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**A review of digital transformation in the wastewater treatment
-Case studies from public sewage water treatment plants-**

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This study examines the applicability of digital transformation (DX) initiatives implemented in public water treatment facilities to the pulp and paper industry, with a focus on enhancing operational efficiency and environmental sustainability. Three representative case studies are presented.

The first case involves wide-area operational monitoring, where multiple public facilities are managed centrally through a cloud-based platform using standardized data formats. This system enables centralized data management, remote monitoring, and optimized personnel deployment. Such an approach is considered transferable to the pulp and paper sector, where inter-facility data integration and maintenance efficiency are increasingly important.

The second case focuses on sludge treatment. An AI- and IoT-based guidance system for dewatering process operation is under development. This system utilizes image analysis of floc size and near-infrared spectroscopy to measure moisture content of dewatering cake in real time. The goal is to optimize dewatering conditions and reduce CO₂ emissions. Given the variability of sludge characteristics in the pulp and paper industry, this technology is expected to be highly applicable.

The third case addresses nitrification control through a combined feedforward and feedback (FF+FB) control strategy. This approach adjusts aeration volume based on real-time influent load conditions, improving energy efficiency while maintaining effluent quality. Although nitrogen removal is not a primary concern in pulp and paper wastewater treatment, the FF+FB control methodology is applicable to other processes with high load variability.

These case studies demonstrate that DX technologies developed in the public sector can offer valuable insights and practical solutions for the pulp and paper industry. The findings suggest that adopting such innovations can support digital transformation, improve operational performance, and contribute to environmental goals.

Kurita's prediction system uses water quality data to reduce environmental impact while improving productivity

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In recent years, raw materials and operating conditions have changed dramatically in the paper industry, and the water quality conditions and operating conditions in the production process and wastewater process are constantly changing during daily operation and management. Under such conditions, it is not easy to carry out stable operations. In addition, due to increasing societal demands such as promoting a circular economy and achieving carbon neutrality, there is a need to further reduce the environmental impact, making operation and management even more difficult.

We have developed an operational optimization system for wastewater treatment by utilizing our extensive knowledge of water, which is used in large quantities at paper factories, and solutions that cover everything from the manufacturing process to the wastewater treatment process.

This system makes it possible to predict problems that may arise during wastewater treatment and ensure stable wastewater treatment even when operating conditions are changing. When combined with our technology, this system will optimize operations throughout the entire factory, including not only the wastewater process but also the manufacturing process. Furthermore, development is being carried out not only with the aim of stable operation, but also with the aim of setting operating conditions that are geared towards energy conservation and waste reduction and achieving both.

In this paper, we will introduce the technology for constructing a wastewater treatment optimization system, as well as a defect prediction model for the production process and its linkage. We will also introduce our wide range of solutions that reduce environmental impact and improve productivity as solutions to problems based on prediction results.

Spatiotemporal perspective on global environmental pollution caused by industrialization - with a focus on water quality-

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The Doomsday Clock is currently set at 89 seconds. The survival of humanity depends entirely on the preservation of the Earth's environment, and the existence of healthy water is vital. Of the water available on Earth, only 0.77% is freshwater, and of that, only 0.00672% is usable by humans. The Earth's environment, which supports the freshwater ecosystem, is like a thin membrane covering the Earth's surface, making it extremely fragile. Then, recovery is not easy once it is damaged by environmental destruction or pollution. Since the Industrial Revolution, humanity's massive consumption of fossil fuels has first led to some localized pollution, including air and water pollution; however, the area of the pollution has been expanding to a global scale, causing irreversible and irreparable impacts that are beginning to exceed the limits of the Earth as a planet. In order to solve these global issues and achieve the "Nature Positive", humanity must understand that the global ecosystem implies an irreversible one-way flow of energy in the ecology economy, and that a circular economy is virtually impossible within the human timeframe. We must strive to build a sustainable society by practicing Herman Daly's three principles. To this end, normalizing the carbon balance without using fossil resources has become an urgent international issue. The fossil resources that humanity uses are the remains of carbon cycles that took place on Earth hundreds of millions of years ago. The fundamental issue behind current global environmental problems is extending this remains into the modern carbon cycle. To resolve this issue and normalize carbon balance in modern society, a drastic paradigm shift is necessary—shifting from ancient carbon resources to current carbon resources, specifically forest resources like cellulose, for energy and material production.

