

March 31, 2025

Total Care System Co.  
Sumitomo Heavy Industries Environment Co., Ltd.  
Daio Paper Corporation  
TOPPAN Inc.  
NIPPON SHOKUBAI CO., LTD.  
Livedo Corporation  
The University of Kitakyushu

## **Reduction in CO<sub>2</sub> emission achieved by material recycling of disposable paper diapers**

Results of calculations using Life Cycle Assessment (LCA)

In an effort to tackle ever increasing CO<sub>2</sub> emissions generated during the disposal of paper diapers, **Total Care System Co.** (Head Office: Fukuoka City, Fukuoka, CEO: Takeshi Cho), **Sumitomo Heavy Industries Environment Co., Ltd.** (Head Office: Shinagawa-ku, Tokyo, President: Takanori Nagai, a fully owned subsidiary of Sumitomo Heavy Industries, Ltd.), **Daio Paper Corporation** (Head Office: Chiyoda-ku, Tokyo, President and Representative Director, CEO: Yorifusa Wakabayashi), **TOPPAN Inc.** (Head Office: Bunkyo-ku, Tokyo, President and Representative Director: Masanori Saito), **NIPPON SHOKUBAI CO., LTD.** (Head Office: Chuo-ku, Osaka, President & CEO: Kazuhiro Noda), and **LiveDo Corporation** (Head Office: Chuo-ku, Osaka, President and Representative Director: Tomohito Uda) (hereafter “the six collaborating companies”) are collaborating in a project to establish a “novel material recycling system for disposable paper diapers” (\*1).

To evaluate the environmental impact of this system the six collaborating companies have carried out a Life Cycle Assessment (LCA) together with **The University of Kitakyushu** (Headquarters: Kitakyushu City, Fukuoka President: Masato Yanai).

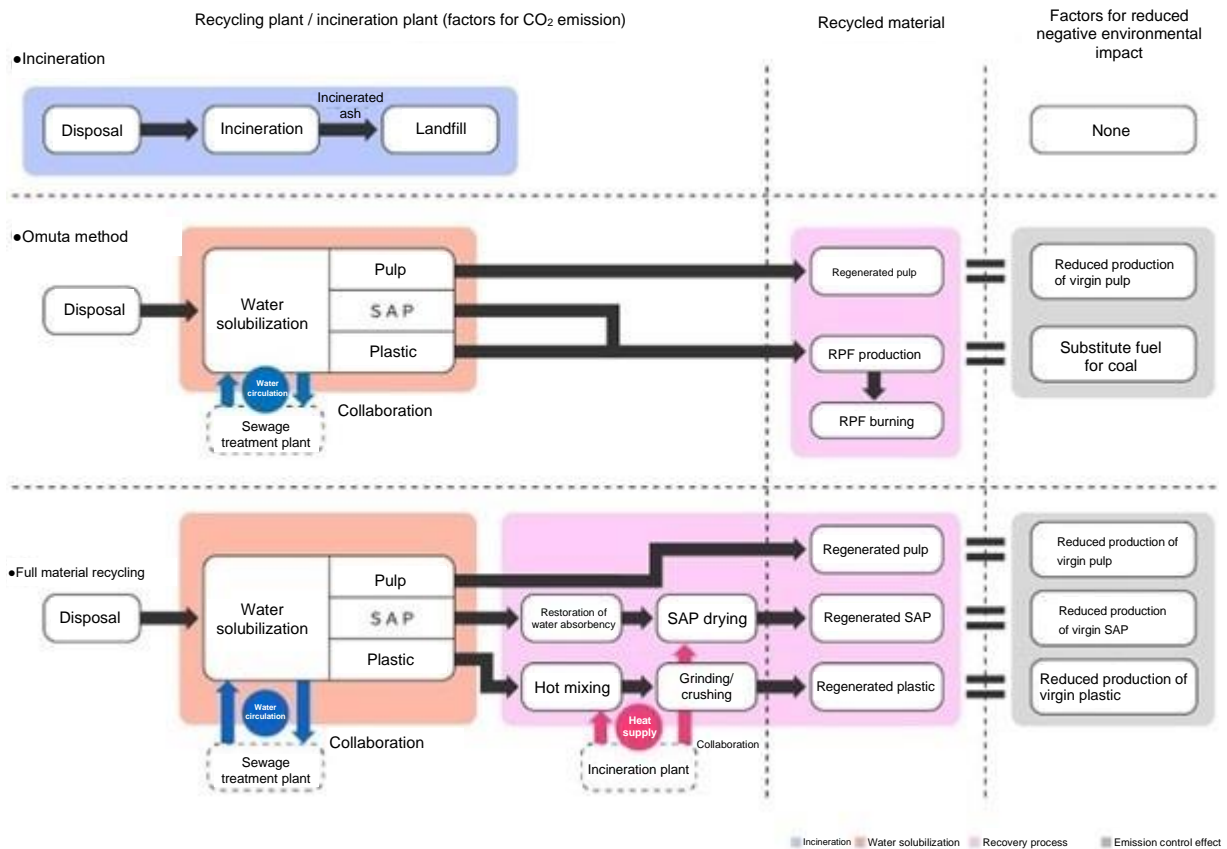
Initiatives on diaper recycling are now moving forward. In March 2020 the Ministry of the Environment (MOE) published its “Guidelines for Recycling of Disposable Paper Diapers”, and in August 2024 the Japanese cabinet approved “The 5th Fundamental Plan for Establishing a Sound Material-Cycle Society” aiming by 2030 to have 150 local authorities implementing or considering projects to recycle disposable diapers.

