

**COLOR FROM NATURE  
FOR US, FOR EARTH**



**GREENWEAR**

# Greenwear offers eco-friendly dyeing solutions for the fashion industry.

Greenwear provides sustainable dyeing solutions that minimize environmental and human impact from raw materials to the production process, including refining/processing technology for biomass dyestuffs and biomass dyeing techniques for a variety of colors and materials.



## Greenwear Produces and Develops High-quality & Sustainable Biomass Dyeing Products.

CO<sub>2</sub> emissions, chemical abuse, and hazardous wastewater are emerging as serious problems that threaten the survival of mankind as well as nature and animals by destroying the global environment. Various eco-friendly technologies have also emerged in the textile fashion industry, but most of them are limited to materials such as upcycling and eco-friendly raw yarn. It seems that the current textile fashion industry has a long way to go to achieve true sustainability.

We develop sustainable colors that allow humans and nature to coexist with each other through high-quality biomass dyeing technology using natural materials.

### Eco-Friendly

Greenwear has developed a dyeing technique optimized for natural materials to minimize the impact on the natural environment and the human body by minimizing CO<sub>2</sub> emissions, wastewater concentrations, residual chemicals, and water usage.

### High Quality

Greenwear's biomass dyeing technology has solved the low-quality problem of traditional natural dyeing. We have improved the quality of biomass dyed products through R&D on biomass dyes, binding of biomass dyes to fabric, production processes, and chemical usage and usage.

### A Variety of Colors

Greenwear's biomass dyeing technology overcame the color and dyeable material limitations of traditional natural dyeing. We are developing technologies optimized for biomass dyeing, developing a variety of colors with quality, and continuously developing new colors.

# Why Biomass Dyeing?

Biomass dyeing is a sustainable method that benefits for human and nature by replacing carbon-based resources, addressing chemical concerns, producing clean wastewater, reducing visual fatigue and minimizing skin irritation.



## Replacing Fossil-Based Resources

The dyeing industry now depends on synthetic dyes from petrochemicals like BTX, benzene, and coal tar.

Biomass dyes have potential as a net-zero resource, absorbing CO<sub>2</sub> during cultivation. However, mass production, quality, and reproducibility need further development.



## Less Harmful Wastewater

Biomass dyes minimize dyeing and wastewater issues due to their low toxicity and concentration.

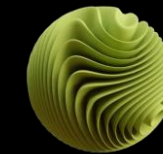
In the textile industry, wastewater from the manufacturing of synthetic dyes and their use in chemical dyeing processes is the most toxic among all industries, accounting for 20% of global industrial wastewater.



## Skin-Friendly

Fabrics dyed with biomass dyes are gentle and non-irritating to the skin, making them ideal for sensitive skin.

Historically, biomass(natural)dyes served as medicinal herbs in regions like ancient Asia. In contrast, chemical dyes and dyeing processes involve numerous chemicals that may cause allergies, inflammation, and skin irritation.



## Visually Friendly Wavelength

Biomass dyes consist of diverse colorants and organic substances.

Biomass dyes offer visually comfortable colors with a wide range of smooth wavelengths. They create distinctive color perceptions, changing subtly with different lighting conditions and angles.



**TECHNOLOGY & QUALITY**

# Our Technology

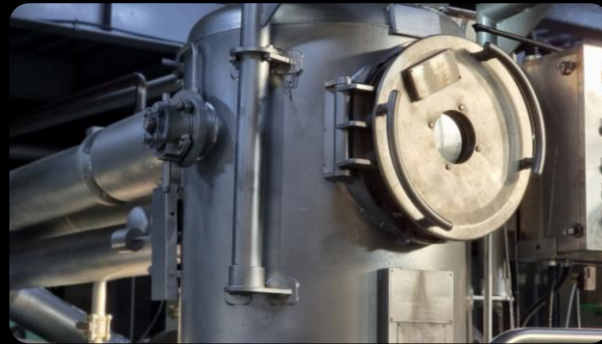
Greenwear has developed the biomass dyeing technology of high quality and various color through research on various biomass dyestuffs.



