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Eco Tableware Using Waste of Bamboo and Polypropylene

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Yokohama China town

International harbor opened from 1859

Contents

1. Situation of waste in Japan

- Waste and using of bamboo

Abandoned bamboo forests in Japan

In Japan, much bamboo forests are abandoned without maintenance. Therefore, a lot of bamboo waste are not used effectively now.

If the products using the bamboo are increased more, a lot of bamboo forests are maintained, and the forests to harvest bamboo are developed. The development of the biomass products is important because there are few reserves in underground resources in Japan.

Incineration of bamboo waste in Japan

Car speaker cone using bamboo fiber by Panasonic

Panasonic developed speaker cone using the paper from bamboo fiber on 2007. The company utilizes bamboo fiber because it grows faster than soft wood. And it is lighter and harder than wood. In this cone, short fiber and long fiber of bamboo are mixed.

The surface of short fiber is opened rag to make rigid cone. Hence, bamboo cone speaker has a wider sound and good treble than conventional wooden paper cone. http://panasonic.co.jp/

The bamboo composite parts for Lexus

Lexus GS from 2012

Source; Web site of Lexus Enthusiast

1. Situation of waste in Japan

- Polypropylene cap waste

Sorting and collection PP cap of plastic bottle in university

A large amount of polypropylene is used in the world. The PP material is produced approximately 2.5 million tons/year in Japan. The PP is produced approximately 9 million tons/year in European Union. In Japan, most PP waste are used for thermal recovery as a substitute of fuel.

1. Situation of waste in Japan

- Waste in hospital

National Center Hospital for Health and Medicine
Shinjuku, Tokyo, Japan

Plastic waste from hospital in Japan

Storage of contagious waste

Mixed waste of noninfectious plastic and contagious waste

In the general hospital, a lot amount of noninfectious plastic waste for container package are generated than contagious waste. In the hospital, much noninfectious plastic wastes are discarded into contagious waste.

Those waste are incinerated for sterilization. Most of noninfectious plastic waste are not recycled in Japan.