Total Care System already has 20 years experience in this field, having established its “Love Forest Omuta” recycling plant in Omuta Eco Town, Fukuoka Prefecture in 2005. This plant exclusively recycles paper diapers using a water solubilization treatment (Omuta method) and the regenerated pulp is used as building materials in applications such as exterior walls and interior design. As a successor to the Omuta method, the six collaborating companies are investigating the recycling of each of the three main constituents in diapers – pulp, super absorbent polymer (SAP), and plastic film.

The present LCA determined the CO<sub>2</sub> emissions under three scenarios: (1) incinerating the diapers in an incineration plant, (2) using the Omuta method to recycle only the pulp, utilizing the recovered SAP and plastic film as a solid fuel, and (3) full material recycling of all three main components. To obtain the results, the seven participants thoroughly examined points such as the assumed conditions, quantification of each recycling scenario, and opportunities for collaboration with existing infrastructure, as well as considering the MOE visualization of CO<sub>2</sub> emission reduction for the promotion of recycling.

Calculation based on the 5,000 tons (1,500 tons dry weight) of diapers annually processed by the Omuta method showed that full material recycling reduced CO<sub>2</sub> emission by 2,813 tons per year compared to incineration. This corresponds to the annual CO<sub>2</sub> emission of around 1,000 households (\*2).

## ■ System diagram

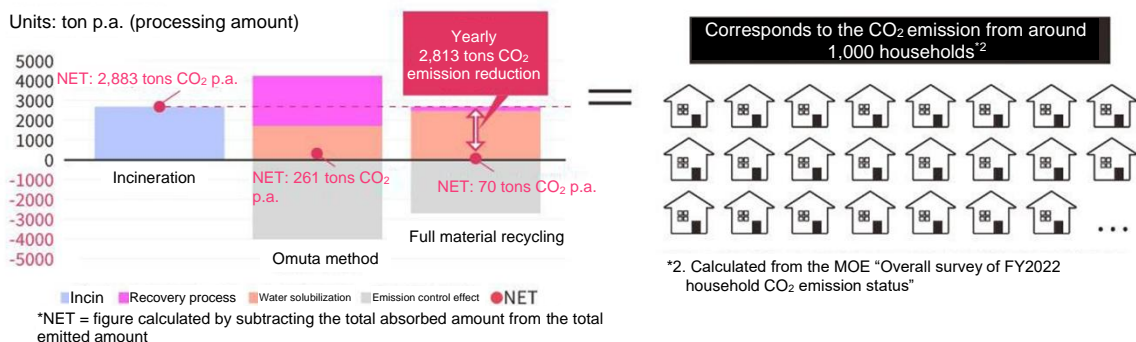


## ■ LCA

Assumption: - diapers for adult use : diapers for infant use = 5 : 5 (based on the number of diapers)  
 - when 5,000 tons per year of diapers (1,500 tons dry weight) are processed

