Hansol
Paper

Hansol Paper's mission: Creating Path to the Sustainable Earth

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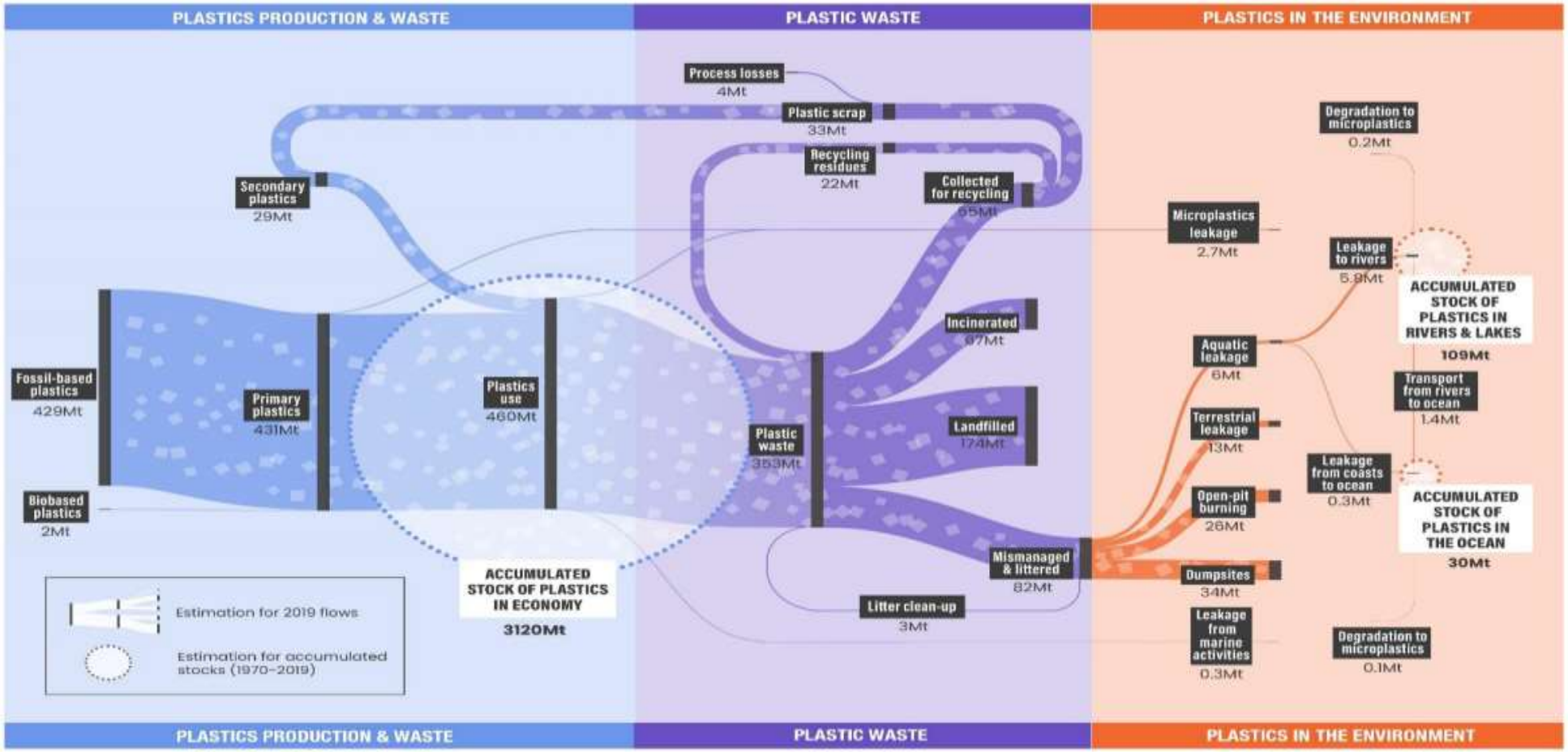
Plastic Waste Issues

Of the 460 million tons of plastics produced, 353 million tons were plastic waste as of 2019.
23% of the total plastic waste, or 82 million tons, was put In landfills or incinerated, or dumped into the world's natural environment, such as rivers or oceans.
To reduce plastic waste, OECD called for the 'development of green alternatives,' as well as enhancing waste management and recycling efforts..



Source : OECD

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Status of Plastic Alternatives

Various efforts are underway to combat plastic waste issues, looking into resources such as plastic recycling and biodegradable materials development.
As an eco-friendly material that can help address the waste problem, Paper is globally recognized as a re-orient material.
Hansol Paper continues to work to develop and expand sustainable materials that can replace plastics.

Mechanical Recycle

Sorts out plastics that are difficult to recycle, and cleans out the dirty plastics to turn them into the material that is ready to be recycled

Source : Mikacycle

Strengths
① Affordable facility investment cost
② Lower in CO2 emission than other recycling methods
Shortcomings
① Recyclable plastic types are limiting
② Recycling is challenging if foreign substances or additives are mixed

Chemical Recycle

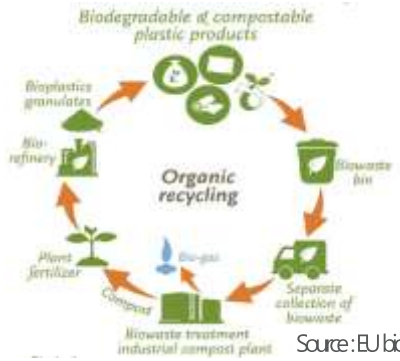
Through chemical reactions, plastics in the form of polymer are converted into monomers, an original form of raw material, indicating that the process creates a full reversal

Source : ENI

Strengths
① Composite plastics can be recycled separately
② Less risk and pollutant emissions compared to incineration
Shortcomings
① Inefficient in carbon emissions reduction in terms of LCA
② High technology and investment cost

Biodegradable

Biodegradable under certain conditions or in nature, it uses microorganisms and food resources



Source : EU bioplatics

Strengths
① No environmental or harmful substances
②Biodegradable in a short-term compared to petroleum
Shortcomings
① Poor heat resistance, strength, physical properties, etc.
② Storage and high-cost issues