## Dye Extraction & Processing

Biomass dyes contain various pigments and organic substances unlike synthetic dyes.

Due to this characteristic, biomass dyeing requires a high level of dye processing technology compared to the chemical dyeing that uses single pigments of synthetic dyes. Greenwear has accumulated expertise and data on the refining and processing of biomass dyes through research and analysis of the composition of biomass dyes.



## Optimal Dyeing Process

Greenwear has developed a dyeing technology optimized for biomass dyeing.

The production process of Greenwear achieves sustainability in terms of energy and carbon emissions, water and resource usage.



## Commercial Scale Production

Greenwear established a high qualified mass production system.

By optimizing the biomass dyeing process using conventional chemical dyeing machinery, we have established a mass production system that ensures high quality.

# Technological Advantages

Greenwear can implement high-quality colors on various materials.

## Color Diversity

We have developed a wide spectrum of diverse colors with assured quality.



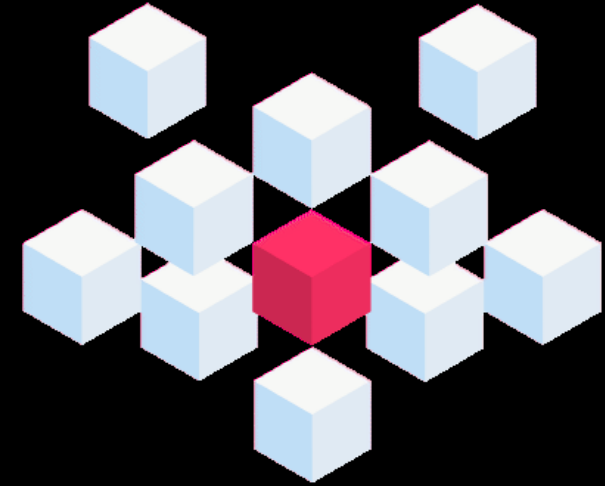
## High Quality

Dyeing quality improved on the back of consistent R&D efforts with focus on multiple key areas such as biomass dye extraction/processing, interaction between dyestuff and fabrics, dyeing process et al.

### Dyeing Quality Comparison

		Greenwear	Other Natural Dyeing
Reproducibility	Level	High	Low
	Light	3▲	1~2
Fastness	Washing	3~4▲	3
	Rubbing	3~4▲	2~3
Leveling	Listing	4▲	2~3
	Ending	4▲	2~3

\* Fastness can be different depending on the fabric, yarn, etc.



## Applicability to All Fabrics

Traditional natural dyeing is possible only for cellulosic fibers such as cotton but our breakthrough biomass dyeing technology can be applied from polyester to polyethylene fiber that chemical dyeing cannot be possible.

### Applicable Fabric Comparison

Fabric type	Fabric	Greenwear	Other Natural Dyeing	Chemical dyeing
Natural fibers	Cotton	○	○	○
	Modal	○	○	○
Regenerated fibers	Tencel	○	○	○
	Acetate	○	×	○
Semi-synthetic fibers	Polyester	○	×	○
	Recycled Polyester	○	×	○
	Nylon	○	×	○
	Polyethylene	○	×	×



**SUSTAINABILITY**

# Our Sustainability

We offer new sustainable solutions for the dyeing industry, ranging from reducing pollutant emissions in dyes and manufacturing processes to minimizing CO<sub>2</sub> emissions.

20%

CO<sub>2</sub>

Reduced carbon emissions by over 20% through process optimization, efficiency enhancement, and low-temperature dyeing methods.

80%

Wastewater

Achieved low-pollution wastewater with toxicity one-fifth of chemical dye wastewater concentration.

83%

Chemicals

Reduced chemical usage by 83% and ensured residual chemicals meet eco-friendly standards at less than 1/20 of specified limits.

