A Study on the Estimation of Calculation Guideline about Emissions of greenhouse gases(GHGs) in Nonferrous Metal Industries
- Industries of lead production -

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ABSTRACT

In order to confront with international trend of CO_2 reduction, we prepare for establishing accurate calculation guideline of GHGs emissions, through various researches focused on the types of industries, which consumes energy plentifully in domestic

In this study, we performed basic research based on setting standard and limitation of quantities and a kind of GHGs for industries of lead production. The results shows;

The lead producing industries that produce ingot shows common fact that emission from stationary combustion, mobile combustion and fugitive emission. Kyoto protocol regulates CO_2, CH_4, N_2O, PFCs, HFCs, and SF_6 as global warming gases.

The result of investigation, which divides lead production with detail, the main emission gas was CO_2, moreover, the emission sources were generated from use of fuel, firing of coke, lime production and desulfurization process. Generating CO_2 from desulfurization process is related with a reaction between $CaCO_3$ and CaO.

Eventually, development of calculation guideline of GHGs emissions in lead production affects similar process to construct its calculation guideline.

INTRODUCTION

Environmental, economic and social problems that effected by using fossil fuel became a big issue since Kyoto protocol came into force on 16 Feb 2005 that ratified by Russia for advanced countries and the member of

OECD countries include Korea. It is reasonable that South Korean economy goes down once 2nd commitment period (2013~2017) starts related on reducing CO_2 regulation.

South Korea prepares to set the accurate standard about limitation of GHGs emission for industries that use huge quantities of energy to correspond for any other countries. However there are not accurate standard or limitation for non-ferrous metal industries compare to what metal industries have.

In this study, we performed research that calculate generation rate of GHG at industries of lead production and produced in Korea on reference IPCC Good Practice Guidance and Uncertainty Management (2000), IPCC Guidelines (1996), WRI/WBCSD Guideline (GHG Protocol). And it's limited only the company which produces the ingot from in lead production industry as the research object.

Calculation method of emission

Fixation about operational boundary of company

We have to set up the boundary which belongs to the subject of the company to calculate GHG emissions amounted by the business activity. We can define the boundary as three articles. Firstly, the local boundary about establish the emission of the company as inside or outside. Secondly, the organization boundary between cooperative company and the one. Lastly, management boundary about direct emissions (Scope 1) placed in the company and indirect emissions (Scope 2, 3) placed outside of it.

In this study, we investigate it focused on the third definition, as an operational boundary related to the production activity of the company.

Tier 1 and Tier 2 method of IPCC

Tier 1 is method that calculates by emission coefficient used fuel form, in other hand; Tier 2 is method that calculates using the emission coefficient by fuel and combustion form. In general in case of process emission source, if process data exist, Tier 2 method is recommended because type of equipment is very different as individual process, however, Tier 1 method is recommended when we get uncertainty from Tier 2 method hugely.

Result of emission calculation

GHG generated in lead production process

Emission in compliance with emission source of process means the GHGs which occur with the by-product through a chemical reaction at process. CO_2 emission source in process is the case that use the shaft furnace, roasting process when galena is done lead oxide, QSL(Queneau Schuhmann Lugri)process, assistance fuel, fuel for initial ignition and coke or coal powder for reduction. And also, desulfurization process emits CO_2 in lead production process. Fig. 1 shows algorithm to calculate GHG generated from lead production process and No1 to 5 shows emission source of GHG.

