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Influence on the global warming of the exhaust heat the consumption of mining energy resources accompanies

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According to a published scientific book[1)], we should apprehend that increases in the consumption of mining energy resources which accompanies the emission of exhaust heat may bring about climate change. Nevertheless, it seems that the influence on the global warming of the emission of exhaust heat have not been well discussed in IPCC Fourth Assessment Report. The reason for this is probably due to the estimation that urban heat islands which are partly attributed to exhaust heat would not almost influence on the global warming if judged from observation of semisphere or sphere scale. However, the mankind's activities such as industrial production, transportation, communication and house living which are performed in the modern world consume vast amounts of thermal energy produced by combustion of the fossil fuel in the driving of various heat engines. Exhaust heat generated in the processes in which those engines of the whole world consume vast amounts of thermal energy is thought to be emitted not only into the atmosphere near urban areas, but also into the atmosphere, river and sea of larger areas of global environment.

In this study, the total amounts of exhaust heat generated through the consumption of energy of the whole world are estimated from the world energy statistic, and compared to the radiative forcing induced by an increase in CO_2 concentration of the atmosphere. In conclusion, it is surmised that the influence on the global warming of exhaust heat is not disregarded, though may be small compared to that of CO_2 radiative forcing. Also, it is shown that the combustion heat accompanied by generation of CO_2 gas of unit mass is different depending on kinds of the compound contained in fossil fuel. These things suggest that not only the amounts of CO_2 but also the amounts of exhaust heat should be examined as a criterion for restraint of global warming.

According to a world statistic[2)], the world energy consumption Q_{WF} increases monotonously year after year, in which the amounts in 2000 are Q_{WF}(2000) = 8075 [Mtoe yr^{-1}] = $1.072/10^{-13}$ [W]. We assume that exhaust heat Q_{WE} emitted into environment is approximately expressed by $Q_{WE} = Q_{WF}(1 - h)$, where h(0 ˜ 0.4) is an average thermal efficiency. Also we assume that the amount of exhaust heat that contributes to global warming is expressed by $F_{EH} = Q_{WE}/A_{glob}$, where A_{glob} is surface area of earth. Then, the F_{EH} in 2000 is estimated to be F_{EH}(2000) = 0.0126˜0.0210 [W m^{-2}]. On the other hand, CO_2 concentration in the atmosphere increases from 370ppm to 372ppm in 2000, and radiative forcing F_{CDO} by CO_2 is estimated to be F_{CDO}(2000) = 0.0288 [W m^{-2}]. Thus, it is inferred that F_{EH}(2000) is not disregarded though it may be smaller than F_{CDO}(2000).

From the above thinking, it is surmised in spite of a rough estimation that not only CO_2 gas but also exhaust heat which are generated in combustion of fossil fuel may contribute to increasing in temperature of the atmosphere. By the way, it is thought that the combustion energy accompanied by generation of CO_2 gas of unit mass are different depending on kinds of fossil fuel and that the exhaust heat released via combustion of hydrocarbon accompanied by the generation of H_2O is larger than that by combustion of carbon without generation of H_2O. Therefore, it is inferred that not only the amount of CO_2 but also the amount of exhaust heat should be examined as a criterion for suppression of global warming. This suggests that there is a necessity to take account of also the exhaust heat that is emitted from nuclear power stations.

1) SMIC, Inadvertent Climate Modification, MIT Press (1971) pp.51-74.
2) BP Statistical Review of World Energy 2009.

Keywords: energy consumption, mining energy resources, fossil fuel, heat engine, exhaust heat, global warming