Replace

Utilizing resources in plantation forestry, it manufactures paper, food packaging materials, cushioning materials, etc. while playing a role of excellent green resource that is easy to recycle

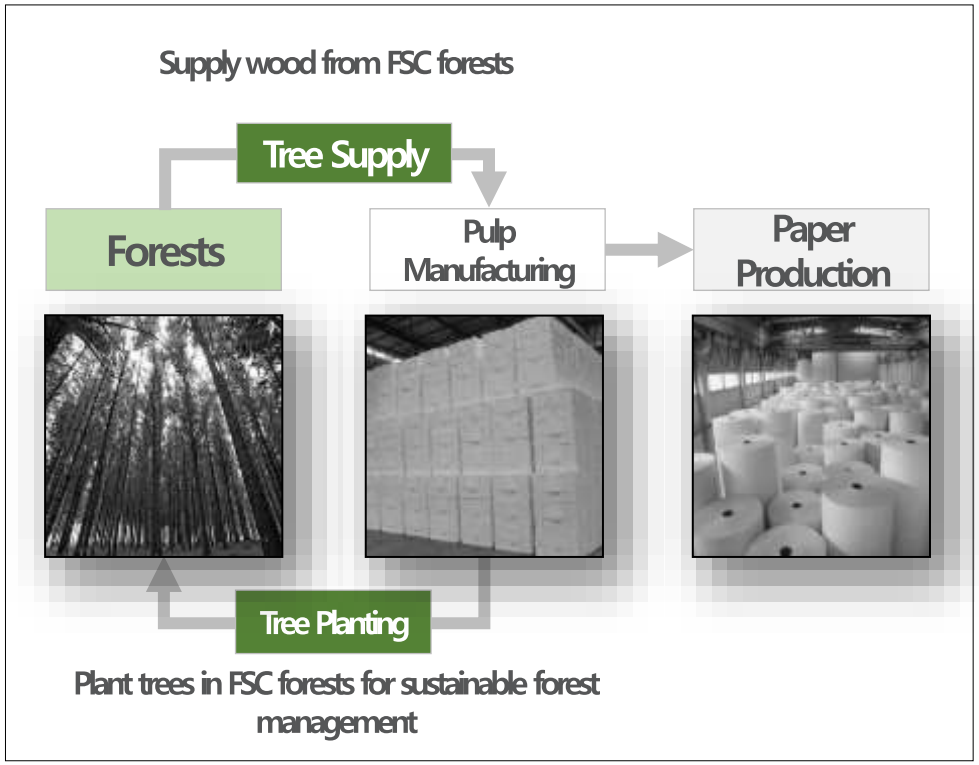
Source : Suez

Strengths
① Contributing to the carbon cycle through plantaion forestry
② Helping with resource circulation by recycling more than 90%
Shortcomings
① Physical and barrier properties poorer than plastics
② Technology development takes time

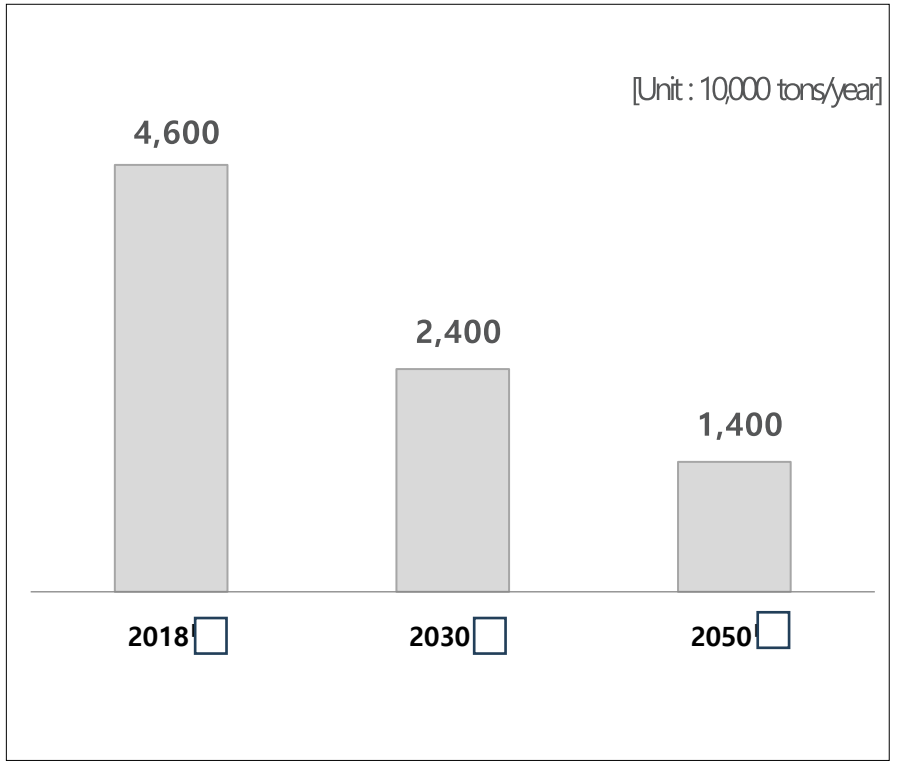
Eco-friendliness of paper ① Carbon neutral

Trees, the raw material of paper, grow in forests, **contributing to the carbon cycle** with more trees are raised.
These sustainable forests are managed with forest management certifications system, FSC.
Trees absorb less CO_2 as they grow, making it crucial to replace generations of trees to maximize the CO2 absorption.