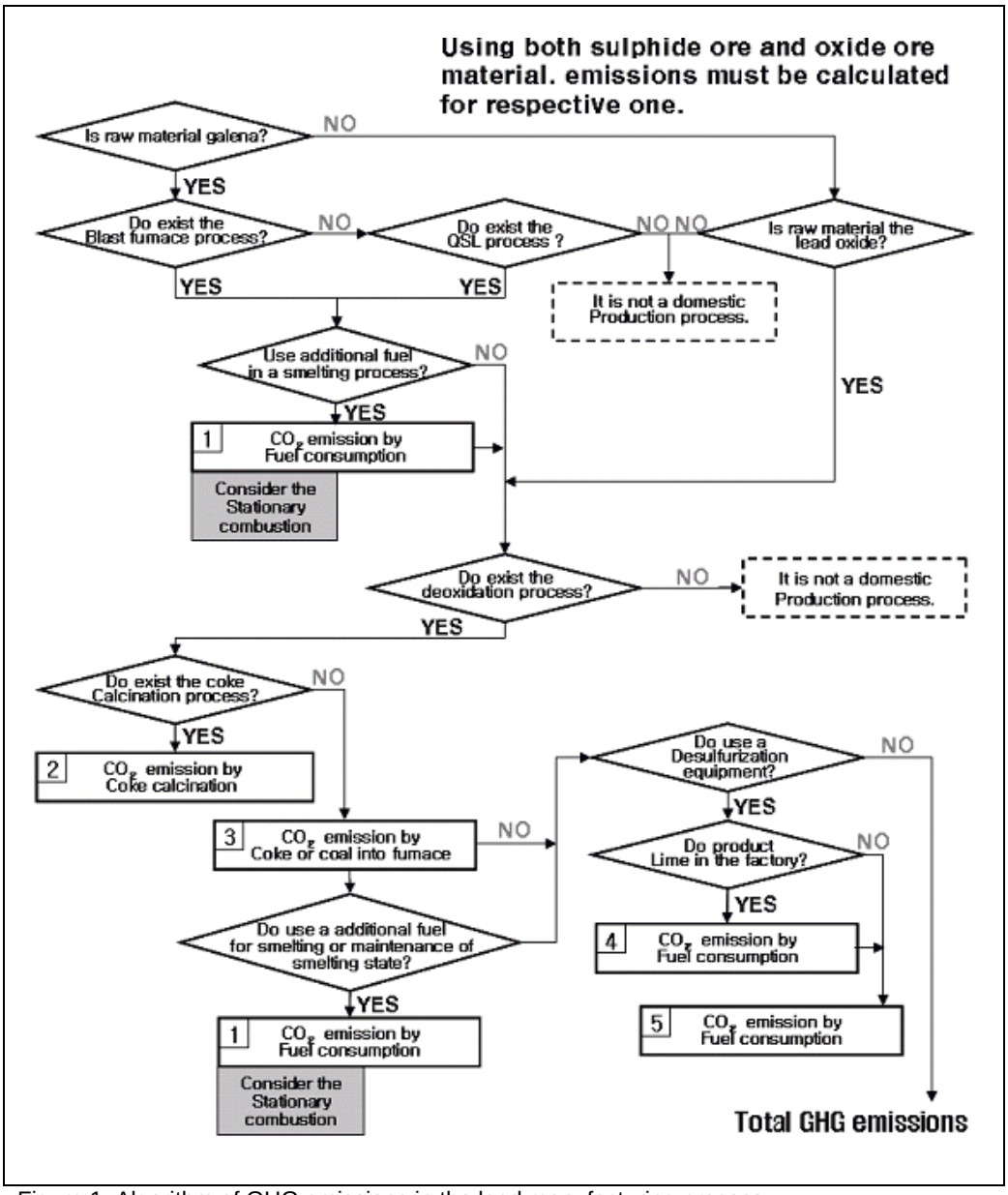

Figure 1: Algorithm of GHG emissions in the lead manufacturing process

Equation of GHG generated from lead production process.

Equation of GHG generated from lead production process id described below.

(1) Calculation of CO_2 emission by combustion when used assistance fuel. (No. 1 of Fig. 1)

Equation of GHG by using the assistance fuel of initial stage for ignition in the roasting process and QSL process that product lead oxide is below.

