

## A Study on the Environmental Regulations and Innovation: The Case of the European REACH Regulation

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**Abstract**-- Concerning of relationship between environmental regulations and innovation, the Porter hypothesis is known as "properly designed environmental regulations induce innovation in enterprises, resulting in an increase in the improvement and benefit competitiveness" It had been carried out various studies for it for a long time, and one of research topic is "What kind of environmental regulations can cause innovation?"

In this study, I would like to discuss the relationship between environmental regulation and innovation in this topic using the case study of European Chemical regulations, called REACH regulation. It is said to Environmental Regulations of stakeholder participation, so I discuss the interaction of REACH regulations and corporate innovation. In general" Restrictions on hurdle is high, but there is no alternative and society requires the product" In this case, there is a high possibility to induce innovation. The "stakeholders can participate in policy processes regulating" in the present case, it was indicated it is difficult to induce a revolutionary innovation.

### I. INTRODUCTION

Relationship of environmental regulation and innovation, Michael Porter has been proposed "Environmental regulations that have been properly designed to induce the innovation of the company, results in an increase of the improvement and the benefit of competitiveness" It is known as [1]. It had been carried out various researches for a long time. In this study, based on the awareness of the issues of "What kind of environmental regulations to induce innovation?" I would like to discuss the relationship between environmental regulation and innovation.

### II. PURPOSE OF RESEARCH

In recent years, stakeholders who appeared newly taken up the case of environmental regulations to carry out the policy decisions, do the discussion in a new point of view about the relationship between environmental regulation and innovation, it aims to connect to theorize. More specifically address the European REACH Regulation [2], to consider whether alternatives would happen by environmental regulations, or whether the innovation will happen on the basis of the examples. Again in environmental regulations, a discussion focused on chemical regulations. More specifically address the European REACH Regulation [2], to consider whether alternatives would happen by environmental regulations, or whether the innovation will happen on the basis of the examples. Again in environmental regulations, a discussion focused on chemical regulations.

### III. PREVIOUS RESEARCH

The relationship between environmental regulation and innovation, Porter hypothesis has been known for a long time. For Porter hypothesis, with respect to establishment of conditions and hypotheses that ask the pros and cons, so far a number of empirical studies have been carried out. It was indicated Environmental policy leads to some sort of innovation as in [3]. Also one paper indicated positive impact as in [4] and another paper indicated the research and development activities of the patented number as in [3]. These are known as the support Porter hypothesis. Also it has been survey the major empirical studies on the relationship that are made environmental policy and innovation as in [5]. But Porter hypothesis, in addition to the claim, such as do not take into account the strategic interdependence between the company and the environment regulatory authorities, objections such as "environmental regulations have not been implemented, companies are working on innovation" as in [6]

It has also been made. So what would be the "appropriate environmental regulations," which is a prerequisite in the Porter hypothesis? In the Porter hypothesis argues that "people of strict environmental regulations to induce innovation." It was indicated "strict environmental regulations will bring the long-term to improve some of the productivity" as in [7]. This result is remarkable in sectors which are exposed to more international competition, suggesting the importance of the analysis with more emphasis the dynamic aspects. In recent years, environmental regulations that can be directly reflected in the policy decision the opinion of stakeholders have been hammered out. That is, those that stakeholders to propose a regulated substance. With regard to REACH regulations, various studies have been made as in [8] [9] [10]. But those discussed the relationship between the REACH Regulation and the innovation is not so large. For example, there is a study on the dynamics of the REACH regulation and corporate behavior as in [11]. In order to take many years to the regulation of chemical substances in the REACH regulations, it is very little regulated substance. That is not well done so far for the empirical research.

### IV. HYPOTHESIS

In this paper, I discuss the relationship between the chemical substance regulation and innovation. Before presenting a hypothesis, indicating the prerequisites below.

- Product (chemical) is the subject being required by the society

- Consider a case where strict regulations have been made to the existing products
- Replacement has a performance that can clear the strict regulations.

Based on previous research, I present the following hypothesis.

## • Hypothesis 1

If the regulation has been carried out, but there is no alternative → It is likely to occur innovation

## • Hypothesis 2

Although regulations have been made, if the replacement is present → Substitution proceeds. Innovation does not occur.

## • Hypothesis 3

Hypothesis 2 plays a role of standardization regarding availability of chemicals.