FSC[1] Management System



Estimated CO_2 absorption by aging trees in Korea[2]



1 FSC(Forest Stewardship Council) : The sustainable forest management certification has a management system (chain of custody) that has a cycle from forests to final consumers

2 Excerpt from the article 'Forest Management to Achieve Carbon Neutrality' from National Institute of Forest Science (2021) (Premise : Old trees older than 51 years are not cut down)

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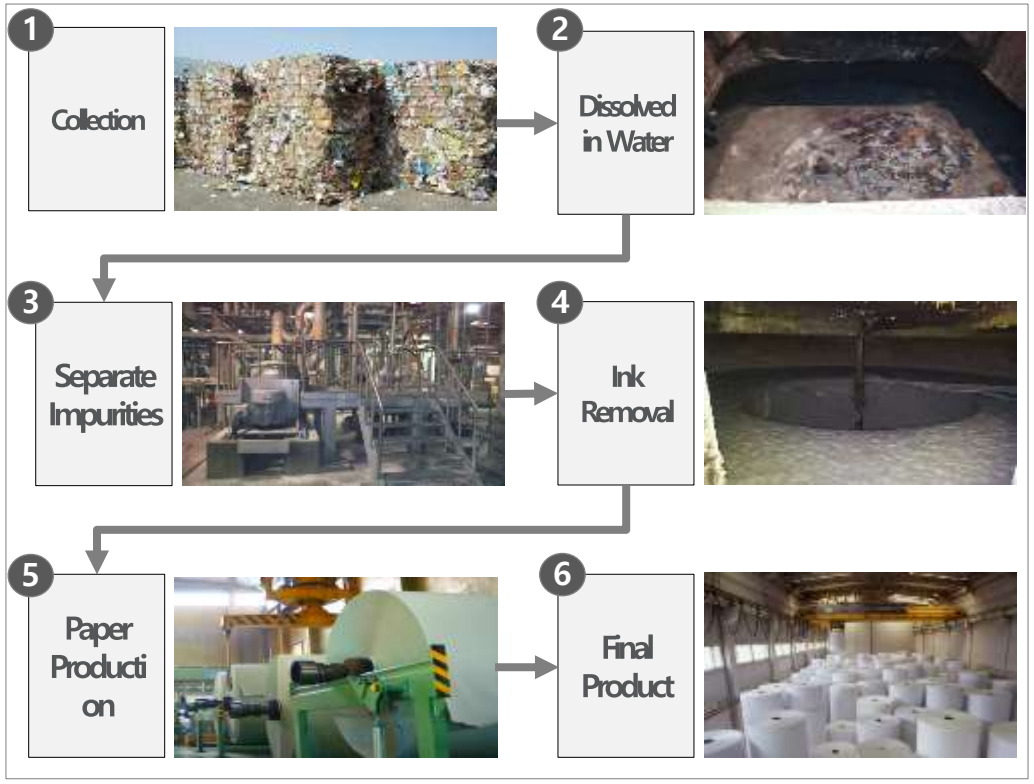
Eco-friendliness of paper ② Resource circulation

90% of paper is recycled, mostly to paper, making it most easily recyclable natural resources.

Recycling standard cost of paper[1] is KW8/kg, making it possible to achieve a circular economy without EPR system.

Paper Resource[2] Recycling Process (Hansol Paper)



Standard cost of paper recycling

[Unit:KW/kg]

Cost of Recycling	Purchase of paper resources	70
	Collection/Transportation	23
	Selective Pressing	30
	Sales Transport	20
	Sub Total	143
	Reduction rate (5%) applied	150
Paper manufacturer purchase cost		△142
Recycling standard cost		8

Source : Environmental Statistics Portal of the Ministry of Environment, Yeongjeong Bae of Seoul National University, 'Evaluation of paper recyclability as an eco-friendly packaging material'

1 Recycling Standard Cost: The cost from collection to recycling is calculated and used as basic data for calculating the government's environmental budget allocation

2 Paper resources : The Korea Paper Federation replaced the term 'waste-paper' with 'paper resources' to emphasize on paper's eco-friendliness (08/19/22)

Hansol Paper's Corporate ESG activities

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① Resource Circulation : Paper Carton Recycling

Paper cartons are barely recycled, but they are valuable resources that are high-quality raw materials

Reasons for the low recycling rate of paper cartons

Mixed Materials	**Various paper resources mixed in paper packs** → Creating issues such as inflow of Al metal flakes from sterilization packs
Insufficient washing	**Spoiled residual beverage due to insufficient cleaning** → Causes a problem of corruption along with other paper resource
Multilayer structure	**Double-sided plastic film coating for water resistance** → Requires a process different from the existing paper recycling system

[Regular carton] 3 layers
- PE (14%)
- White pulp(86%)

[Sterilized Carton] 6 layers
- PE (21%)
- Al (4%)
- Yellow pulp (75%)

source : 한국일보 기사 인용

Why do we have to recycle paper cartons?

Green Trend	**Growing importance of green movement and the rising need for ESG management** → Increasing demand for eco-friendly paper products such as paper resource mixing
Utilization of quality raw materials	**General paper cartons (milk cartons) can be used for high-quality natural pulp** → Produce high level of purity and durability
Shortage of Paper Resources	**Declining demand for printer paper (3% drop per year)** → Addressing paper resource supply issues becomes more challenging

Good Recycled

친환경 환경부

Excellent Recycling (GR) Certification: Certification of products with excellent quality among products manufactured by recycling waste resources

Eco-label certification: Product certification that has improved the degree of pollutant emissions throughout the entire process of production, consumption and waste

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① Resource Circulation : Paper Carton Recycling

Hansol Paper's internal tests found that composite materials such as paper packs can be easily recycled as long as combined with facility investment.

Basic Line Flow

Paper Cartons

Pulper (dissociation process)

Mixing paper resources with water and have it ready for the next process

Screen (cleaning process)

Removing foreign substances in paper resources (sand, glass, etc.) and films, etc. by using centrifugal force

Thickener (enrichment process)

Washing and concentrating process to prepare the materials for the final production stage

Recycled

New Investment

Introducing technology that removes double-sided PE film

- Technology that helps easily separate films such as PE materials often attached to composite materials in water

Investment in micro vinyl removal facilities

-Introducing equipment capable of removing fine foreign substances to detach from the raw material

Adding thickener facilities to keep up with the increased production capacities

- Launching additional water concentrating facilities that help remove moisture from the recycled materials

A test result shows that the recycled paper quality is in good condition (color/durability)

→ With an enhanced sorting/disposal process, it can riase the paper carton recycling rate in South Korea

