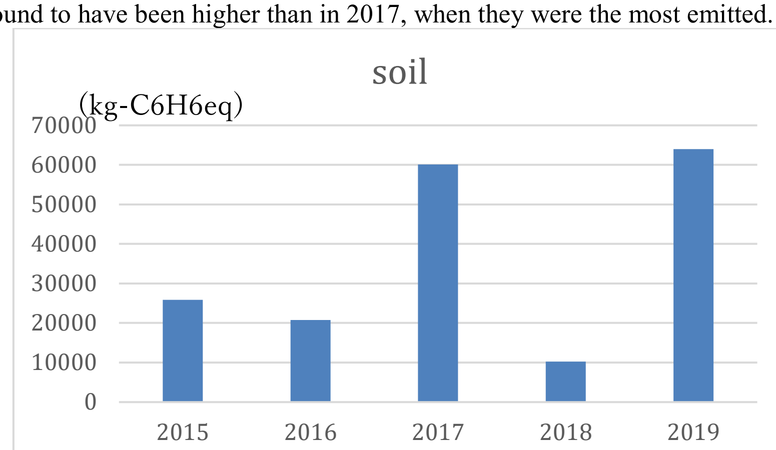

Figure 6 : emissions of soil

The results of aquatic ecotoxicity potential (AETP) and terrestrial ecotoxicity potential (TETP) are shown below. Figure 7 shows the emissions of substances that affect aquatic life. The emissions affecting aquatic life shown in figure 5 were calculated based on benzene as well as their impact on the atmosphere. Emissions in 2019 fell more than in 2017, when they were the most emitted.

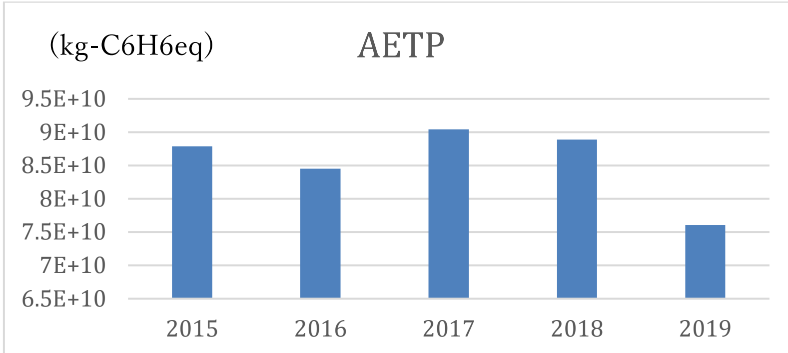

Figure 7: emissions of AETP

Figure 8 shows the emissions of substances that affect terrestrial organisms. The emissions affecting terrestrial organisms shown in figure 6 were calculated based on benzene as well as their impact on the atmosphere. Emissions in 2019 were found to have decreased significantly compared to the results assessed in 2015.

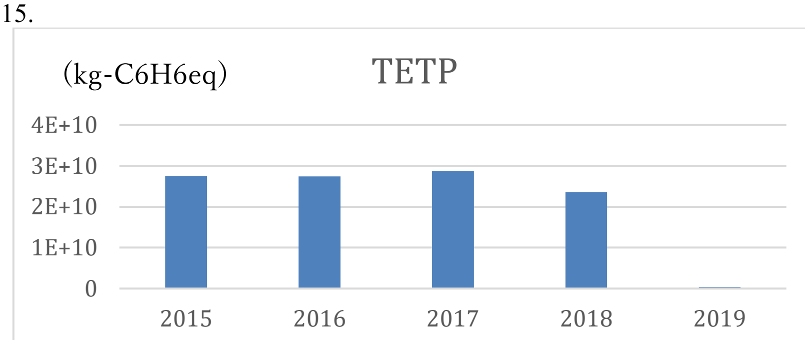

Figure 8 : emissions of TETP

Figure 9 shows emissions of ecosystem toxicity (summing aquatic and terrestrial organisms). The emissions of ecosystem toxicity shown in figure 7 were calculated based on benzene as well as their impact on the atmosphere. Emissions in 2015-2018 were increasing or decreasing, but in 2019 it was found to have decreased more than in other years. The list of substance emissions in ecotoxicity is shown in Table 2. Emissions of trichlorfon and Total mercury were high.