TABLE 1 OVERVIEW OF THE HYPOTHESIS

|              |                 | Regulation              |   |
|--------------|-----------------|-------------------------|---|
|              |                 | Take place              | Not carried out                                   |
| Alternatives | Take place      | Alternatives to proceed | No change<br>(Continued use of existing products) |
|              | Not carried out | Occur innovation        | No change<br>(Continued use of existing products) |

## V. CHEMICAL REGULATION OF THE WORLD AND FEATURES OF THE EUROPEAN REACH REGULATIONS

Even though environmental regulations, the contents are wide-ranging. Therefore, in this paper, to focus the chemical substance regulation among the environmental regulations.

### A. Chemical regulation of the world

Looking back at the history of regulation of chemical substances. The 1960s, pollution problem has been frequently in the world. This is due to knowledge was less on the safety of chemicals. By highly toxic chemicals have been released into the environment, it is the damage came to a number of residents. Then, research on the safety of chemicals proceed, with regard to the hazard (toxicity) has been found a lot of things. And the beginning of the 21st century, the concept of risk assessment has become a mainstream. This is the safety of chemicals hazards (toxicity), as well as emissions into the atmosphere (exposure) is also a notion that we have to think fit. For the safety of chemicals today, it has become customary that of using a technique called risk assessment.

### B. European chemical regulations

#### 1) REACH Regulation

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) is a rule is a comprehensive system of registration, evaluation, authorization and restriction of chemical substances as in [2], which came into force in 2007 .

The objects and features of REACH are shown below.

#### [Purpose]

Protection of human health and the environment, improve maintain the competitiveness of the European chemical industry

#### [Characteristic]

Of chemical safety (risk) assessment, the manufacturer is to implement

- Do the manufacture and sale of chemical substances in Europe, must be registered
- Obligation of information transmission on chemicals between the supply chain (outside Europe is also the subject)
- Regulated substances is proposed by the European Member States
- For the scientific uncertainty, which is incorporated the "precautionary principle"

REACH is a rule requiring a safety evaluation and registration to target the approximately 30,000 chemical substances. Not only the chemicals, also has become a regulated final product containing the chemical substance. If you sell a year 1t or more chemical substances in the EU, the manufacturer community to perform the safety test.

### C. The method of determining the regulated substances in REACH Regulation

As a policy feature of the REACH Regulation, it is mentioned a method of determining the regulated substances. Regulatory authorities (European Chemicals Agency) is not, is the stakeholders (European Member States) is to propose a regulated substance. In general, when performing the regulation of chemicals, consider the amount of exposure to the safety and the environment in, performed on the basis of the scientific point of view (risk assessment). However, in the REACH Regulation, in the first stage of the decision-making process, by the "stakeholders (European Member States)", is the regulation of suggestions for a particular chemical substance is carried out. Decision-making process of regulatory candidates is as follows. First, the European Member States to propose a regulated substance. If there is no particular opposition from other member states within the European Union, it is proposed to the European Chemicals Agency as a candidate substance regulated. After that, regulatory authorities (European Chemicals Agency) and stakeholders (manufacturers, consumers, NGO, etc.) policy process proceeds while through the public comments from, the regulations ultimately reduction is carried out if there is no particular problem. What determines the regulated substances by using such an approach is European only.

## VI. CASE STUDY

Here, I take up the case of the plasticizer DEHP

(Di-Ethyl-hexyl-phthalate) and a blowing agent ADCA (Azo-di-carbonamide) and flame retardant (Deca-BDE).

#### A. Plasticizer

Such as plastic bags and toys, soft vinyl chloride has become an indispensable part of our lives. The vinyl chloride is to soften, is a chemical substance called a plasticizer. Currently, plasticizers that are most used in the world is the DEHP (Di-ethylhexyl phthalate). DEHP is also superior product performance, price is also cheaper. Therefore, so far in the world year 3,000,000 tons or more have also been used.

For DEHP the European Commission in 2008, has announced that "no problem in safety." However, in the enforced REACH regulations in the same year, it has been proposed as a restricting candidates from the European Member State (Sweden). Before REACH rules are enforced, Europe's flagship manufacturer has discontinued the production of DEHP, had started the production of a substitute DINP (Di-isononyl phthalate). Therefore, the European market, was already DINP has become the mainstream [11] Then, regulation of DEHP has progressed in the REACH regulations. And, it is specified in the restricted substances in 2012 (subject to authorization substances).

Regulation of DEHP have been conducted only in Europe, it has not been regulated in other areas such as Japan and the United States. Today, in the Southeast Asian region, supported by robust demand of vinyl chloride, 2 million per year tons of DEHP have been produced. By the regulation of DEHP by the European REACH regulation, it is considered the future affect the supply chain of laws and regulations around the world and in each country.