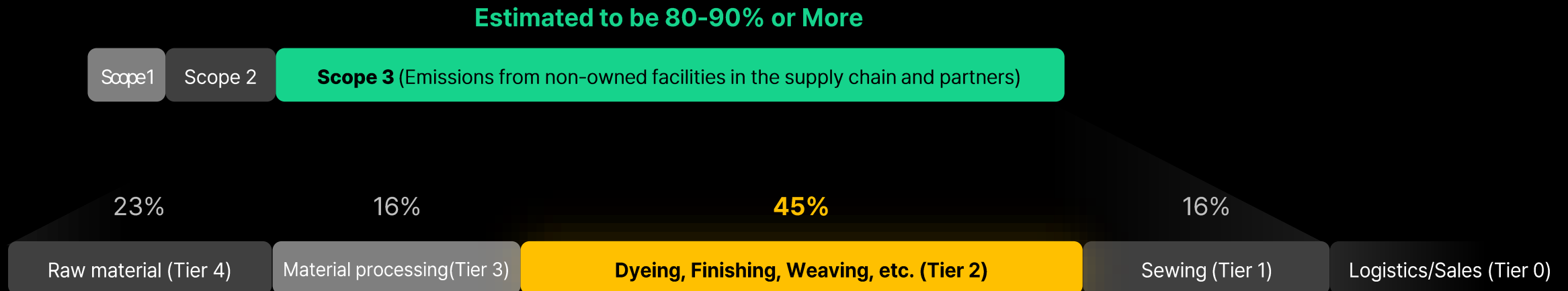


# CO<sub>2</sub> Emission Issue in the Dyeing Process

The textile and fashion industry accounts for 10% of global carbon emissions, and within this industry, the dyeing process holds the largest share in the product supply chain.

## Carbon Emission Share of Dyeing Process in the Supply Chain

In the supply chain, carbon emissions from the dyeing process in Scope 3 (suppliers and partners) account for over 80% of the entire fashion brand's supply network sector. Additionally, within Scope 3, Tier 2 sectors such as dyeing, finishing, and weaving constitute half of the emissions. Therefore, to achieve carbon neutrality, it is crucial to adopt dyeing solutions that minimize CO<sub>2</sub> emissions.



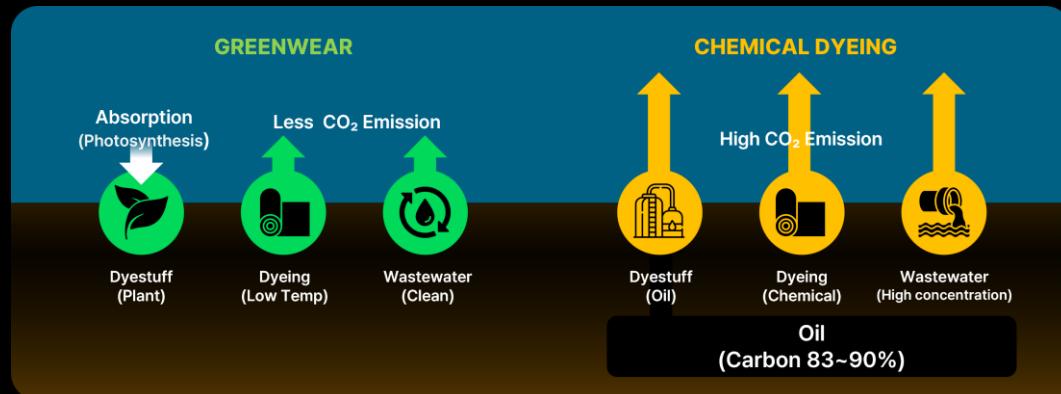
\* In Tier 2, dyeing is estimated to account for over 75% of the total, Source: WRI and Aii, Mckinsey, Quantis.

# CO<sub>2</sub> Emission Minimization Solutions

Greenwear offers sustainable biomass dyeing solutions that ensure carbon emission reduction.