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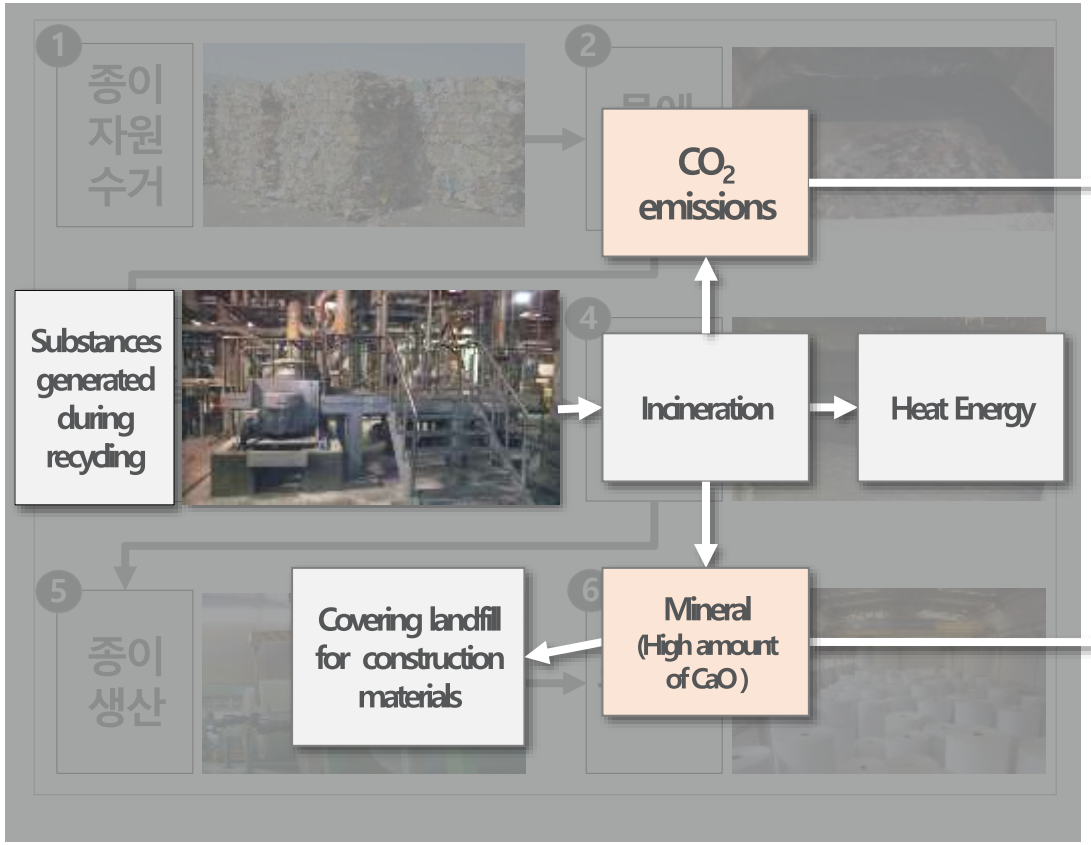
① Resource Circulation : Waste Recycling

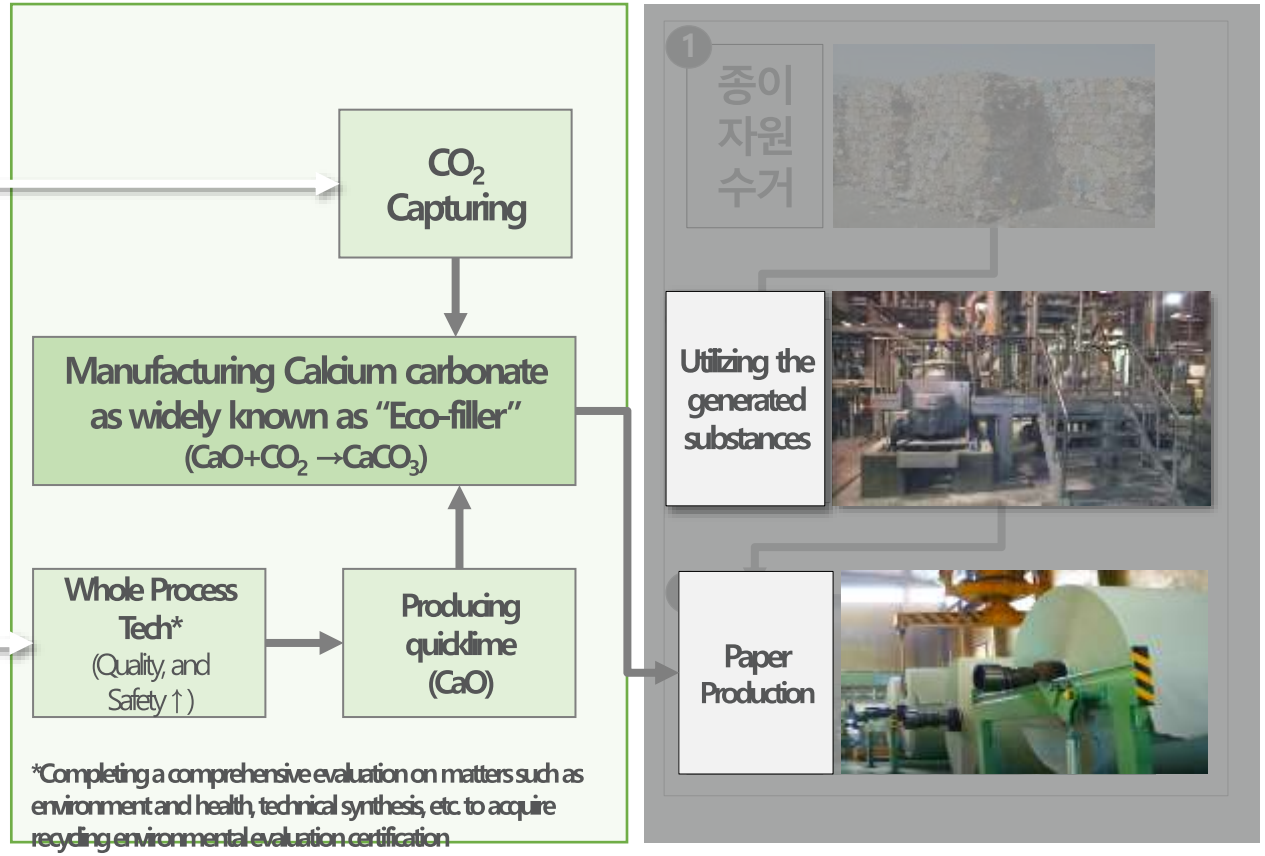
Developing a technology that utilizes the substances generated during the recycling process can turn waste into reusable resources and reduce the atmosphere's CO2 content.