Introducing Functional Products Contributing to Transition to Paper-Based Packaging -Aiming for an Environmentally Friendly Society-

Takefumi Nomura

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This paper examines the growing focus on reducing plastic waste in packaging, driven by stricter environmental regulations and rising consumer awareness. Plastic waste is projected to increase significantly by 2040, with packaging accounting for a substantial share. To address this challenge, new regulations such as the Packaging and Packaging Waste Regulation (PPWR) in Europe and the Plastic Resource Circulation Act in Japan have been introduced, setting targets for recycled content and mandating recyclable design.

In response to these trends, this article introduces functional coating products that enable paper-based packaging solutions. These products provide essential properties such as oil and water resistance, heat seal strength, water vapor barrier, water repellency, and transparency, while complying with food safety and environmental regulations. Through the effective utilization of paper-based materials and the development of advanced technologies, the artience Group aims to contribute to a more sustainable society by reducing both plastic waste and CO₂ emissions.

Initiatives to Establish the Economic Value of Oji Forests toward the Era of Natural Capital Accounting

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Oji Holdings, a company with a long history dating back to 1873, has long prioritized sustainability and circularity in its core businesses, which include paper, pulp, and packaging. From its early days using waste clothes as raw materials to its current global operations managing approximately 635,000 hectares of forest, Oji has consistently emphasized responsible resource use. About 30% of its forests are designated as conservation area, and the company integrates production and conservation forest management to maximize multifunctional forest benefits. This paper focuses on the initiative toward natural capital accounting—a framework that evaluates and visualizes the economic benefits of natural resources like forests, soil, water, and biodiversity. By quantifying ecosystem services such as CO₂ absorption, water retention, and biodiversity conservation, companies can integrate these values into financial reporting and decision-making. In September 2024, Oji conducted an economic valuation of its domestic forests (approximately 190,000 hectares), using updated methodologies based on Forestry Agency of Japan's disclosure in 2000. The assessment, reviewed by an external environmental assessment firm, estimated an annual economic value of ¥550 billion (¥275 billion for erosion and landslide prevention, ¥204 billion for water resource cultivation, ¥43 billion for biodiversity conservation and ¥28 billion for air quality conservation and recreational benefits). To further refine natural capital accounting, Oji emphasizes two critical needs; Identifying elements of value and Establishing standardized quantification methods. As part of this effort, Oji launched the Sarufutsu Project in Hokkaido, collaborating with six researchers from Hokkaido University. The project focuses on five forest value elements—CO₂, biodiversity, soil, nutrients, and water—through quantitative assessments and ecological restoration. The company's forest landscape includes upstream habitats for endangered freshwater fish (Ito), midstream peat wetlands, and coastal forests. Restoration efforts include removing artificial river structures and re-meandering rivers to support aquatic life. Peat wetlands in Sarufutsu are also being studied for their carbon storage capacity and ecological impact on marine productivity, particularly scallops. Advanced technologies such as acoustic sensors, drones, environmental DNA, and AI are used to monitor biodiversity, with results contributing to frameworks like the Taskforce on Nature-related Financial Disclosures (TNFD). Looking ahead to the next 150 years, Oji aims to balance carbon neutrality and nature positivity through a comprehensive roadmap. This includes developing the "Oji Model" for evaluating forest values and maximizing their benefits. The company also explores new wood-derived materials and solutions rooted in natural capital. Recognizing the need for global collaboration, Oji actively participates in international forums such as COP conferences, the World Economic Forum, and OECD. In September 2023, Oji became a founding member of the International Sustainable Forestry Coalition (ISFC), which now includes 23 companies managing over 30 million hectares of forest. ISFC's current focus is piloting natural capital accounting standards for the forestry sector. Through these initiatives, Oji aspires to lead the transition into the era of natural capital accounting and contribute to a sustainable future.