## The Potential of Biomass Dyes

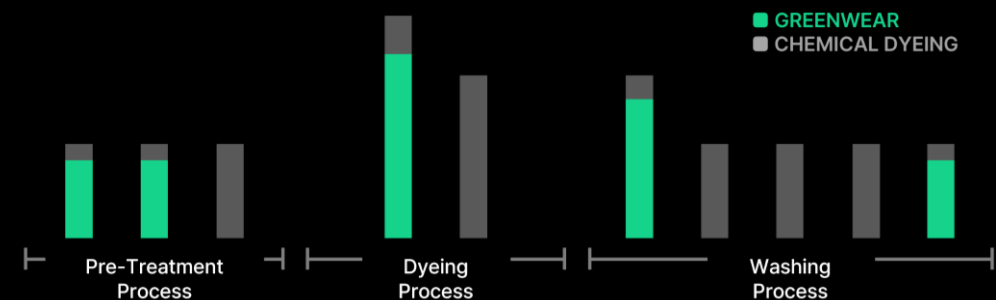
Greenwear's biomass dyeing products contribute to minimizing carbon emissions across the entire value chain of raw materials, processes, emissions, and waste.



## Carbon Emission Reduction Dyeing Process

The biomass dyeing process implemented by Greenwear involves temperature control (low-temperature dyeing technology) and process optimization, reducing energy consumption and minimizing CO<sub>2</sub> emissions.

### Dyeing Process Comparison



\*Estimated Standards for Cellulosic Fiber Fabrics / Intermediate Concentration Colors.

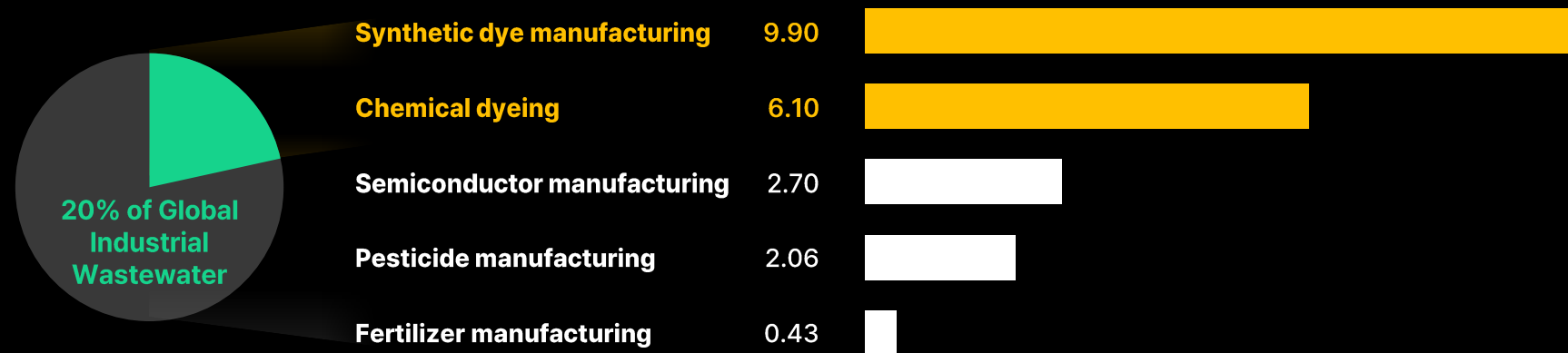
# Toxic Wastewater Problems

Synthetic dyes and chemical dyeing processes discharge toxic wastewater during production, polluting water bodies such as rivers, streams, and oceans.

## Most Toxic Dyeing Wastewater

The textile and fashion industry accounts for 20% of global industrial wastewater, with dyeing and processing industries being significant contributors. Wastewater from synthetic dye manufacturing and chemical dyeing processes is the most toxic among all industries, with toxicity levels 3-5 times higher than that of pesticide/semiconductor process wastewater. Environmentally-friendly alternatives are needed to address the highly toxic wastewater generated by synthetic dye-based dyeing processes.

\* Synthetic dye production ranked 1st (9.9), chemical dyeing process ranked 3rd (6.1), eco-friendly standards range from 1.0 to 2.0.



# Wastewater Toxicity Reduction Solution

Greenwear offers eco-friendly alternatives for chemical dyeing, which is known for its high toxicity and significant wastewater discharge.