-Utilization on the substances : 27,000 tons/year - CO_2 emissions reduction: 58,000 tons/year

Prior to the new technology (Paper resource recycling process)



After the new technology (Development of eco-friendly filler)



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① Resource Circulation : Development of Upcycling System

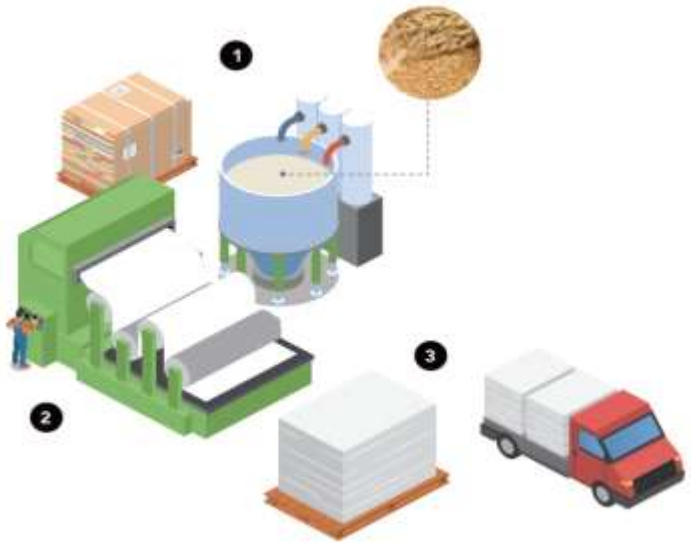
Hansol is actively engaging in developing resource-recycling products that produce paper using by-products collected from its clients' manufacturing facilities and supply the upcycled products to its clients.

Material Collection
(Collecting by-products)

Raw Material Processing
(Pretreatment of by-products)

- Tangerine peels
- Aloe skins
- Cacao skins
- Oat peels

Paper Manufacturing
(Adding the by-products during the paper manufacturing process)



① Stock preparation
② Paper making process
③ Finish process

Supplying products
(Recyded paper utilizing by-products)

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② Post Plastics : High Barrier Paper (reduced plastic film usage)

① Background

▪ **Growing needs for plastic replacement for food packaging**

- Many businesses including confectioners, are seeking to replace food packaging materials with eco-friendly ones

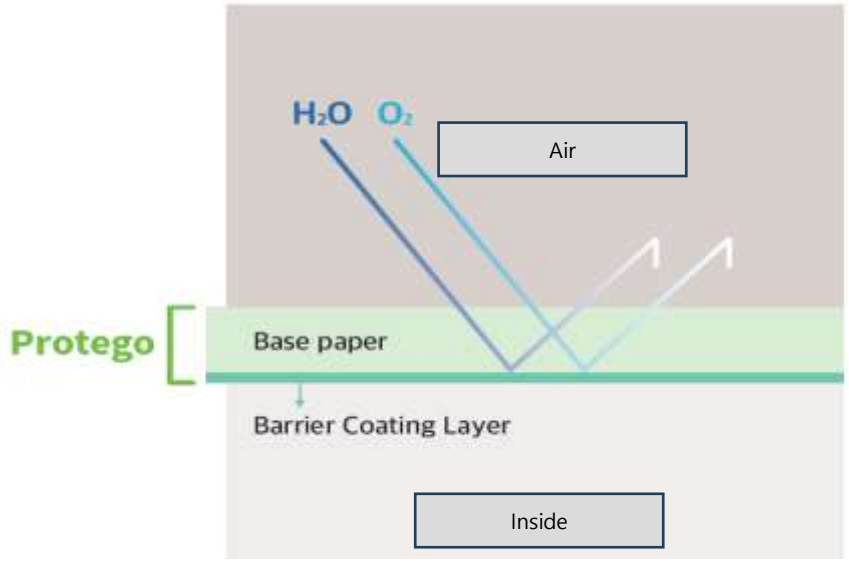
- However, it is challenging to find eco-friendly materials that will be safe from all aspects including food safety, food distribution and manufacturing process.

② Application & Technology

▪ **Protego: Eco-friendly, high barrier paper material**

- Paper material with high barrier properties to replace existing packaging materials that rely on aluminum and plastics

- Blocks the permeation of oxygen and moisture into the paper by forming a water-based barrier coating on the material surface



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② Post Plastics : High Barrier Paper (reduced plastic film usage)

③ Development Status

▪ **4 major companies collaborate to develop products tailored to specific needs**

- Lotte Group Central Research, Lotte Confectionery, Lotte Aluminum, and Hansol Paper

(setting & evaluation of quality and required property, field test, material development)

Collaboration to develop and apply the technology through line tests

▪ **Issues and solutions**

① Enhancing packaging properties and shelf life

- Meets the oxygen and moisture barrier standards with base paper and coating technology

② Manufacturing process optimization

- Optimization of production conditions for paper materials that require processes different from the existing film process

(under the condition that no additional replacement or improvement of equipment)

③ Resolving bursting issue caused by high weight contents

- Applying additional coating layer to Protego base paper

- Manufactures stand up pouches

④ Application & Technology

▪ **Lotte's Jelly Packaging**

① Carbon Emissions Reduction

- 45% reduction in plastics & metals

② Cost Reduction

- Cost reduction through packaging structure simplification and 100% productivity improvement by removing the laminating process

③ Differentiation

- Adding a luxurious feel to the packaging

- Improvement of the corporate image to promote the firm's eco-friendly policy

Recyclability Evaluation

- Internal assessment of 'paper resource' utilization shows more than 90% of raw materials can be reused

