Abstract We give an overview of the management systems of household hazardous waste (HHW) in Japan and discuss the management systems and their risks. To get basic information, we conducted a survey of consumers to discover their behavior and awareness of HHW items throughout the entire life cycle, which is made up of the purchase, use, and disposal of a product. The results showed that many people hold end-of-life batteries, fluorescent lamps, empty spray cans, and others in their houses after use. Also, the results showed that a lot of such waste items were discarded in waste streams different from those stipulated by local governments. In particular, many people do not remove NiCd batteries inside products such as shavers or cordless phones before discarding. On the other hand, people’s knowledge of and concern regarding the risks, collection, and recycling of HHW were high. When information about the risks was specifically presented in the questionnaire, people tended to show a more positive intention to participate in a collection and recycling system compared to those who were not presented with such information. Our studies on NiCd batteries and fluorescent lamps showed that it is important to collect and recycle HHW to control the domestic and international flows of cadmium and mercury.

Key words Questionnaire · Fluorescent lamp · Battery · Mercury · Cadmium

Introduction

Nowadays, household products vary widely not only in their purpose, style, and shape, but also in the usage of materials. Some materials pose problems of exhaustion of resources or toxicities to human during manufacturing, purchase, use, and disposal. For example, it is well known that used spray cans or cassette gas cylinders pose a risk of explosion during collection or treatment if they are not fully emptied and punctured. Also, mercury is used in a number of household products, including fluorescent lamps and thermometers. However, the management system of waste products, including recycling, has only been set up for a few types of household hazardous waste (HHW), and the management of most HHW is up to each local government. Further, for many products, it is difficult to assess the material and its flow because of the lack of information.

Therefore, in this study, we give an overview of the management systems of HHW in Japan and a few other countries and discuss the management systems and their risks. To get basic information, we conducted a survey of consumers to discover their behavior and awareness of HHW items throughout the entire life cycle, which is made up of the purchase, use, and disposal of a product.

Theory – management systems for HHW

Risk characterization of HHW

Household products that need special management because of their hazardous or dangerous properties have been discussed as “waste necessitating special control” or “hazardous household waste.” The definition of these items is summarized in Table 1. The concept of hazardous properties for waste has recently been extended to include not only dangerous properties, such as flammability, but also toxicity originating from hazardous household chemicals (HHC), carcinogenicity, eco-toxicity (toxicity to the natural environment), as well as acute toxicity to humans.1

Difficulties in the treatment of HHW arise from the variety and complexity of its hazardous properties. Hence the scope of risk generation is wide ranging. Fig. 1 shows the risks and major hazardous properties existing within the life-cycle flow of products. For heavy metals, some studies have been done on recycling and final disposal. However, in order to consider and manage the risks from waste...
products, we must gather information about the properties of relevant products and think in terms of life-cycle management.

Targeted HHW and management in Japan

In this article, we targeted a variety of HHW items based on the concept of Fig. 1. The main targets and the reasons for their selection and the existing systems for the targeted items are summarized in Table 2. In Kyoto city, where we carried out a questionnaire survey, municipal solid waste (MSW) should be separated as shown in Table 3. It should be noted that at the time when the questionnaire survey was conducted (2003), Kyoto city stipulated that fluorescent lamps should be discarded in the original box as combustible waste and spray cans should be fully finished, punctured, and disposed of as combustible waste. Household appliances are an important category, but we do not target them in this article. Table 2 shows that the management of

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Table 1. Definition of waste necessitating special control, or hazardous waste

<table>
<thead>
<tr>
<th>Definition of waste necessitating special control in Japan</th>
<th>List of hazardous properties in Basel Convention Appendix III</th>
<th>Concept of hazardous properties for waste which needs special management in Japan</th>
<th>Definition of hazardous properties for hazardous waste in the EC</th>
<th>Definition of hazardous properties for hazardous waste in the USA</th>
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</thead>
<tbody>
<tr>
<td>Waste which poses a risk of damage to facilities or damage to workers' health and safety (e.g., risk of explosion) = Focusing on environmental preservation, safety of final disposal or work place</td>
<td>Explosive Flammable (liquid) Autogenous ignition</td>
<td>Explosive Flammable Reactive (autogenous ignition) Reactive (Water-reactive) Reactive (oxidizing)</td>
<td>Explosive Highly inflammable Flammable</td>
<td>Reactive Ignition</td>
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<td>Waste which possesses hazardous chemical or biological characteristics such as substances that are difficult to remove and detoxify, environmental pollutants, or compounds including such chemicals = Focusing on safety of collection and transportation, intermediate processing, final disposal, environmental preservation, or safety of the work place</td>
<td>Toxic gas generation</td>
<td>Toxic (acute) Toxic (acute or chronic toxicity caused by epicutaneous, oral, or airway exposure)</td>
<td>Toxic gas generation Generation of another chemical Toxic</td>
<td>Toxic Eluting toxic</td>
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<tr>
<td>Waste with extreme physical characteristics. For example, the gross weigh, capacity, and the volume are extremely large or compression and crushing are extremely difficult. = Focusing on safety of collection and transportation, intermediate processing, final disposal or work place</td>
<td>Eco toxic Infectious</td>
<td>Eco toxic Infectious</td>
<td>Eco toxic Infectious</td>
<td>Eco toxic Infectious</td>
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\(^a\)The Ministry of Health and Welfare (former) notified “Self-evaluation guideline for products on difficulty of waste management by entrepreneurs” to Prefectural governors

\(^b\)Living environmental council, waste management departmental meeting, waste management technical committee defined during the process of specifying concrete specially controlled waste

\(^c\)Concrete waste is listed in Resource Conservation and Recovery Act and controlled