## Wastewater Concentration Reduction

Greenwear's low-pollution wastewater exhibits over 80% lower concentrations in BOD, TOC, SS, T-N, T-P, and other wastewater measurements compared to chemical dyeing wastewater.

### Wastewater Comparison



## Greenwear Wastewater Test Results

Greenwear's biomass dyeing process discharges low-pollution wastewater with non-detection of 31 toxic substances, as confirmed by harmful substances testing.

### 31 Items that were not Detected

Cyanide, Chromium (VI), Lead, Arsenic, Cadmium, Antimony, Mercury, Selenium, Vinyl chloride, 1,1-Dichloroethylene, Dichloromethane, Acrylonitrile, Chloroform, Carbon tetrachloride, Benzene, 1,2-Dichloroethane, Trichloroethylene, Tetrachloroethylene, Styrene, Bromoform, Naphthalene, 1,4-Dioxane, Phenol, Pentachlorophenol, Diethylhexyl phthalate, Diethylhexyl adipate, Acrylamide, Epichlorohydrin, Formaldehyde, Organic compounds, Polychlorinated biphenyls (PCBs)

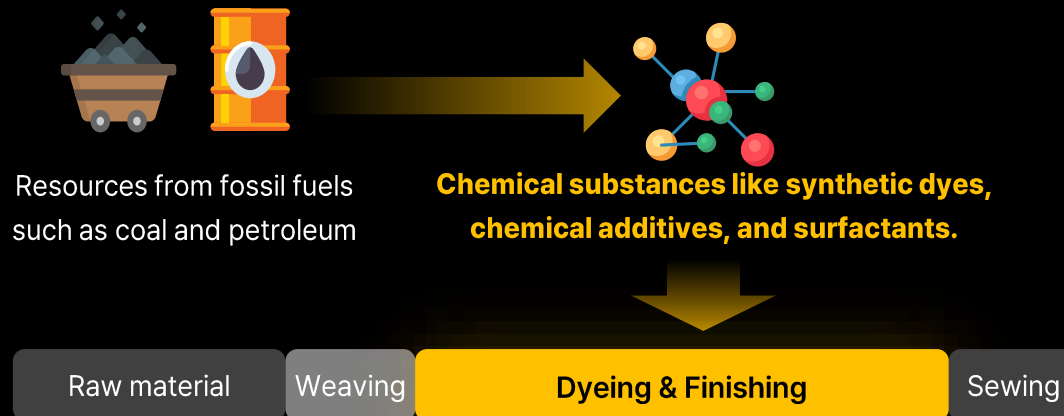
Wastewater	BOD	TOC	SS	T-N	T-P
Chemical Dyeing	468.5	318.8	125.0	47.1	2.4
Greenwear	33.9	22.3	25.1	6.1	0.7
Effluent Limits	10	25	10	20	0.5

# Chemical Issues

In the modern dyeing industry, over 8,000 types of chemical substances are used, leading to environmental problems due to their residues in wastewater, waste, and products.

## Need for Changes in Dyeing Processes

Chemical dyeing processes involve a vast amount of chemical substances, many of which can have adverse effects on the skin, human health, and the environment. Petrochemical-based synthetic dyes and various chemical additives used to improve dyeing quality can cause skin allergies, inflammation, and contribute to ecological pollution through discarded clothing and fabrics.



Over **8,000 types** of chemicals  
Annual usage of **43 million t**

# Chemical Minimization

Greenwear's biomass dyeing provides a chemical minimization solution, reducing skin irritation, soil contamination, and ecological destruction caused by chemical substances.

## Test result of residue chemicals on fabrics

Fabric residues meet the OEKO-TEX® STANDARD 100 criteria at levels 1/10 to 1/20.

항목	TBT	TPhT	DBT	DMT	DOT	DPhT	DPT	MBT	MOT	MMT	MPhT	TeBT	TeET	TCyHT	TMT	TOT	TeOT	TPT
<b>Greenwear</b>	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
<b>Global Standard</b>	< 1.0	< 1.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Source : CENTEXBEL / Global standard : OEKO-TEX STANDARD-100 (Unit : mg/kg)

## Hazardous Substance Testing for Fabrics (Products)

Certified by authorized fiber testing institutions as safe textile products.

