Survey of Enhanced Added Value of Convenience in Lives of Residents Using Sewerage Facilities

(Study period: FY 2019 – FY 2022)

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1. Introduction

In August 2017, Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) formulated the "New Sewerage Vision Acceleration Strategy" and summarized the measures that the national government should implement in a selective and concentrated manner over approximately 5 years from the viewpoint of accelerating the realization of the New Sewerage Vision. Since one of the key elements of the New Sewerage Vision Acceleration Strategy is enhancing added value by utilizing sewerage, the possibility of accepting paper diapers (disposable diapers) in sewerage systems as a response to Japan's aging society and other issues was adopted as a topic for study. In January 2018, MLIT set up a "Study Group for Realizing Acceptance of Paper Diapers in Sewerage Systems," which drew up a "Study Roadmap toward Acceptance of Paper Diapers in Sewerage Systems," to be implemented over a period of roughly 5 years beginning in FY 2018 [1]. To support that effort, NILIM collected basic information on paper diapers, such as the types/weights of paper diapers and the pollution load and physical properties of each diaper material. NILIM also began arranging knowledge concerning the conditions for syneresis (separation of moisture from a gel, etc.) of superabsorbent polymer (hereinafter, SAP), which is one diaper material (assuming syneresis by adding Ca to urine-laden SAP (**Photo 1**, **2**)), behavior in sewage, and the technical effects on sewerage system facilities (manhole pumps, bedload transport) and wastewater treatment facilities (sedimentation characteristics). This article introduces a portion of the status of arrangement of this basic information concerning paper diapers.

2. Types and Weights of Paper Diapers

In accordance with the guidelines [2] on labeling of the materials of commercially-available paper diapers (disposable diapers), diaper materials are classified as 6 items, i.e., surface material, absorbent material, waterproofing material, fastening material, stretching material and bonding material. Except for the adsorbent material and the bonding material, the raw materials of these materials were virtually all plastic products derived from naphtha. The absorbent materials were frequently described as one of 3 types of materials: absorbent paper (nonwoven fabric), cotton-like pulp or the above-mentioned SAP.

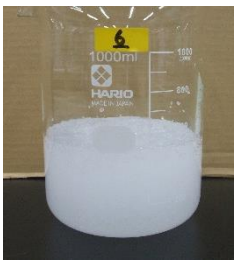

Photo-1 SAP before syneresis treatment

Photo-2 SAP after syneresis treatment

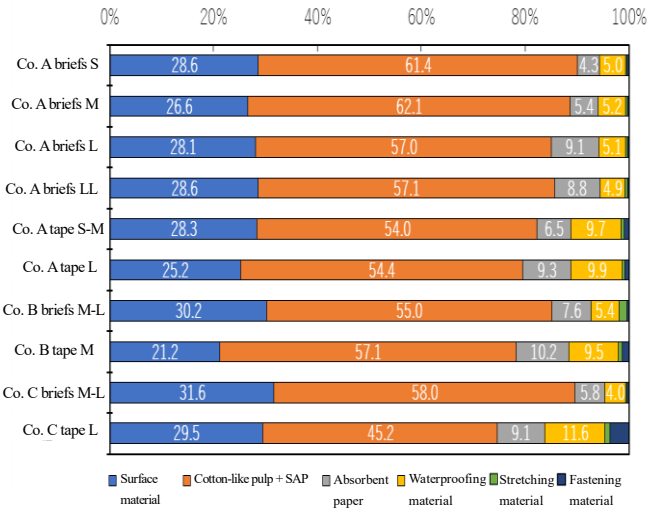

Fig. Weight ratios of materials used in paper diapers

The results of weight measurements of the paper diapers showed that the weight of the briefs type (38 samples) was 52 g to 107 g (average: 77.3 g), while that of the tape type (30 samples) was 84 g to 178 g (average: 117.9 g). Thus, the tape type tended to be heavier than the briefs type, and the weight of most tape-type diapers exceeded 100 g.