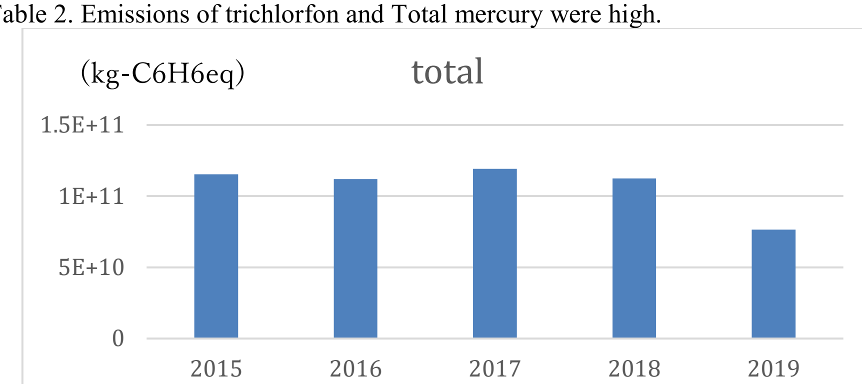

Figure 9 : Total emissions(C6H6eq)

material	emission(kg)	Amount of emissions (%)
trichlorfon	50,557,576,585	66.1%
Total mercury	8,448,272,175	11.1%
chlorpyrifos	6,366,379,401	8.3%
permethrin	5,794,425,884	7.6%
dichlorvos	2,732,669,053	3.6%

Table2: Environmental Impact of Ecotoxicity

Figure 10 also shows a breakdown of emissions (atmosphere, water bodies, soil) in 2019. In terms of the effects on ecotoxicity, it was found that the emissions were high in the order of water bodies, atmosphere, and soil. Furthermore, figure 11 shows the breakdown of emissions to ecotoxicity (aquatic organisms and terrestrial organisms). In figure 11 was found that most of the emissions of ecotoxicity affect aquatic organisms.

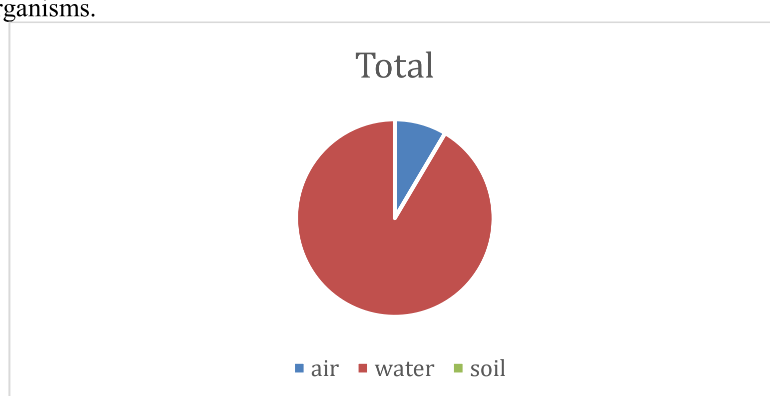

Figure 10 : Total emissions (air, water, soil)

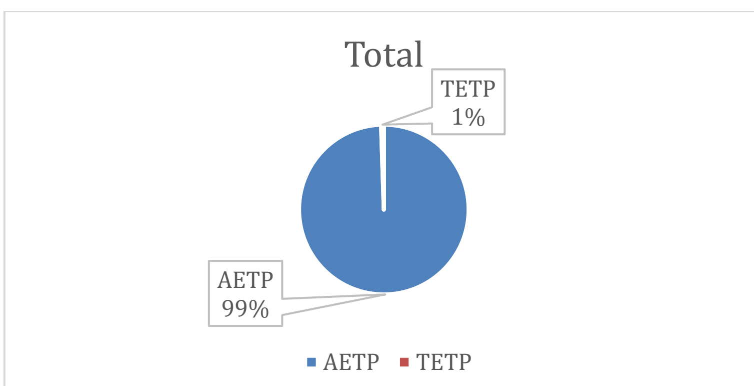

Figure 11 : Total emissions(AETE,TETP)

Results of emissions of carcinogens and chronic diseases to the lungs

Figure 12 shows the emissions of carcinogens and substances related to chronic diseases to the lungs from 2015 to 2019.

It was found that there was an increase or decrease in emissions in 2015. It also found the lowest emissions in 2019. The list of substance emissions in Cancer and chronic diseases is shown in Table 3. Emissions of dichloromethane and trichloroethylene were high.