#### B. Foaming agent

The foaming agent is a chemical substance for producing bubbles in the product. Blowing agents are used in plastics, rubber, food, etc. And it is necessary in our lives. Examples of the foaming agent of plastic are known ADCA, have been used for a long time in the world so far. The main application is interior material of an automobile. Manufacturer that has been manufacturing the only ADCA in Europe (BAYER Inc.) was discontinued in 2012. In 2013, the European Member States (Austria) was proposed as a regulated substance in the REACH regulations. Then progresses regulation of ADCA in REACH regulations, specified in the final regulated substances in 2013 (substances of very high concern).

Regulation of ADCA have been conducted only in Europe, it has not been regulated in other areas such as Japan and the United States. Today, the Southeast Asian region, supported by strong demand of plastic, especially in China region, a large amount of ADCA have been produced. By the regulation of the ADCA by the European REACH regulation, it is considered the future affect the supply chain of laws and regulations around the world and in each country. For there is no substitute for the ADCA, it is noted whether the future of new products as a blowing agent is developed.

#### C. Flame retardants

Today, plastic is used in a variety of fields such as consumer electronics and automobiles. For plastic is originally flammable, by blending a flame retardant, it is possible to use more safely. Particularly Deca-BDE is as a flame retardant for consumer electronics products, have long been used heretofore. The main use of Deca-BDE is the outer frame of the cathode-ray tube TV. cathode-ray tube TV generates heat. Thus the plastic of the outer frame by blending Deca-BDE, it is necessary to perform flame retardancy. Deca-BDE in the ROHS directive is subject substance candidate, manufacturers and industry has tried to develop a replacement. But in the end replacement could not be developed. So instead of a flame retardant, it was also made studies of flame retarded plastics. For the flame retardant of the final plastic, development has ended in failure. If the Deca-BDE is restricted, it is the industry is troubled.

After that, there was a big change from the cathode-ray tube TV to the plasma TV and LCD TV. The amount of plastics used for TV also decreases, European manufacturers have ceased production. European Member States (UK) has made a proposal of as controlled substances in the subsequent REACH regulations. Currently, regulation of Deca-BDE is in progress in the REACH Regulation. In order to replace from cathode-ray tube TV to the plasma TV and LCD TV, the demand for Deca-BDE is in the worldwide downward trend. But the production of Deca-BDE in the Asian region still being carried out.

### VII. CONSIDERATION

#### A. Illustration of the hypothesis 1

##### Hypothesis 1

If the regulation has been carried out, but there is no alternative → It is likely to occur innovation

- Case of flame retardant  
Regulation of existing products Deca-BDE (alternative development is difficult, even difficult new material development) → Innovation happened in the final product (TV)
- Case of the foaming agent  
Regulation of existing products ADCA (alternative development is difficult) → In the future, what happens?

In hypothesis 1, it suggests the possibility that innovation occurs in the final product.

#### B. Illustration of the hypothesis 2

##### Hypothesis 2

Although regulations have been made, if the replacement is present → Substitution proceeds. Innovation does not occur.

- Case of plasticizer

Regulation of existing products DEHP → substitution occurs, innovation did not occur.

Even existing products is regulated, it is only replaced with alternatives.

Why would the existing products is a proposed regulation of? To reflect the opinion of the European manufacturers and environmental NGO, the European member countries is also considered if the proposed regulation of the existing products.

### *C. Illustration of the hypothesis 3*

#### Hypothesis 3

Hypothesis 2 plays a role of global standardization regarding availability of chemicals.

If you want to regulate the existing products, the replacement manufacturers and environmental NGO is it possible to be involved is the regulation of stakeholder participation (REACH regulations). It's chemical safety, that is or not than to play a role to create a world standard for usability?

In any of the cases of plasticizer DEHP and a blowing agent ADCA, after the European manufacturer was discontinued, respectively, proposed regulations of the European Member States in the REACH regulations have been made. The case of the blowing agent is a situation where ongoing regulation processes, believed that there is no substitute case. In the future, we want to note how the notch innovation occurs. Now in the policy process in REACH Regulation, it is possible to stakeholders (European Member State) is to propose a regulation candidates. Usually, there are many cases include a "scientific basis" as proposed reason. But European industry (companies) and consumers opinion of (civil and environmental NGO), such as, is also conceivable that are reflected. For example, opinion of the European companies with a replacement is reflected, the market if the progress in regulation of is considered to be at once substitution proceeds. Because there is a replacement,

even if other companies even developed a new product, it is expected that (if there is no merit in performance and price, etc.) new innovation is unlikely to occur.

Generally, "high regulatory hurdles, replacement without any product that society requires" in reference is considered to be likely to induce innovation. However, for "regulation stakeholders propose controlled substances" in this case, it has been found that it is difficult to induce innovation.

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