

【3-1801】

Assessment Foundation for Plastics Cycles towards Introduction of Advanced Recycling Technologies and Integration with the Arterial Industries

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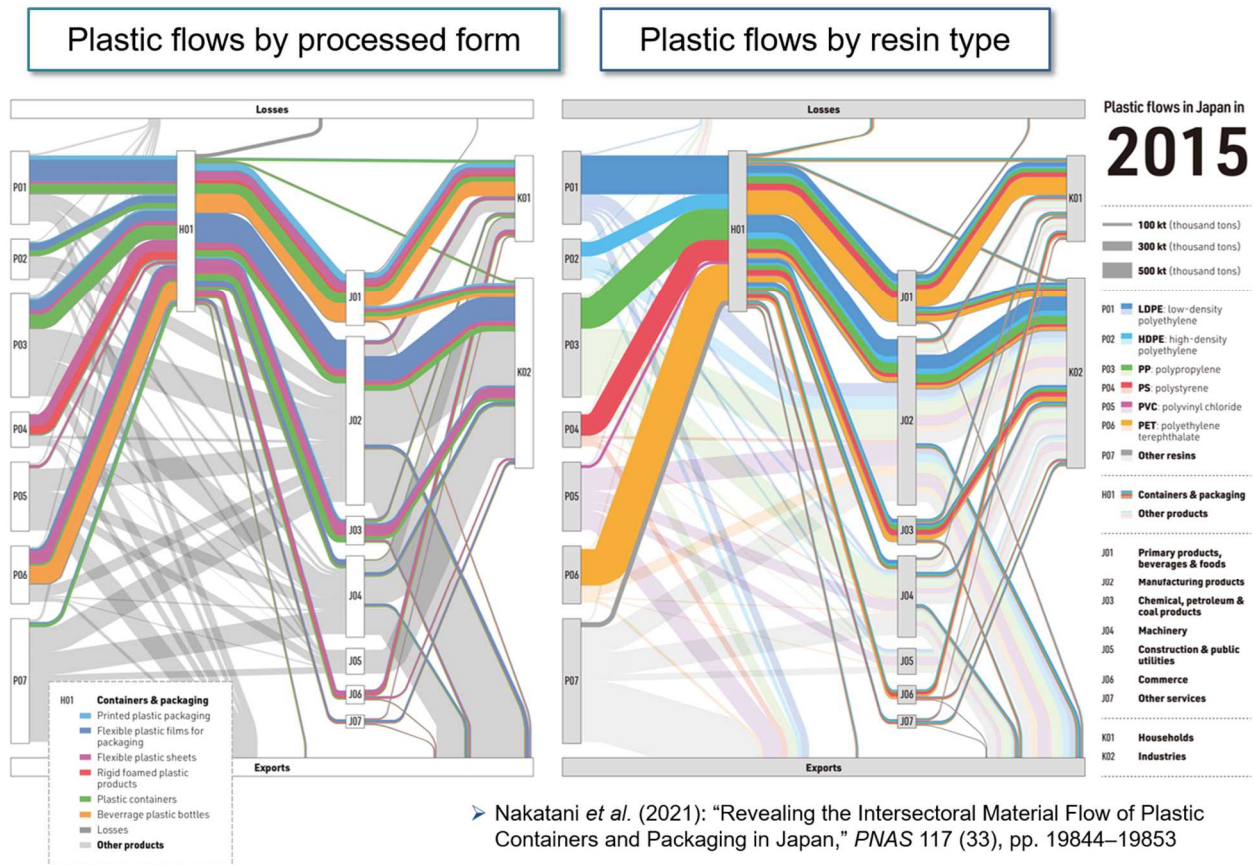
Key words: circulation flow, material flow analysis, sorting technology, chemical recycling technology, pyrolysis, carbon circulation, synthetic resin additive, bromine flame retardant, economic efficiency

This study has aimed at developing an assessment foundation for designing highly sophisticated plastic circulation scenarios oriented to the introduction of advanced recycling technologies and cooperation with the arterial industry. The assessment foundation includes a material flow analysis of plastics, feasibility analysis of recycling technologies, flow analysis of synthetic resin additives and theoretical and empirical analyses of recycling collection regimes. The goal of this study has been to present options for circulation scenarios considering feasible sorting and recycling technologies, the utilization potential of recycled plastics in the arterial industry, variation in the amounts of waste plastics generated and contamination of chemical substances such as additives as constraints.

Regarding plastic flows, we estimated the amounts of general plastics used, including plastic packaging and products in Japan based on a top-down material flow analysis approach, which traced supply chains using an input–output table. In addition, we focused on carbon circulation as a circulation scenario assessment indicator and, as a foundation for the assessment, we visualized the carbon flows of products, and the effect of reducing environmental burdens through recycling of plastic-oriented carbon. Furthermore, we conducted a bottom-up estimation of flows of automobile-oriented waste plastics and their recycling collection, and then analyzed the potential for material recycling and discussed the feasibility of closed-loop recycling of automobile plastics.

Regarding the feasibility of recycling technologies, we conducted tests to verify plastic packaging sorting precision using an optical sorting machine. Meanwhile, we surveyed global academic studies focusing on feedstock recycling using pyrolysis technology. After that, we experimented on pyrolysis of plastics with samples that replicated the resin composition of sorted plastics.

Regarding the constraints on plastic recycling, we estimated the waste treatment and recycling flows of electric-and-electronic-equipment-oriented waste plastics and associated brominated flame retardants. Furthermore, we both theoretically and empirically analyzed the economic impacts on the stakeholders including municipalities and recyclers in cases where a recycling regime such as waste collection categories was changed.



Subtopic [2] Analysis of carbon flows and recycling technologies of plastics

[2]-1 Material flow analysis of carbon circulation by the top-down approach

[2]-2 Technological feasibility analysis of advanced recycling processes

✓ Plastic-oriented carbon flows ↓ ✓ Feasible level of the yields and efficiencies

Subtopic [1] Development of resource circulation scenarios of plastics

[1]-1 Household plastic recycling oriented to introduction of advanced technologies

[1]-2 Equipment plastic recycling oriented to cooperation with the arterial industry