Preparation for the Calculation and Verification of GHG emission on the GX-ETS Scheme

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As one of the Japanese decarbonization policies, the GX Promotion Acts, GX means Green Transformation, has been enacted and implemented for the purpose to achieve carbon neutrality by 2050 with maintaining economic growth.

The amended GX Promotion Acts has been approved in May of 2025 and will be fully implemented from April in 2026.

The amended law requires companies, which emit over 100,000 tons of CO₂, to participate in mandatory emissions trading. This regulation will cover about 3 to 4 hundred companies in Japan, showing about 60% of the Japanese total emissions.

In order to comply with these rules, companies are required to calculate GHG emissions and verify them according to the scheme rules. This report shows the outline of the regulation, monitoring and calculation of GHG emissions, verification process, and the issues founded from the calculation and verification results on the phase 1, which is already in operation.

Risks in Outsourcing Waste Disposal -How to Prevent Being Implicated in Contractor Violations-

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This paper examines the risks faced by waste-generating businesses when outsourcing waste disposal and explores corresponding countermeasures through specific case studies. The Waste Management and Public Cleansing Act imposes strict liability on waste generators, holding them accountable even when procedures are properly followed, should the contractor violate legal obligations. A notable example occurred in Fukuoka Prefecture in 2023, where improper storage by an intermediate treatment company led to a fire and a subsequent removal order. Ultimately, eight waste-generating companies that had entrusted disposal to this contractor were issued administrative orders. To avoid such orders, many companies voluntarily respond during the "removal request" stage. However, during official inspections, even minor clerical errors can be scrutinized, potentially leading to findings of unrelated violations. Moreover, the legal knowledge and operational capabilities of industrial waste contractors vary significantly, and official licenses do not necessarily guarantee proper disposal practices. Thus, it is imperative for waste generators themselves to assess contractor reliability.

Excessive stockpiling or drastic price reductions can be early signs of business deterioration, making periodic on-site inspections essential for early risk detection. Ensuring proper waste disposal requires that the generator possess sufficient legal knowledge and adopts a proactive stance that does not overly rely on the contractor.

Environmental Behavior of PFAS in Soil and Groundwater and In-situ Remediation

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In recent years, per- and polyfluoroalkyl substances (PFAS), specifically perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), have been detected in soil and groundwater across Japan. Given their extensive historical use in industrial activities and consumer products, there is growing concern that groundwater contamination by these substances may become widespread throughout the country. However, investigations and remediations for PFAS in soil and groundwater have not yet been sufficiently implemented in Japan.

This paper first presents the results of an up-flow percolation test, which revealed that the environmental behavior of PFAS in soil and groundwater varies significantly depending on the specific compound. For instance, PFOS tends to accumulate at high concentrations of contamination in the shallow soil layers, whereas PFOA demonstrates a higher potential for widespread contamination in both soil and groundwater.

Next, based on applicability tests conducted using either artificially or actually contaminated soil and groundwater, the effectiveness of two in-situ remediation technologies is discussed: one using heat-activated persulfate oxidation, and the other using alkaline water circulation.

Looking ahead, it is imperative to establish investigation methodologies for soil and groundwater that account for the behavior of PFAS, and to conduct on-site pilot tests to validate the effectiveness of these in-situ remediation technologies under field conditions.

A Report on the 65th National Conference of the Pulp and Paper Industry on Safety and Health

Kohei Watanabe
Japan Paper Association

Japan Paper Association (JPA) held the 65th National Conference of the Pulp and Paper Industry on Safety and Health in person at Hiroshima-city in September 2025. The conference had about 340 participants from member companies and cooperating companies.

The conference took place over two days, and the program of the first day included plenary session, special lecture, and social gathering.

In the second day, six breakout sessions were held, and each session had three presentations of case studies and group discussion. In the group discussions, each group (consisting of six to eight participants) engaged in deliberations on the common theme of "Addressing the challenges and concerns in safety and health activities," and the results were presented in each breakout session and shared with all participants.