Emission (t CO_2e/yr) = consumption amount of fuel (t/yr) × low heating value (TJ/kg) × combustion ratio × CO_2 emission factor(kg/TJ) (Eq. 1)

Low heating value is accepted company that purchases fuel, emission coefficient is used intrinsic value of company after verification or emission coefficient of Department for Environment, Food and Rural Affairs, DEFRA.

(2) Calculation of CO_2 emission by calcinations of cokes in workplace. (No. 2 of Fig. 1)

This equation is additional consideration which calculated only when calcine cokes in workplace. Equation (2) shows CO_2 emission by calcinations of cokes in workplace.

Emission (t CO_2e/yr)=[[supplies amount of green coke (t/yr) × (100 - humidity of green coke (wt%) - volatile matter of green coke (wt%) - sulfur contain ratio of green coke (wt%))/100 + (production of calcined coke (wt%) + amount of coke in the calcination (ton) + emission of coke dust (t/yr)) × (100 - sulfur contain ratio of calcination coke (wt%))/100] × 44/12] + supplies amount of green coke (t/yr) × 0.035 × 44/12 (Eq. 2)

(3) Calculation of CO_2 emission by injection of coke when smelt in shaft furnace. (No.3 of Fig. 1)

Calculation equation of CO_2 emission by injection of coke when smelt in shaft furnace is below.
Standard coefficient about Oxidation ratio that combustible carbon is done carbon dioxide by reaction with oxygen doesn't exist. Therefore, emission coefficient is used intrinsic value of company after verification.

Emission (t CO_2e/yr) = amount of coke injection (t/yr) × oxidation ratio of combustible carbon in the coke (%)/100 × 44/12 (Eq. 3)

Calculation of CO_2 emission by injection of coal powder when use direct smelting method (QSL process)(No. 3 of Fig. 1)
For this case, calculation equation is below.

Standard coefficient about Oxidation ratio that combustible carbon is done carbon dioxide by reaction with oxygen doesn't exist. Therefore, emission coefficient is used intrinsic value of company after verification.

Emission (t CO_2e/yr) = amount of coal injection (t/yr) × oxidation ratio of combustible carbon in the coal (%)/100 × 44/12 (Eq. 4)

(4) Calculation of CO_2 emission generated when product lime in workplace. (No. 4 of Fig. 1)

It is applicable to the case that lime is used sorbent is producted in workplace. As additional consideration, calculation equation is below and coefficient of lime purity is used recommended value in WRI/WBCSD.

Emission (t CO_2e/yr) = amount of quicklime (t/yr) × 44/56 × purity of quicklime (%)/100 + amount of slaked lime × 44/74 × purity of slaked lime (%)/100 (Eq. 4)

(5) Calculation of CO_2 emission generated from desulfurization process. (No. 5 of Fig. 1)

Calculation equation of CO_2 emission by injection of Na_2CO_3 or $CaCO_3$ is below for removal sulfur including raw ore and sulfur oxide generated from production process.

Emission (t CO_2e/yr) = consumption amount of Na_2CO_3 or $CaCO_3$ (t/yr) × molecular ratio of Na_2CO_3 or $CaCO_3$ against CO_2 × purity of Na_2CO_3 or $CaCO_3$ (Eq. 5)

Conclusion

This study was preformed to establish calculation guideline and kind of GHGs emission generated in lead production process in the nonferrous metal industries using the international guideline such as, IPCC, WRI/WBCSD and so on.

Direct emission source in GHG was stationary combustion, mobile combustion and fugitive emission.

As result, main emission gas was CO_2, emission source was emission by using of fuel, incineration of coke, lime production at workplace and operation of desulfurization facilities.

In this study, Calculation of emission was performed around process and the calculation equation will be applied company that product lead and then we correct the equation by feed back system. So we estimate the GHG calculation methodology generated from production process of industries of lead production in domestic.

Finally, calculate equation where it is developed from this research would be made in the continuous discussion with Specialist in company of the corresponding company. But, additional research with comparison and analysis of substantial emissions at the corresponding company is required. And then we still be able to apply industrial site.

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