The above **Fig.** shows the weight ratios of the materials used in paper diapers. The bonding materials could not be distinguished by visual inspection. The average weight ratio of each material in the briefs type was surface material: 29.1 %, cotton-like pulp and SAP: 68.2 %, absorbent paper: 6.9 %,

waterproofing material: 5.0 %, stretching material: 0.5 % and fastening material: 0.3 %. The average figures for the tape type were surface material: 26.1 %, cotton-like pulp and SAP: 52.7 %, absorbent paper: 8.8 %, waterproofing material: 10.2 %, stretching material: 0.7 % and fastening material: 1.6 %.

3. Pollutant Loads of Paper Diapers

To clarify the pollutant loads of each material based on the types and weights of the materials used in the paper diapers, diaper samples were cut apart as shown in **Photos-3** to **7** and then analyzed. SAP was analyzed after performing syneresis treatment. The analysis items were CODcr, BOD, T-N and T-P. In this analysis, the samples were mixed with water at a mixing ratio of 5.0 % for SAP and 0.5 % for the other materials. CODcr was analyzed using a spectrophotometer (DR3900, HACH) and CODcr reagents (HR, HACH), BOD was analyzed by the sewage test method and T-N and T-P were analyzed using an automatic colorimetric analysis device.

Photo-3 Surface material

Photo-4 Cotton-like pulp

Photo-5 Nonwoven fabric

Photo-6 Waterproofing material

Photo-7 Fastening material

Photo 8 SAP

The following **Table** shows the results of the pollutant load analysis of each material. For CODcr, the values of the surface material, adsorbent paper, waterproofing material and fastening material, which are made from polyolefin material, were 174 to 285 g/100 g. The CODcr values for the other materials were cotton-like pulp: 99 to 111 g/100 g, stretching material (polyurethane): 19 g/100 g and SAP 23 g/100 g.

BOD was virtually undetectable, as the values for all the materials were 0.01 g/100 g. For T-N, the cotton-like pulp displayed the highest value, at 0.11 to 0.12 g/100 g, and T-P was substantially not detected, as the values for all materials were 0.01 g/100 g.

The average pollutant load for 1 briefs-type diaper was CODcr = 114.7 g, BOD = 0.01 g, T-N = 0.04 g and T-P = 0.01 g, whereas the average values for 1 tape-type diaper were CODcr = 181.7 g, BOD = 0.01 g, T-N = 0.06 g and T-P = 0.01 g. Since the main components of the diapers are naphtha-derived plastics and cotton-like pulp, CODcr was high while BOD was low.

Table Results of pollutant load analysis Unit (g/100 g)

	Surface material	Absorbent material			Waterproofing	Stretching material	Fastening material
	Polyolefin nonwoven fabric	Cotton-like pulp	SAP	Absorbent paper Nonwoven fabric	Polyolefin film	Polyurethane	Polyolefin
CODcr	234.7	111.0	23.1	285.3	174.2	19.4	250.5
BOD	0.01	0.01	0.01	0.01	0.01	0.01	0.01
T-N	0.01	0.11	0.01	0.00	0.00	0.02	0.00
T-P	0.01	0.01	0.01	0.01	0.01	0.01	0.01

4. Conclusion

Basic information on paper diapers was arranged, including the types of materials used in the diapers and their weights, pollutant loads and physical properties. Based on this information, the assumed effects when paper diapers are disposed in a sewerage system were studied by laboratory tests and desktop study of the effects on sewerage pipeline facilities (manhole pumps, bedload transport) and wastewater treatment facilities (sedimentation characteristics, etc.).

☞For more information:

1)Website of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT): Establishment of Study Roadmap toward Realization of Acceptance of Paper Diapers in Sewerage Systems
http://www.mlit.go.jp/report/press/mizukokudo13_hh_000368.html, March 2018

2)Website of the Japan Hygiene Products Industry Association: Guidelines for Labeling of Paper Diapers