## Decarbonization by recycling paper

### Full material recycling system for resource cycling



Full material recycling of 5,000 tons\* p.a. of disposable diapers will reduce CO<sub>2</sub> emission by 2,813 tons p.a. compared to incineration.

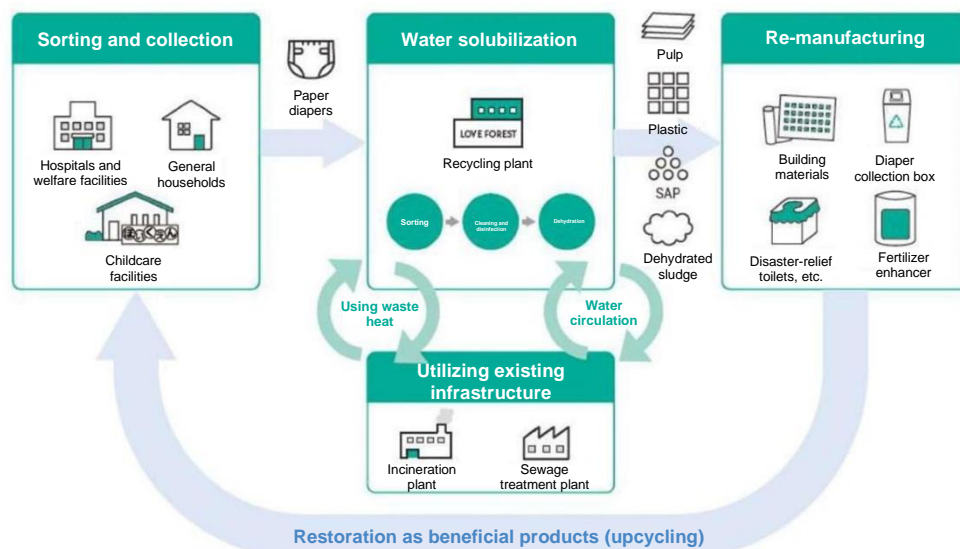
\* Corresponds to the amount of paper diapers disposed of in one year from an area with a population of 300,000 (Source: Calculated from MOE "Guidelines for Recycling of Disposable Paper Diapers")

\*1

## ■ Targets and features of the novel “material recycling system for disposable paper diapers” from the six collaborating companies

(Targets)

- (1) Recovery of the three main raw materials (pulp, SAP, plastic film) from the diapers
- (2) Restoration as beneficial products for the emitter (upcycling)
- (3) Economically viable process by collaboration with existing infrastructure (sewage treatment plants, incineration plants)



(Features)

### - Utilization of recovered plastic

Uses recycled plastic as a raw material for resource collection boxes and dedicated collection bags for paper diapers.

### - Recycling technology for recovered SAP

Can use for applications such as disaster-relief toilets by utilizing a recycling technology that restores water absorbency.

### - Collaboration with sewage treatment plants, incineration plants

Can provide hygiene-related and economic benefits to society by using treated sewage water for the recycling system in collaboration with sewage treatment plants facing depopulation issues. Can also generate environmental and cost benefits by using waste heat from incineration processes as a heat source for the recycling system in collaboration with incineration plants.

### - Initiatives in society to promote recycling

The utilization of recovered materials will boost the effectiveness of local information campaigns and education programs aimed at encouraging sorting and collection activities. It will also promote behavioral change through recycling and by making people even more conscious about the environment.

\*2

Calculated from the annual CO<sub>2</sub> emission of 2.59 tons per household (from electricity/gas/kerosene) reported in the overall survey of FY2022 household CO<sub>2</sub> emissions published by MOE in March 2024.