Separating film from pulps
- Pulps→ Recycled material
- Films → Energy Sources

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② Post Plastics : High Barrier Paper (reduced plastic film usage)

Quarantine Mask Packaging

- **Company : Yuhan-Kimberly**
  - Replacement for quarantine mask film packaging
- **Technology**
  - Protego's High barrier
  (Oxygen/Moisture permeation weakens filter effect)
- **Result**
  - Cut down on plastic use by more than 90%
  - As the 1st company that has applied the technology, it is expected to extend the range of products that utilizes the technology

Wellbeing product packaging

- **Company : HPO**
  - Replacing existing vitamin packaging (PET/Al/PE)
- **Technology**
  - Resolving vitamin discoloration issue caused by heat
  : Biodegradable film lamination with improved opacity
- **Result**
  - Reduced usage of plastics and metals
  - Adding a meaning value to the products, as the packaging is applied for healthcare products

Cold Drink Packaging

- **Company : GS Retail**
  - Replacing film/Al for pouch type beverage packaging
- **Technology**
  - Sterilization process through water-repellent coating
  (Water resistance is required for 60 degree 'boil sterilization' process)
- **Result**
  - Reducing usage of plastics and metals
  → Continue to make progress as part of ESG management

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② Post Plastics : PE Free Paper cups, containers, and straws (alternatives to PE film/glue)

① Background

▪ **Environmental Pollution Issues caused by Plastic Straws**

- Plastic straws found in endangered sea turtle nostrils
- Environmental groups' campaigning movement to refrain from using straws

▪ **Stricter Regulations on Disposable Plastic Straw**

- Implementation of stricter regulations centered around the European Union
- Introduced and enforced the regulations on the use of disposable products laid out by the Ministry of Environment, South Korea (2022)

※Source : YouTube 'Bruno Soagers'

※Source : Greenpeace

② Issues

▪ **Coffee shops enforces ESG activities by introducing paper straws**

※Source : StarBucks

※Source : Mail holdings

▪ **Surge in consumers' complaints on glue-bonded paper straws**

- Water resistance and durability issues of glued paper straws[1)]
- Lower recyding efficiency with the wet steel treatment[2)] and adhesives (60%)

1) Glue-bonded paper straws[1] : poor water resistance issues rise during the manufacturing process where three layers of paper are attached with starch adhesive

2) Wet strength treatment[2] : A paper fabric surface treatment technology that improves the water resistance of paper by using a wet strength agent, etc.

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② Post Plastics : PE Free Paper cups, containers, and straws (alternatives to PE film/glue)

③ Application & Technology

- **Development of water-soluble paper, Terravas**
  - Replacing Plastic (PE film) and adhesives with water-based coating
  - Enhancing recyclability, biodegradability, food safety and moldability

<Paper cups/straws>

Paper Straws

Paper Cups

Paper containers

④ Effect

- **Durability Improvement**
  - Water resistance (Cobb) : 5g/m² 1,800sec ↓ (lower the better)
  - No change detected under cold/hot water (1.0H / 0.5H)

- **Recyclability**
  - Raising recycling rate to over 90% by applying water-soluble coating solution

- **Others**
  - **Simplified process through self-thermal bonding of coating solution (energy saving)**

(6 steps previously: △ Papermaking· coating △ Gluing △ Laminating △ Cutting △ Drying △ Finishing

→ New 4 steps : △ Papermaking· coating △ Laminating· thermal bonding △ cutting △ completion)

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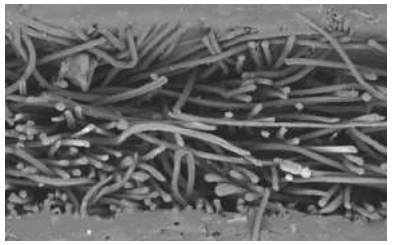
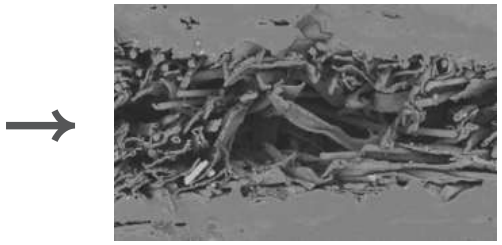
② Post Plastics : PE Free Paper cups, containers, and straws (alternatives to PE film/glue)

① Concept

▪ **Natural Pulps + 100% Vegetable Rayon Wet Tissues**

- Biodegradable by using biodegradable fabric, even under composting conditions
- Using pulps as the main raw material, helping it dissolve well in water (flushable product)
- Eco-friendly wet tissues that do not cause any environmental issues





Plastic Material → **Natural Pulp Base Material**

② Attributes

▪ **Biodegradable**

- Passed the aerobic composting biodegradation test conducted by the Korea Textile Development Institute

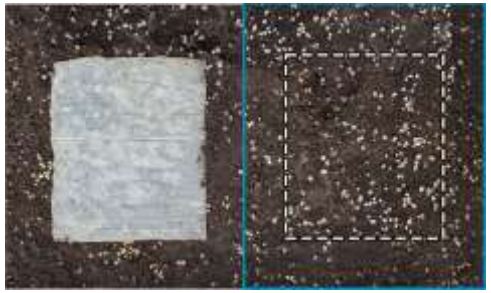
▪ **Flushable Products**

- Passed the International Water Flushing Standard test (INDA ADANA)

※ Test Criteria: must pass all 7 steps to prove that it is flushable

▪ **Hazardous and microplastics not detected**

- Nationally certified testing institutes confirm that 32 harmful ingredients are not detected
- Confirmed that microplastics and sterilization aids (CMIT, MIT) not detected



Result of 41 days later

Result of spinning in water for 2 minutes

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② Post-Plastics : Paper Tray (Alternative to Plastic Ceiling Film)

① Concept

- **Paper tray instead of plastic container**
  - Paper 85% (Body) + Film 15% (Plays a role of the top and barrier)
  - Existing plastic will be replaced with paper trays to cut down on plastic usage
  - Paper parts easily separate from the film after use, improving recyclability

