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THE HEALTH BENEFITS ESTIMATED IN RELATION TO THE PROHIBITED USE OF PFOS AND PFOA

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Introduction

There are 10 kinds of PFCs which include perfluorooctanoic acid, perfluorooctane sulfonate, etc. Among them, in the case of PFOS, it was decided to add to the list of POPs through the 4th Stockholm Convention in May, 2009. PFOS has been widely used in industry and living environment for waterproof, oil resistance, fire foaming agent, coating additives, etc. PFOA has been used for frying pan, digestive medicine and lubricants. Due to the exposure of each substance, it has been reported to cause various disorders like as weight loss, hepatocyte necrosis, and the motor disabilities. In the case of PFOS and PFOA which should be eliminated from the markets, according to the intended use, it must be replaced with another material. In that process, it must be carried out a cost benefit analysis.

In this study, we conducted a risk assessment by considering the exposure concentration of PFOS and PFOA. Through the result of a risk assessment, by deriving the risk which is based on the population residing in Korea, and we calculated health benefit amount.

Materials and Methods

Human risk assessment of PFOS and PFOA is based on the reported literature in Korea, it was performed by using the exposure concentration in the environment and the concentration of blood sample.

For human effect assessment, it was carried out to investigate the toxic effect. In the case of carcinogenic, the possibility of liver cancer was observed by testing the animals, but it was reported that a quantitative evaluation was impossible. The effect of non carcinogenesis was reported that there were liver toxicity (digestive diseases), growth toxicity, and developmental toxicity.

Human risk assessment is conducted only for non-carcinogenic toxicity. For the results of the risk, we derived the distribution level exceeding 1.0 of hazard quotient and also we calculated the exposure possible population in Korea.

In addition, in order to perform a social economic evaluation of the chemical according to the exposure possible population, the benefit calculation techniques were derived from carcinogenic and non-carcinogenic effects. In this study, we calculated the amount of benefit for non-carcinogenic effects, and the applicant technique was used of cost-of-illness (COI). Through the number of patients with the disease which are caused by considering due to PFOS and PFOA, we estimated transportation costs by causing with direct medical expenses, hospitalization, outpatient care and indirect expenses of nursing fee. We considered the evaluation items for the lost productivity costs as indirect costs.

Based on the selection of a disease which is caused by PFOS and PFOA, the medical costs were calculated separately for hospital patients and out-patients. Nursing fee was indirect medical expenses, we used the cost which announced the price of Korea in 2010, transportation fee was also calculated by using the medical panel report in 2010. The number of disease-specific hospitalization was applied to the average age of hospitalized cases of Korea health panel survey. Lost productivity costs as indirect costs were estimated the annual productivity lost costs by using the report of ministry of employment and labor to estimate the economic loss of capacity. When we apply the loss cost, in the case of hospitalized patients, one day was on average, for out-patients, a half day was on average, it was calculated as the capacity decreases.

Results and discussion

By using the concentration of each environment and the serum concentration, through monte carlo simulation, we checked the distribution and conducted the risk assessment.

The result of risk assessment for the environmental media and blood samples concentration, in the case of liver toxicity, it was analyzed HQ 1.0 exceeding ratio was 0.04%, and in the case of growth toxic, it was analyzed 0.2%. For COI calculation, among classified group of disease, liver toxic disease was selected for gastrointestinal effects, in the case of growth toxic, they were selected by 2 disease groups by the effects of birth of terrain, the strain and chromosome, mental and behavioral difficulties. Thus, 0.2% ratio which is exceeding HQ 1.0 of growth toxic was applied by divided 0.1% each. The result of applying the ratio that corresponds to the population of 48.58 million people each disease group in Korea,

it was analyzed the number of risk population who could have burdened disease by liver toxic were 19,432. It was analyzed the number of risk population who could have burdened disease by the effects of birth of terrain, the strain and chromosome, mental and behavioral difficulties were 48,580 each.
Companies in a position to manufacture and import the actual chemicals, as alternative chemicals, for the part of the costs that should be considered is the reduction in order rates and share of all companies. Reference to small and medium sized companies, due to PFOS and PFOA in manufacturing and importing companies and their share of the company that assumed a level that could have an impact for the people at the same rate. Shared ratio and risk reduction ratio were assumed 5%, after calculating the cost burden for each disease group, the amounts of the diseases of the digestive system and birth of terrain, the strain and the effects of chromosome, mental and behavioral difficulties were 109,432,401 dollars, 548,136,626 dollars, and 1,554,549,722 dollars each.
This has been analyzed that benefit amount generated by prohibiting the use of PFOS and PFOA to be quite large, according to the global chemicals management agreements, these materials to be forced out of the market. However, in reality, it cannot be substituted depending on the application or it will cost a lot of money for the development of new materials and for the process improvement. Thus, in the future research, we need the cost benefit analysis, it can be compared with the benefits and costs which are derived from this study.

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References

1. Organisation for Economic Co-operation and Development (OECD). (2012) http://www.oecd.org/officialdocuments/displaydocumentpdf/?cote=env/jm/mono(2011)1&doclan-guage=en.
2. Ministry of Environment (2008) Report of Investigation and Research, p 7.
3. Kannan, K., Corsolini, S., Falandysz, J., Fillmann, G., Kumar, K.S., Loganathan, B.G., Mohd, M.A., Olivero, J., Van Wouwe, N., and Yang, J.H., (2004) Environmental Science & Technology 1;38(17), 4489-95.
4. Lee, G.W., Lee, Y.J., Lee, H.S., Hong, J.Y., and Yang, J.Y., (2015) Environmental Health and Toxicology 30 Suppl:s2015005.
5. Hong, J.Y., Lee, Y.J., Lee, G.W., Lee, H.S., and Yang, J.Y., (2015) Environmental Health and Toxicology 30 Suppl:s2015006.