## ■ Profiles of the seven participants



### - Total Care System

Total Care System constructed “Love Forest Omuta” in Omuta Eco Town, Fukuoka in 2004. The following year, 2005, the plant started to recycle diapers using a water solubilization treatment. This was the first plant in Japan to feature a recycling system for disposable diapers and one of only a few operating in the world. The plant annually recycles 5,000 tons of used diapers originating from medical care and welfare facilities and households in neighboring local authorities.

<http://www.totalcare-system.co.jp>

### - Sumitomo Heavy Industries Environment

Sumitomo Heavy Industries Environment aims to use its water treatment business to realize a sustainable society and ensure “a comfortable living environment.” The company has advanced technologies for water treatment at public and industrial water treatment facilities, together with a track record covering facility design to operational management, and is responsible for the plant design and installation for this project. The company is using all its accumulated engineering prowess to tackle the increasingly serious issue of diaper disposal and contribute to the sustainable development of society.

<https://www.shiev.shi.co.jp>

### - Daio Paper

As a comprehensive paper manufacturer, Daio Paper sells a wide range of products such as paper and container boards, paper for hygiene products, and processed paper products, to help realize its management philosophy of “Shaping an abundant and affable future for the world.” The company is expanding its “Attento” adult diaper and “GOO.N” infants diaper brands and employs recycling techniques such as the use of production waste for the pet care product “kimiomoi” cat toilet litter in its quest to make environmentally friendly products. By proceeding with initiatives for like-for-like horizontal recycling, such as the use of regenerated pulp from diapers for its fluff pulp production, the company is striving to coexist with local communities and contribute to sustainable regional development.

<https://www.elleair.jp>

### - TOPPAN

TOPPAN is strengthening its “DX & SX” initiatives as it aims to become a “creator of value for society” that contributes to the realization of a sustainable society through its business activities. This approach is reflected in an extensive line up of environmentally conscious products such as “GL BARRIER” and “Cartocan™” for packaging applications and “101 Eco Sheet” building materials. The company strives for environmentally friendly manufacturing and aims to realize a sustainable society through its participation in the present diaper recycling project.

<https://www.toppan.co.jp>

## **- NIPPON SHOKUBAI**

Since its foundation in 1941, NIPPON SHOKUBAI has built a global chemical business around its unique catalyst technology. Presently the world's No.1 supplier of the superabsorbent polymers used in diapers (2024 in-house survey), the company provides society with many other essential materials and solutions, such as materials for lithium ion batteries. The company is utilizing its long standing technical expertise to realize the management philosophy of "TechnoAmenity—Providing affluence and comfort to people and society with our unique technology."

<https://www.shokubai.co.jp>

## **- LiveDo Corporation**

LiveDo Corporation "supports the power of life" in the caregiving and medical treatment fields. In the life care business, the "Refré" brand of adult disposable diapers is the product of choice for professionals working in care facilities and hospitals,

while surgical kits for use in hospital operating rooms are gaining market share in the medical treatment field. To address the needs of a rapidly aging society, the company is moving beyond these areas and starting initiatives to expand its business in overlapping and adjacent fields.

<https://www.livedo.jp>

## **- The University of Kitakyushu**

Founded in 1946 as Kokura Foreign Studies Institute, the University of Kitakyushu has grown into a literature and science based university comprising the Kitagata campus (Minami-ku, Kokura) and Hibikino campus (Wakamatsu-ku). With over 6,000 students, it ranks No.3 among Japanese public universities based on student numbers. The university is a hive of research into environmental engineering and technology, having established the Faculty of Environmental Engineering in 2001 followed by the Institute of Environmental Science and Technology in 2012. As one of the team responsible for the current activity, Professor Matsumoto has carried out research using LCA since 2010 and was involved in 2019 in the preparation of the MOE "Guidelines for Recycling of Disposable Paper Diapers."

<https://www.kitakyu-u.ac.jp/>

\*The names of products and services described in this news release are company trademarks.

\*The details described in this news release reflect the situation at the time of publication. They may be revised without prior notification.

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