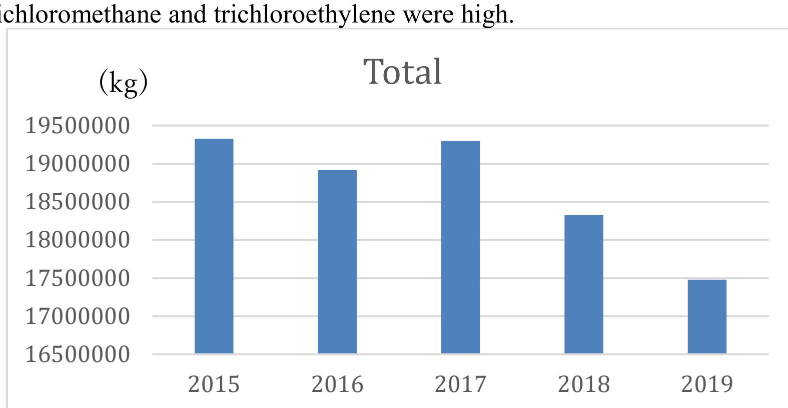

Figure 12: Total emissions

material	emission(kg)	Amount of emissions (%)
dichloromethane	9,238,569	53.1%
trichloroethylene	2,454,860	14.1%
styrene	1,829,736	10.5%
benzyl chloride	804,341	4.6%
tetrachloroethylene	598,396	3.4%

Table3: Environmental load of Cancer and chronic diseases

Figure 13 shows the emission of substances related to carcinogens (benzene equivalent). Although it decreased from 2015, it was found to have increased from 2017 and decreased in 2019 compared to 2018. However, emissions in 2019 increased from 2016, the lowest.

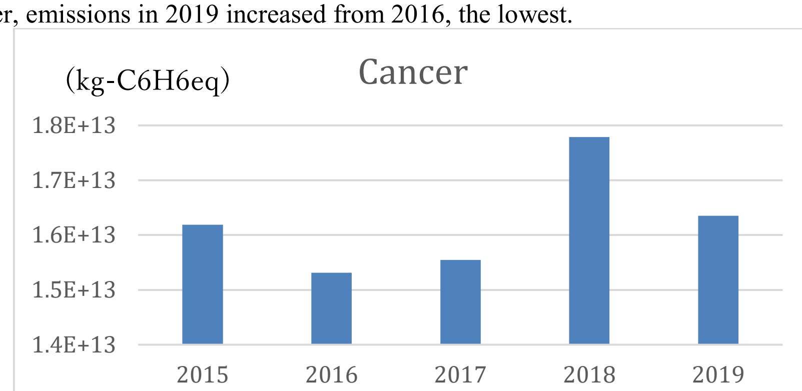

Figure 13: Total emissions of cancer

Figure 14 shows the emission of substances related to chronic diseases to the lungs (benzene equivalent). It was found to be declining from 2015 to 2019.

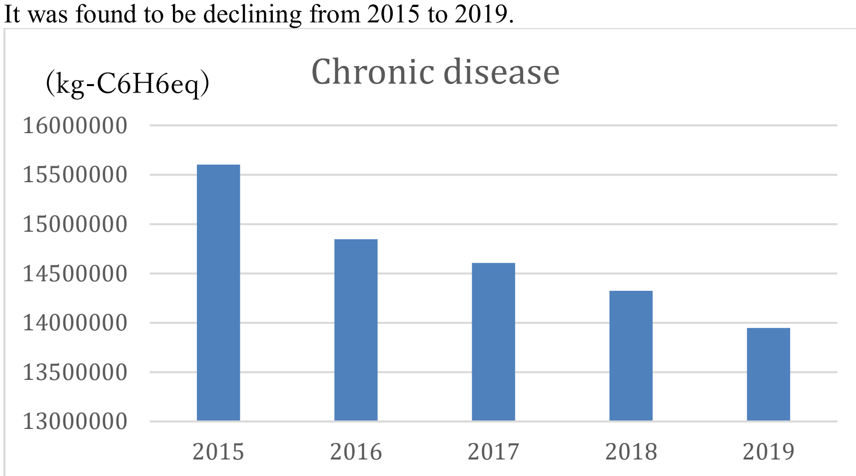

Figure 14: Chronic disease emissions

Figure 15 shows the emission of carcinogens and substances related to chronic diseases to the lungs. In 2019, the result was an increase compared to the lowest emissions in 2016. Furthermore, figure 13 shows a breakdown of the emissions of carcinogens and chronic diseases to the lungs by emission. It was found that most of them were discharged into the atmosphere, and then there was a lot of discharge to water bodies and soil. The list of substance emissions in Cancer and chronic diseases is shown in Table 4. Emissions of dioxins were high.