Before : Plastic film Tray

After : Paper Ceiling Tray

Complete Products Packaging

Vacuum packaging

② Attributes

- **Reduced Plastic Usage**
  - 2.5g of plastics (film) used compared to the control group of 17.5g
  - Use only FSC certified paper in an effort to expand the green movement
- **Improved Recyclability**
  - Increased paper recycling rate with paper that easily separates from film after use
  - When disposed separately, waste volume is lowered
- **Utilization of existing facilities**
  - Can apply to existing plastic MAP[1] packaging equipment

Image of a paper tray

Image of paper container separated from the film

1) MAP(Modified Atmosphere Packaging) : A packaging method in which the air inside the product is replaced with a gas mixture

③ Carbon Neutral : Cellulose microfibers (alternative to petrochemical-derived thickeners)

① Background

▪ **Clean Beauty**

- Growing demand for hypoallergenic and natural-based cosmetics in the market
- Lack of natural substances that can replace the basic formulation ingredients such as preservatives, thickeners, and emulsifiers

▪ **Carbon Neutral**

- Expansion of the alternative cosmetic products made of natural materials to replace petrochemical-based products

※Source : Woman&Home

※Source : COS in Korea

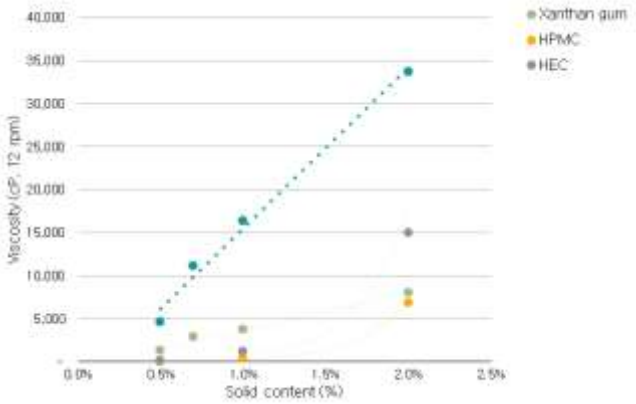
② Application & Technology

▪ **Developing new thickener that use pulps, a carbon-neutral material**

- Sources : Wood (Natural Pulp, cellulose)
- Brand Name : Durade
- Sustainable material (FSC[1] certified pulps)
- Biodegradable material, no microplastic issues

1) FSC(Forest Stewardship Council) : The sustainable forest management certification has a management system (Chain of Custody) that cycles from forest to final consumers

▪ **Viscosity Elevation Technology**



Data per additional 1%

- Durade : 15,000 cPs
- xanthan gum : 4,000 cPs
- HEC[2] : 1,000 cPs

2) HEC (hydroxyethyl cellulose) : Chemically modified cellulose derivatives

③ Carbon Neutral : Cellulose microfibers (alternative to petrochemical-derived thickeners)

③ Progress

▪ **Applied for a patent for an eco-friendly thickener** (Patent number : 10-2022-0081448)

- Applied for a patent for manufacturing a high-concentration eco-friendly thickener to make it easier for consumers to use while enhancing the thickening effect in the formulation

▪ **Collaboration with cosmetic manufacturers**

- Signed an MOU with AmorePacific in April 2021 to develop green cosmetic brands that using green materials/packaging

④ Result

▪ **Obtained vegan certification**

- It is an eco-friendly certification given to the brands that do not use animal-based raw materials or conduct animal testing

▪ **Launching new cosmetic product lines**

- The technology has been applied to KLALAB (serum) and Koreana Cosmetics (sunscreen)

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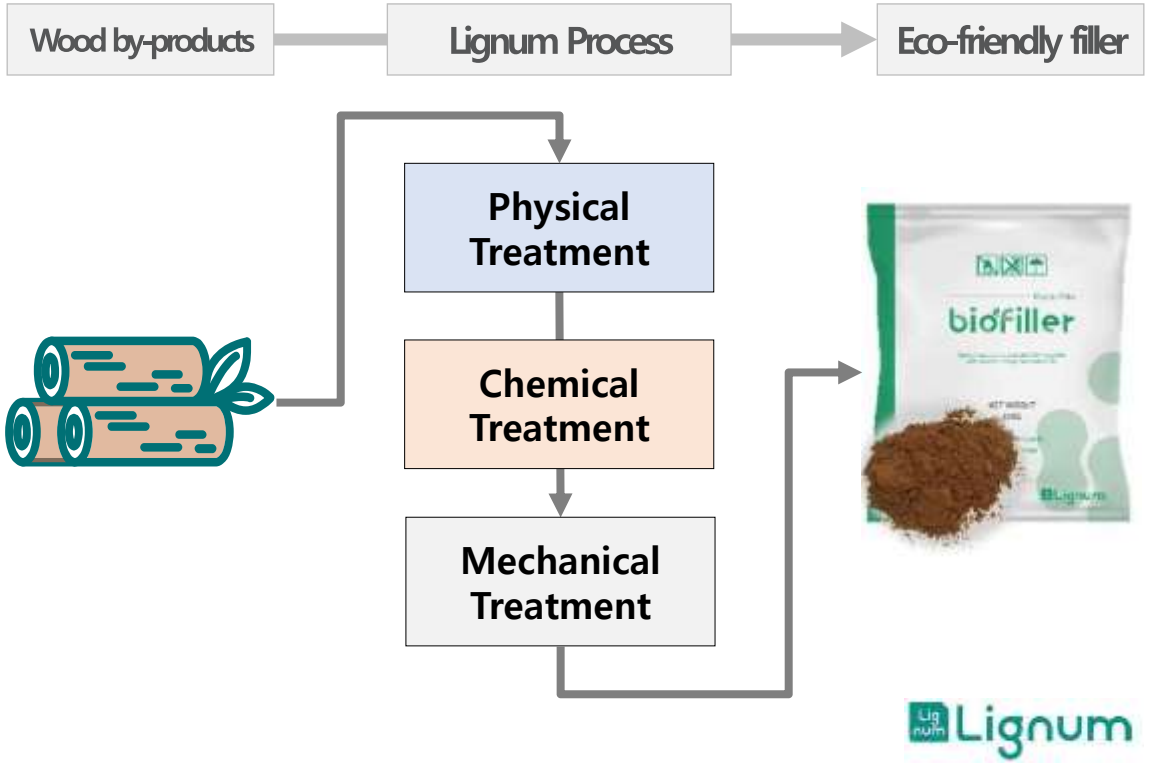
③ Carbon neutral : Wood-based green filler (plastic/rubber filler)