Test	Requirements	Detection Amount	Result
<b>Arylamines</b>	Test for 24 substances, <30 mg/kg	<b>Below detection limit</b>	<b>Pass</b>
<b>Formaldehyde Content</b>	<75 mg/kg	<b>0 (Not Detected)</b>	<b>Pass</b>
<b>pH</b>	pH 4.0 ~ 7.5	<b>6.6</b>	<b>Pass</b>
<b>Allergic Disperse Dyes</b>	Test for 22 substances	<b>Below detection limit</b>	<b>Pass</b>

GREENWEAR

**COLOR, FABRICS & DYES**

# Biomass Dyes

Greenwear uses a variety of natural materials as dyes, many of which are sourced from by-products or waste of other industries, ensuring sustainability in resource utilization.



**Madder**  
Rubia cordifolia



**Pomegranate**  
Punica granatum



**Gallnut**  
Quercus infectoria



**Catechu**  
Acacia catechu



**Myrobalan**  
Terminalia chebula



**Himalayan Rhubarb**  
Rheum emodi



**Marigold**  
Tegetas erecta



**Mulberry**  
Morus Alba



**Lac**  
Kerria lacca



**Indigo**  
Indigofera tinctoria

## Eco-friendly Certifications

### OEKO-TEX® STANDARD 100

Greenwear has obtained OEKO-TEX® STANDARD 100 certification, which verifies the safety and sustainability of its textile and accessory products, instilling trust in customers.



STANDARD  
100



2212290  
Centexbel

### Certified Biomass Dyes

Greenwear utilizes biomass dyes certified by GOTS 6.0 and ZDHC, demonstrating sustainability in resource usage and environmental friendliness while reducing chemical concerns.



GOTS 6.0  
Certificated



ZDHC  
Certificated

## Mordant

### Fe Sulfate



### Al Sulfate



A mordant is a medium that help biomass dyes dyeing on fabric. Greenwear uses the iron(Fe) or aluminum(Al) sulfate as a mordant.



# Color & Fabrics

Greenwear offers biomass dyeing solutions with a wide spectrum of colors and materials.

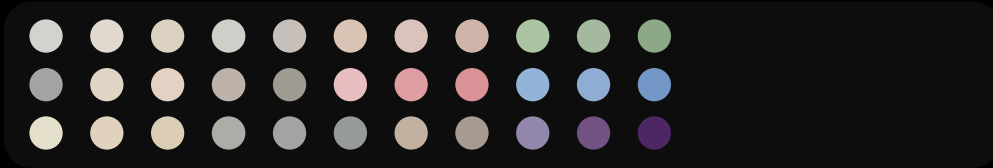
## Earth Tones : Colors from Nature

Discover our signature biomass dyed colors, crafted from sustainable sources and inspired by Earth's beauty.

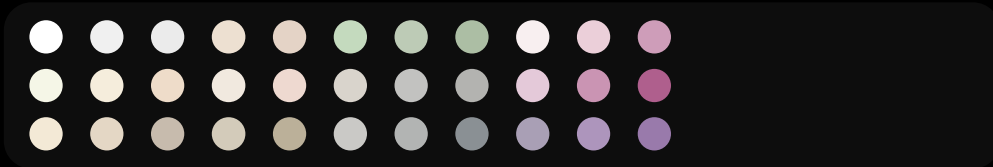
### Cotton



### Polyester



### Nylon



## Fabric Applications

Biomass dyeing is possible for a variety of materials and structures, not just cellulose-based fibers like cotton, but also synthetic fibers like polyester and nylon, as well as materials such as polyethylene that are difficult to dye with chemical dyes.

### Cotton



+ Mixed

Organic Cotton, Spandex, Polyester, Modal, etc.

### Polyester



+ Mixed

Cotton, Rayon, Modal, Spandex, Polyethylene, etc.

