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Study on integration techniques for Environmental Impact Assessment of different media based standard industrial classification: A case study of South Korea

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ABSTRACT

Integrated techniques allow calculating the impact of individual pollutants forced on the environment and human health. It is quite difficult to manage and legalize the individual pollutant. Despite various efforts made so far for the effective environmental management, there exists a big challenge for implementing the policy and legislation to meet required standard for safe environment and health. Therefore, recently the integrated management of both medium based (water and air) pollutants has been conceptualized. Hence, this study focuses to compare the current practices of levy enforcement system to the integrated pollutants management system based on the real force of pollutants to the environment and human health.

Total environmental performance score (EPS) with highest penalty is found to be 9,873,809,093 (46.59%) for facility categories with Code 51 (Coal Mining), the topmost rank with highest score among total facilities. Eleven industrial categories out of 88 have similar EPS with traditional practices while rest 77 have a dissimilar score. Thirty-three industrial categories rank higher in current levy enforcement than EPS penalty and 44 industrial categories have higher levy than EPS penalty. The existing compliance of legal charge based on simple sum of pollution (SSP) by volume rather than their degree of impact on environment is not scientific. Merely the volume cannot sufficiently reflect the real impact of pollutants. Thus, the enforcement should be amended as per the EPS penalty of pollutants. Hence, this study recommends for the revision of existing policy of legal levy system (LLS) based on IEPS penalty to regulate the equitable enforcement system for the pollutants as a whole.

1. Introduction

The Korean peninsula is located in East Asia surrounded by China, Japan, and Russia. South Korea covers the southern half of the Korean Peninsula with longitude 126.9667° E and latitude 37.5500° N. Most of the regions of the country are occupied by mountain having 50 million population. Industrial sector is the leading sector of economy after the rapid industrialization during 1970s and early 1980s. There is a significant degradation in environment with the increase in number of industries and rapid pace of urbanization. With the rapid pace of industrialization, the economy has been boosted on one hand and on the other hand, the continuous pressure on the environment is prevailing.

The issue of environmental protection has been prioritized since 1990s to render harmful effect and promote sustainable development. Extremely high population density in a small habitable area (35% habitable area and 65% forest area) and the rapid pace industrialization resulted serious environmental conditions. The increasing amount of industrial pollutants are forcing to the environment and human health. Balancing among industrial development, environment and human health is the issues of is the prime necessity. Although Government of Korea (GoK) has poetized the management of industrial pollutants binding it legally, it is required to revive the standard as per scientifically derived real impact of pollutants on the environment and human health.

Officially registered 51,375 industries of the country discharged 5.23 million tons/day wastewater in which 25 substances are hazardous in nature. Out of 950,000 tons/day air pollutants released from 46,705 industries, 35 substances are hazardous in nature. (KSIC, 2008). The Government is working to improve the

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environmental issues of wastewater discharge and air quality to the allowable standard to ensure the quality of health and environment.

The shifting of pollution from one environmental medium viz., air, water or soil to other for minimizing the impact is not the best alternative.

Therefore, the integration of emission into air, water and soil is the best way to prevent and control the pollutants forced to environment and human health. Integrating effects of pollutants is the appropriate strategy which promotes the single license (Raya and Vázquez, 2009; Daddi et al., 2012). This process is called integrated environmental authorization (Styles et al., 2009), which could be implemented. Environmental Impact Assessment (EIA) process is the best tool to integrate the environmental impacts so that it can be facilitated to categorize industries as per their actual force to environment. The integrated management of the industrial production process is quite challenging to regulate the industrial environment. The directive adopted by Integrated Pollution Prevention and Control (IPPC) in 1996 (European Commission, 1996) and the Directive was codified in 2008 (Schoenberger, 2009). The Industrial Emission Directive (IED), 2010/75/EU2 was formulated (European Parliament, 2010) for the management of EU-wide discharge facility as per the extent of effect to the environment. IED Guidelines which incorporates the provisions from other six guidelines can significantly contribute for further utilization of Best Available Technique (BAT). The five principles of the IED can be summarized as Integrated Approach (IA),BAT, Flexibility, Environmental Inspection (EI) and Public Participation (PP). The integrated environmental approach for regulation of industrial activities has been guided by IPPC directives. This includes emission to air, water (discharge to the sewer), land and other range of environmental effects collectively to protect the environment in a holistic approach.