27th May 2016

Investigation of noninfectious waste in hospital

Medicine department in hospital

Noninfectious waste of paper

Plastic PP package for drip

Plastic package of medical supplies

Noninfectious waste of plastic package in hospital

The recyclable plastic waste which sorted by student

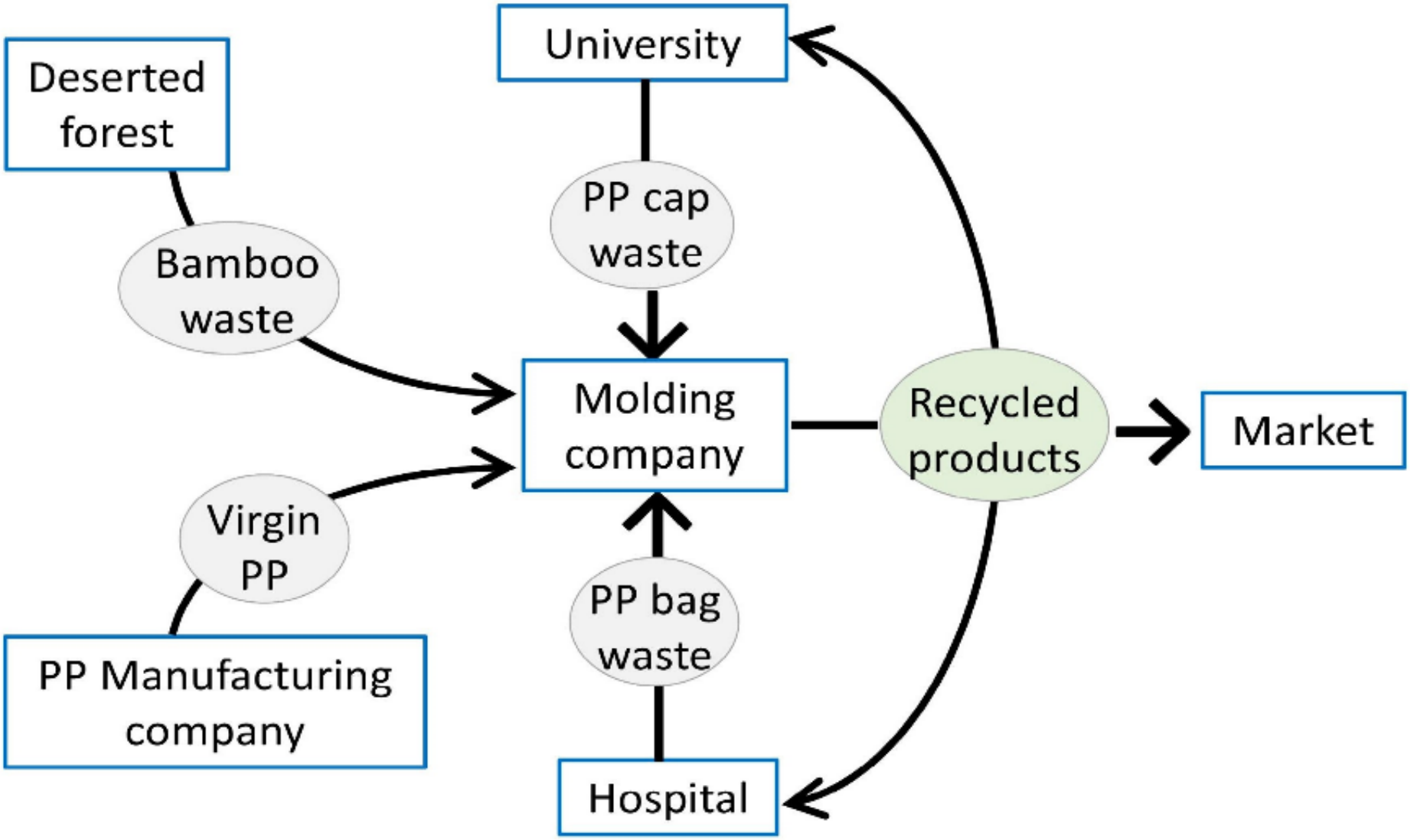
2. Objectives of study

1. The marketing of products using waste of bamboo and PP is suggested as the case studies in Japan.

2. The development of various eco-products using the waste of bamboo and PP should be increased in the industry by the expanding of our case studies.

3. The properties of eco-products are examined and the functions of eco-products should be improved.

Flow for production of eco tableware



3. Preparing and recycling method

- Bamboo waste

Collection and preparing of bamboo waste material in Japan

Collection of felled bamboo waste from area of Shimane and Tokushima → Crashing of bamboo waste → Powdering of bamboo waste → Drying of fine powder of bamboo

Coarse powder and fine powder of bamboo waste

3. Preparing and recycling method

- PP waste of cap and medical supplies

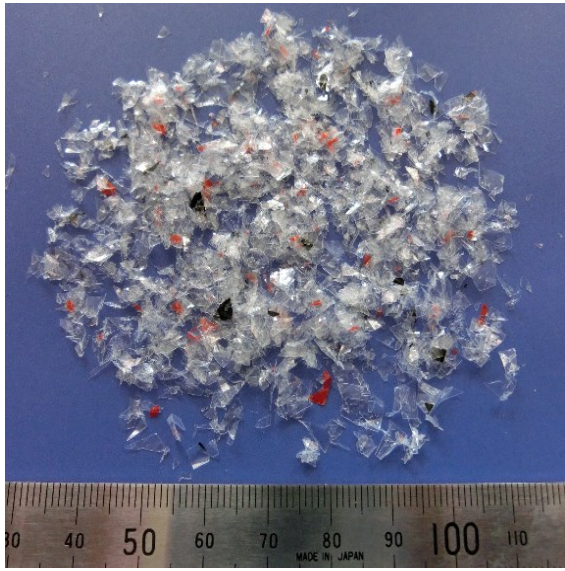
Collection and preparing of PP waste material

Sorting and collection of PP cap waste from plastic bottle in university → Washing and drying of PP cap waste + Sorting and collection of PP bag waste in hospital → Crushing and mixing of PP waste

PP cap waste of plastic bottle

Crushed PP cap

Packaging PP bag waste of instillation instruments



Crushed packaging PP bag

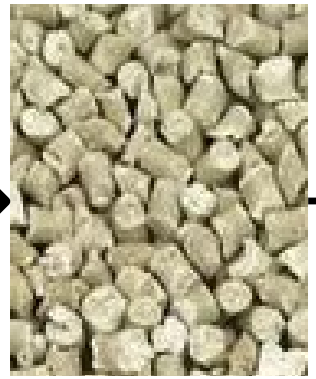
3. Preparing and recycling method

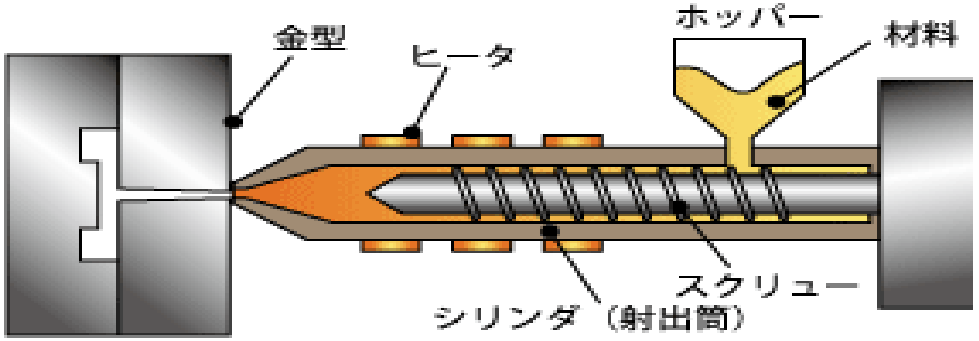
- Molded tableware using waste

Production bamboo and Process for eco tableware using waste of PP

Virgin PP pellet of 35wt% + Bamboo powder of 35wt% + Small amount of additives → Pellet compounded with PP & bamboo + Crushed PP waste of 30wt% → Plastic products by injection molding