### Nylon



+ Mixed

Spandex, Tencel, Rayon, Mulberry, Modal, Polyester, etc.

### Acetate



+ Mixed

Polyester

### Polyethylene



+ Mixed

Polyester, Graphene

### Recycled Polyester



+ Mixed

Cotton, Rayon, Modal, Spandex, Polyethylene, etc.

### TENCEL™ Lyocell



+ Mixed

Spandex, Polyester, Modal, etc.

### Modal



+ Mixed

Spandex, Polyester, Tencel, etc.

# Fashion Application

*Frenchie L*



**JAJU**



## Brand SMINUN

SMINUN([www.sminun.com](http://www.sminun.com)) is Greenwear's sustainable fashion brand that minimizes environmental impact with biomass dyeing techniques. Our clothing is created with consideration for the negative impact of the current textile and fashion industry on the planet.

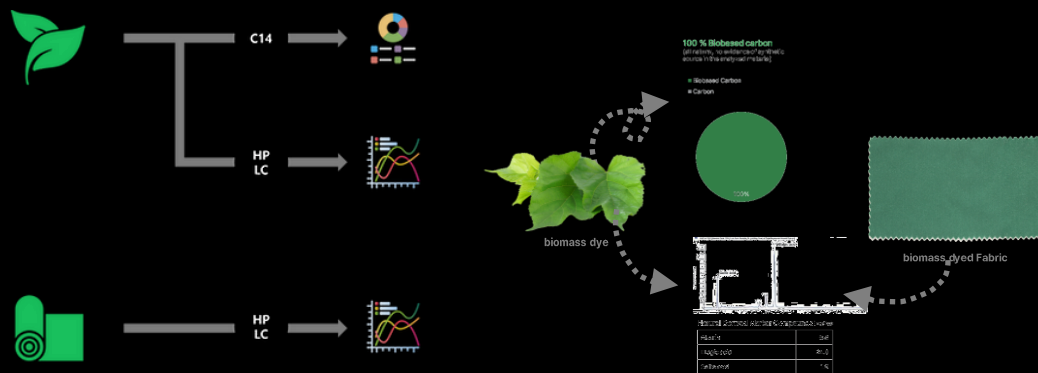


# Biomass Dye Verification

Greenwear has a verification system for biomass dyes and fabrics dyed with biomass dyes and provides various related information about biomass dyes through its website.

## Radioisotope Analysis : Natural Origin Verification System

Greenwear uses radioisotope analysis for biomass dyes to measure the biomass content, proving that the dyes used for dyeing are truly of natural origin and not synthetic materials. The key components of the biomass dyes are disclosed, enabling verification of the authenticity of the fabrics dyed with biomass dyes. By comparing the radioisotope analysis results of natural-origin substances with those of dyed products, the authenticity of the biomass dye products can be confirmed.



### 1. Analysis of Biomass in Dyes

In the atmosphere, there's a constant ratio of C-12 (stable carbon) to C-14 (radioactive carbon). C-14 is created when nitrogen reacts with cosmic rays from the sun. Plants absorb carbon dioxide from the atmosphere during photosynthesis. When living things die, they no longer absorb C-14, and the previously absorbed C-14 decays into nitrogen over time.

By making a biomass dye/product from biomass that absorbs carbon dioxide in the atmosphere, the mass of carbon in it can be analyzed to determine if it is bio-based or petroleum-based synthetic material.

### 2. Analysis of the Marker compounds of Dye and Dyed Fabric

Biomass dyes use marker compounds for analysis. HPLC (High-Performance Liquid Chromatography) analyzes these markers. While HPLC alone doesn't prove the natural origin of dyes, it complements radioactive isotope analysis, which directly detects synthetic components, demonstrating the use of natural substances (biomass dyes) in products.

# Washing Tips



**1. Wash with a neutral detergent.**

Please refrain from using detergents that contain oxygen-based bleaching agents, such as sodium percarbonate or sodium perborate.

**2. Do not use detergents that contain chlorine-based bleaching agents.**

**3. Do not wring the product strongly.**

**4. Dry in the shade.**



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