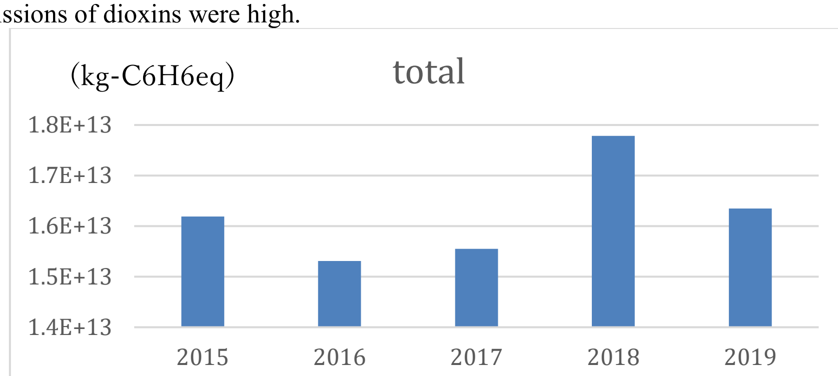

Figure 15 : Total(kg-C6H6eq)

material	emission(kg)	Amount of emissions (%)
dioxins	16,347,791,235,695	100.0%
chromium and chromium(III) compounds	938,988,270	0.0%
S,S-bis(1-methylpropyl) O-ethyl phosphorodithioate	656,560,118	0.0%
nickel	440,313,053	0.0%
chromium(VI) compounds	365,243,180	0.0%

Table4:Environmental Impact of Cancer and chronic diseases

Furthermore, figure 16 shows a breakdown of the emissions of carcinogens and chronic diseases to the lungs by emission. It was found that most of them were discharged into the atmosphere, and then there was a lot of discharge to water bodies and soil.

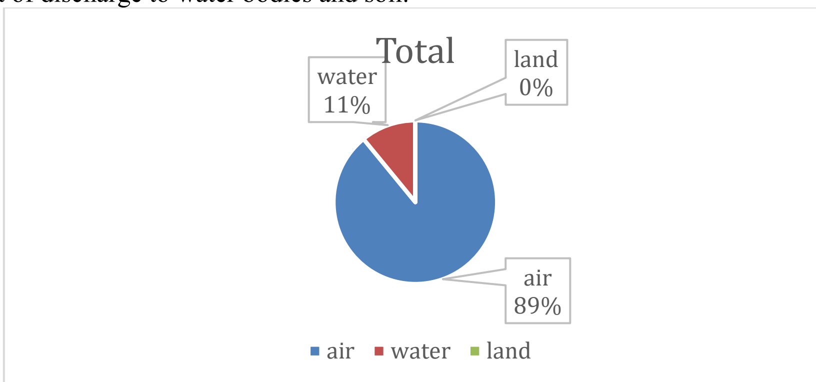

Figure 16: Total (air, water land)

Figure 17 shows the breakdown of carcinogens and substances related to chronic diseases to the lungs (2019). It was found that most of the carcinogens emit a lot.

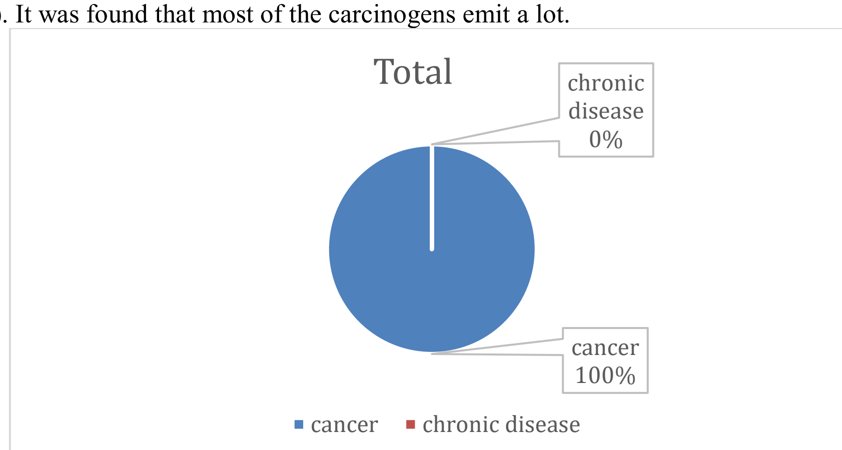

Figure 17: Total emissions (cancer, chronic disease)

4 Conclusion

In this study, while clarifying the discharge and the quantity of transfers of PRTR in each year, it was able to clarify the quantity of discharge about the carcinogen (air) which is one of the evaluation criteria of an environmental impact.

In this study, about target discharge and quantity of transfers of the whole industry, although it was little, it turned out that it was decreasing. Therefore, even when it classified, it turned out that almost all cases are decreasing and it have achieved the institutional purpose. And, in the case where the amount of substance and characterization factor coefficient in connection with the carcinogen which is one of the environmental impact items are used, when characterization factor coefficient was used, it turned out that it is increased.

A subject need to compute and compare the result of having used the characterization factor about other environmental impact items in the quality of a subject of PRTR.

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