The pollution management system as provisioned in the IPPC directive puts into practice with medium-based pollutants. This is a synergetic and coordinated approach to protect environment (Lopez- Gamero et al., 2009). The IPPC permit includes the nature, quantity and sources of emission, degree to force on environment and pollution avoidance and prevention techniques that should be complied by the facilities (Bello Bugallo et al., 2013). The relative environmental risks of each pollutant need to be analyzed with the scientific approach. It is quite difficult to measure the ecological and environmental risks of contaminants precisely. The emission charges of proxy indicator per unit of polluting substances, as defined in the regulations, have been enforced already as social costs and environment conservation levy. However, the regulation does not have any provision to measure the extent of impact in practice.

In this study, we used the legal emission coefficient due to the environmental impact intensity as defined in the *Act on Water Quality and Ecosystem Conservation* (Decree Annex 14) and *Clean Air Conservation Act* (Decree Annex 4). The per unit amount of pollutant is estimated as per the Appendix 12 of Clean Air Conservation Decree Annex 4, Annex 14 and Quality and Ecosystem Conservation (Appendix 13).

We study to introduce integrated environmental management system that allows optimal management techniques based on BAT. It devotes many efforts to set up an integrated medium and optimal level of emission based on the BAT guidelines. Most of the developed nations of the world including EU have already sought the way for its management by identifying the environmental impact of different pollutants and have promulgated their regulations accordingly. They have already enforced the permit system to use the BAT and medium-specific integrated approach into their operating system. They have considered the comprehensive economic and environmental assessment of medium-based pollution and facilities. However, in case of domestic comfort, it is necessary to implement by introducing the medium integrated licensing system conducted by EU and other developed countries, reviewing the pollutants classification system for pollution control.

The major objective of this study is to analyze an integrated impact on environment of medium in accordance with an operation of an industrial facility and production activities. Currently, there is no proper integrated industrial environment management system due to lack of assessment of integrated medium-based actual impact of emission. This study has focused on integrating the environmental impact of medium-based pollution using TRACI. This can be applicable to categorize the industries as per their actual adverse impact to environment and health. Therefore, it is helpful to enforce actual levy based on impact extent of pollutants to the industrial facilities. It is also useful to make the revision of current pollutant tax rate calculation, which is merely based on the amount of pollutant released.

The EPS results can be used to compare with the existing industrial categorization based on SSP and LLS enforcement system and finally recommend for its revision.

2. Industrial classification system in Korea

In Korea, the standard industrial classification (KSIC) was endorsed based on the international standard industrial classification (ISIC, 1958) in 1963. The classification has been revised repeatedly and last revision was done in 2007, incorporating the provisions for emerging industries and change in industrial structure.

2.1. Principle of classification

Major principles of KSIC comply the ISIC. The main criteria are associated with the economic activities determine the degree of similarity. Three major aspects included in the process of classifications are as mentioned below:

i. Production procedure of services and goods.
ii. Utilization of services and goods.
iii. Procedure and technology of production

2.2. Structure of classification

The KSIC has classified industries as sectors, divisions, groups, classes, and subclasses. The version 6 of KSIC (1991) has similar provisions as in ISIC in terms of structure and categories. High tech and service oriented industries are categorized by KSIC version 6. However, the industries are categorized by the recently revised KSIC version 8. Integrated environmental management system has been applied to sector classification based on KSIC Sub categories as depicted in Table 1.

3. methodology and methods

3.1. Modeling methodology/tool

TRACI is used to compute the integrated environmental impact of individual pollutants released from industrial facilities. Both medium-based pollutants emitted from facilities viz., Water-Chemical Oxygen Demand (COD), Total Phosphorous (TP), and Total Nitrogen (TN) discharged in wastewater and air pollutants - NOx, SOx and particles (PM10) are utilized to calculate the total impact. TRACI guides companies, industrial facilities and other