

## 【Grant-in-Aid for Scientific Research (S)】

### Broad Section K



## Title of Project : Systematization of Halogen Control Technologies toward Environmental Impact Reduction

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Keyword : Halogens, Chlorine Circulation, Plastic recycling, deductive LCA, Environmental Impact Assessment

### 【Purpose and Background of the Research】

The global production, use, and disposal of plastics are following a growth trend and are expected to further increase in the future. This situation urgently calls for deliberation on how to recycle plastics. However, the recycling of plastics, regardless of the technical method, faces a bottleneck that is the question as to how to handle halogens.

Halogens become repellents in the process of plastic recycling. However, this research project aims to academically explore the possibilities of deploying technologies centered on dehalogenation while viewing halogens as “circular resources.” Dehalogenation technologies are generally divided into “dry” and “wet” methods. This study will develop technologies for the removal, and effective uses of halogens to turn used plastic into secondary raw material, chemical raw material, and high-quality fuel, making maximal use of the advantages of both types methods. Furthermore, concurrently with the technological development, this study will analyze the latest trends in deductive LCA and international technologies/policies and conduct interdisciplinary research aimed at optimizing the speed of technological introduction and its compatibility with social systems.

### 【Research Methods】

This study will seek technical methods that can be developed and deployed around dehalogenation technologies, attempting to systematize the underlying technologies. This study will thereby aim to construct a platform for technological development purposed for the circulation of halogens and effective use of plastics. In addition to the “process development” itself, data measured and obtained in this manner will be used for MFA and LCA as shown in Figure 1, to analyze material flows and evaluate environmental impacts. Furthermore, through “research on international trends in technologies/policies,” this study will evaluate and analyze the possibilities of industrial uses of plastic-derived secondary raw materials in relation to legal regulations both in and outside Japan. These three different fields of research, which differ in specialization, will be fused, aiming for a multifaceted approach involving technological, environmental, and social

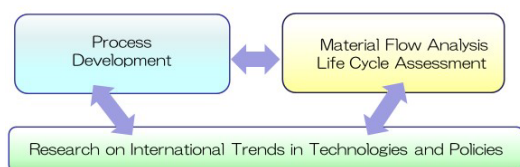


Figure 1 The structure of this research

perspectives.

### 【Expected Research Achievements and Scientific Significance】

The recent development and spread of the use of high-function and compound plastics have made the process of separation and sorting for recycling difficult. Halogens such as chlorine, bromine become repellents in the process of recycling. As shown in Figure 2, efficient removal of these halogens can raise the efficiency of separating useful substances such as metals while also raising the value of renewable resources. Halogens have been a major hindrance to the circular use of plastic. This study, however, views halogens as circular resources and aims to optimize dehalogenation not only from the viewpoint of maximizing it but also from the viewpoint of “control” by which plastic-derived secondary resources can be improved to standards acceptable by industries. Furthermore, through scrutinizing and systematizing the underlying technologies, this study aims to construct a platform for the technical processes of recycling that could contribute to the reduction of environmental impacts.

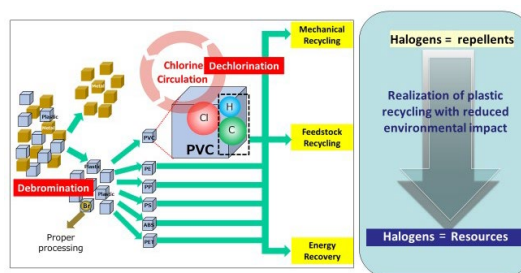


Figure 2 Overview and Scientific Significance of this research

### 【Publications Relevant to the Project】

- Shogo Kumagai, Jiaqi Lu, Yasuhiro Fukushima, Hajime Ohno, Tomohito Kameda, Toshiaki Yoshioka, Resources, Conservation & Recycling, 133, 354-361, (2018)
- Jiaqi Lu, Siqingaowa Borjigin, Shogo Kumagai, Tomohito Kameda, Yuko Saito, Toshiaki Yoshioka, Waste Management, 99, 31-41 (2019)

【Term of Project】 FY2020-2024

【Budget Allocation】 153,700 Thousand Yen

### 【Homepage Address and Other Contact Information】

<http://www.che.tohoku.ac.jp/~env/index.html>