Production process for eco tableware using waste of PP waste

Virgin PP pellet of 33.3wt% + Crushed PP waste of 66.6wt% → Plastic products by injection molding


+

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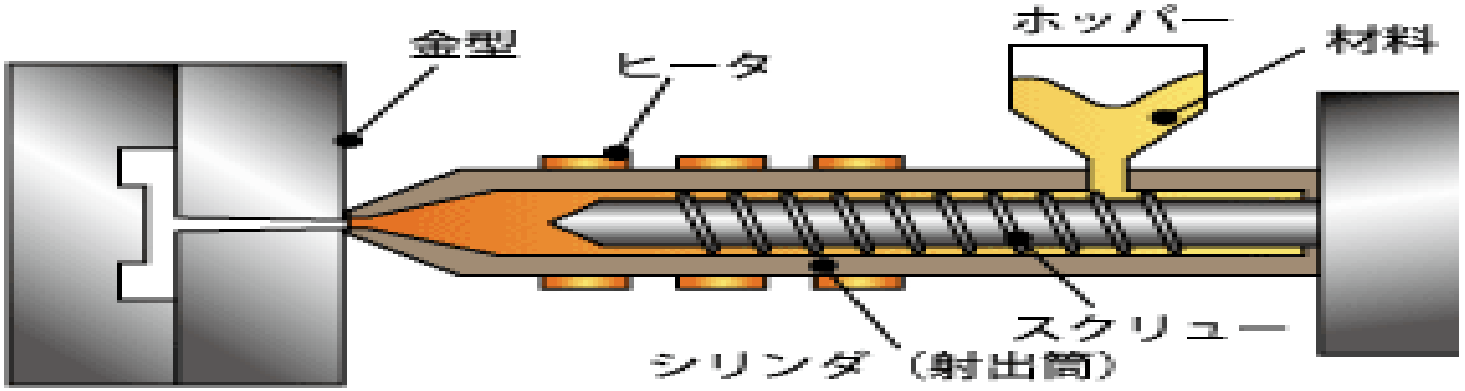

Tableware products in trials using waste of bamboo and PP

Composite including waste of PP & bamboo

Composite included PP waste without bamboo

4. Sanitation of tableware

Japanese regulation test for sanitation of tableware has the material test and migration test.

The material test is to analyze the contents of heavy metals, such as cadmium and lead, remaining additives and stabilizers in plastics.

The migration test is to estimate the amount of migration of substances from plastics into food. It is carried out according to the type of food and the temperature of food during processing or cooking in the selected some migration solvents and migration conditions.

Sanitation of tableware by Japanese regulation test

Item	Sanitation limit (μg/g)	PP cup without bamboo (μg/g)	PP cup with bamboo (μg/g)
Material test			
Cadmium	100	Pass*	Pass*
Lead (Pb)	100	Pass*	Pass*
Migration test			
Heavy metals (as Pb)	1.0	Pass*	Pass*
Consumption of $KMnO_4$	10	Pass*	3.0
Water	30	Pass*	14
4% Acetic acid	30	Pass*	107**
n-Heptane	150	114	Pass*
20% Ethanol	30	Pass*	10

* Undetected value and good sanitation, ** Unsanitary value

In the material test, cadmium and lead from both products with and without bamboo were not detected, it was confirmed that both of eco-products were sanitation tableware.

In the migration test, the migration amount of substances from the tableware including bamboo into 4% acetic acid water was exceeded of sanitation limit. The sanitation limit is 30μg/g, and the measurement value was 107μg/g. It is considered that this test will be passed if the ratio bamboo in PP tableware is decreased from 35wt% to below 10wt%. In the other migration tests, the lower value were obtained as compared with sanitation limit.

Conclusions

1. In this study, new process for production of eco-tableware was developed. In this process, the collection and using of bamboo and PP waste were developed between the university and the hospital, molding company.

2. The eco-friendly teacup and chopsticks including waste of bamboo and PP could be produced by the injection molding as trial products. The eco-products have a good appearance.

3. The ratio of bamboo powder in PP tableware should be prepared to less than 10wt% to obtain good sanitary condition from the results of Japanese regulation testing.

Future experiments

The following studies will be carried out in the future.

a. The PP tableware with a little bamboo addition will be produced experimentally and those products will be evaluated.

b. The examinations such as mechanical strength and cold heat cycle, endurance test for the eco produced tableware will be carried out. The molding condition and new additive will be developed to improve the functions such as antifungal properties.

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Thank you for your attention!

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