① Definition

▪ **Green filler that uses wood-based by-products**

- The technology includes unique treatment process for wood by-products that have impact mechanically and chemically

- Green products that result in many positive outcomes such as CO_2 reduction, improved physical properties, enhanced functionality



② Attributes

▪ **CO_2 reduction by using eco-friendly material**

- Bio-based low-carbon material using wood by-products (0.56 kg CO_2 – eq)

※ PP carbon emissions : 1.6 ~ 1.9 kg CO_2 – eq

▪ **Improved physical properties**

- Unique properties of lignin that has a high level of resistance against scratches

▪ **High-functional additives**

- Using lignin properties, high resistance to exposure to sunlight and oxidation

▪ **Examples of Products**

Automotive parts for interior and exterior (door trims and tailgates)

④ Symbiotic Management

Hansol Paper is fulfilling its corporate social responsibilities by ceaselessly communicating with society and members of the industry.

Stability in Paper Supply Chain

▪ Contributes to stabilizing paper resource price and recycling market operation at the time of imbalance s in supply and demand of paper resources

Win-win relationships with printing and packaging industry

▪ Cooperative agreement designed to improve business environment, increase the market demand, and boost the industrial competitiveness

Progress

Hansol Paper's green management is well recognized by a number of organizations from home and abroad.

Acquired Platinum grade in Ecobody's sustainability evaluation

PLATINUM Top 1%
2023
ecovadis
Sustainability Rating

Ranked 1st in 'Korea's Most Admired Companies' for 20 consecutive years

Suggestion

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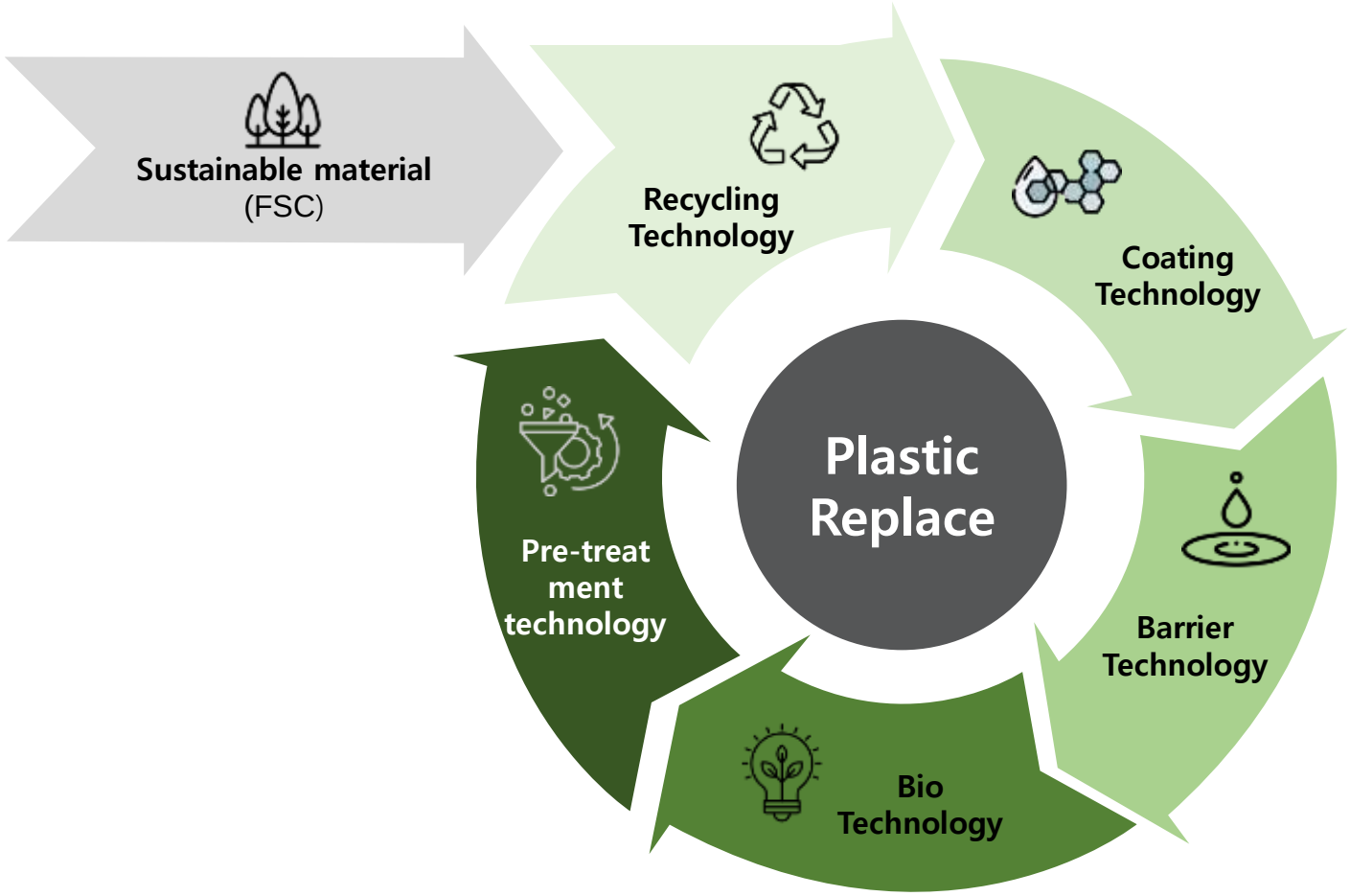
Hansol Paper will lead ESG management and create a sustainable future by developing technology that overcomes limitations of paper.



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