Hong Kong Textile and Fashion Industry – Road to Sustainability

Green Textile Innovations and Technologies

The Hong Kong Research Institute of Textiles and Apparel

Katherine Chan, Director of Business Development

9 May 2023

HKRITA

About HKRITA

- was established in 2006
- is funded by the Innovation and Technology Commission of the HKSAR government
- PolyU being the host institute

Our vision -
to be the leading centre of excellence in research, development and technology transfer in fashion and textile industry.

Our mission -
to be a Hong Kong based world renowned research institute for the textiles and clothing industry by concerted and focused R&D efforts to enhance the economic development of the HKSAR, mainland China and overseas. And by facilitating technologies transfers of R&D results, in pursuance of continual development technologies to enhance the competitiveness of the industry locally and internationally.

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Technology Focus

Advanced textiles and clothing production technologies

Enhanced industrial systems and infrastructure

New materials and textiles and apparel products

Innovative design and evaluation technologies

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Achievement - Awards

Until April 2023: 105 Hong Kong, mainland and overseas

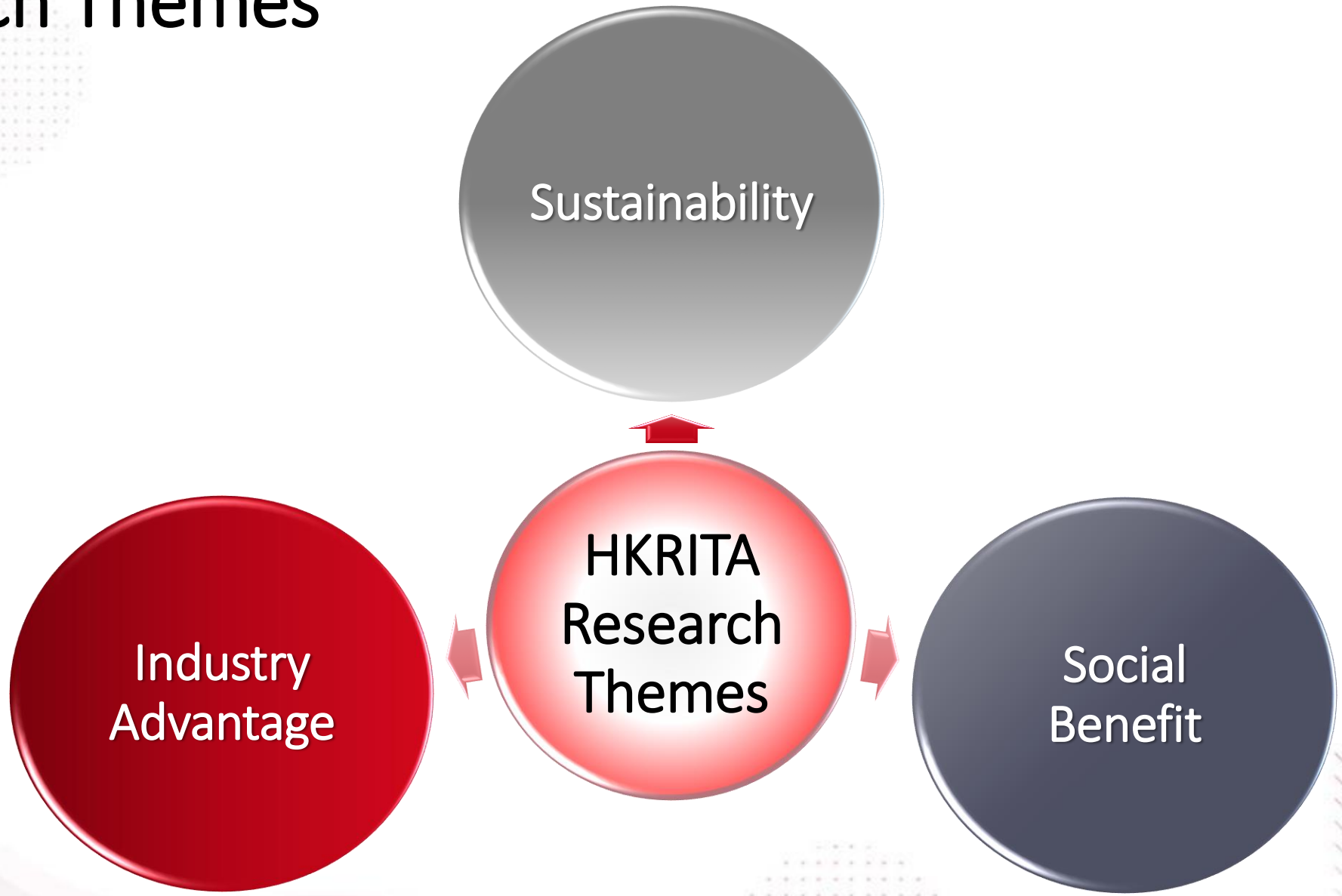
reddot design award
winner 2019

FAST COMPANY'S
INNOVATION BY
DESIGN AWARDS
2019 HONOREE

2019
R&D 100
WINNER

EDISON AWARDS

Research Themes



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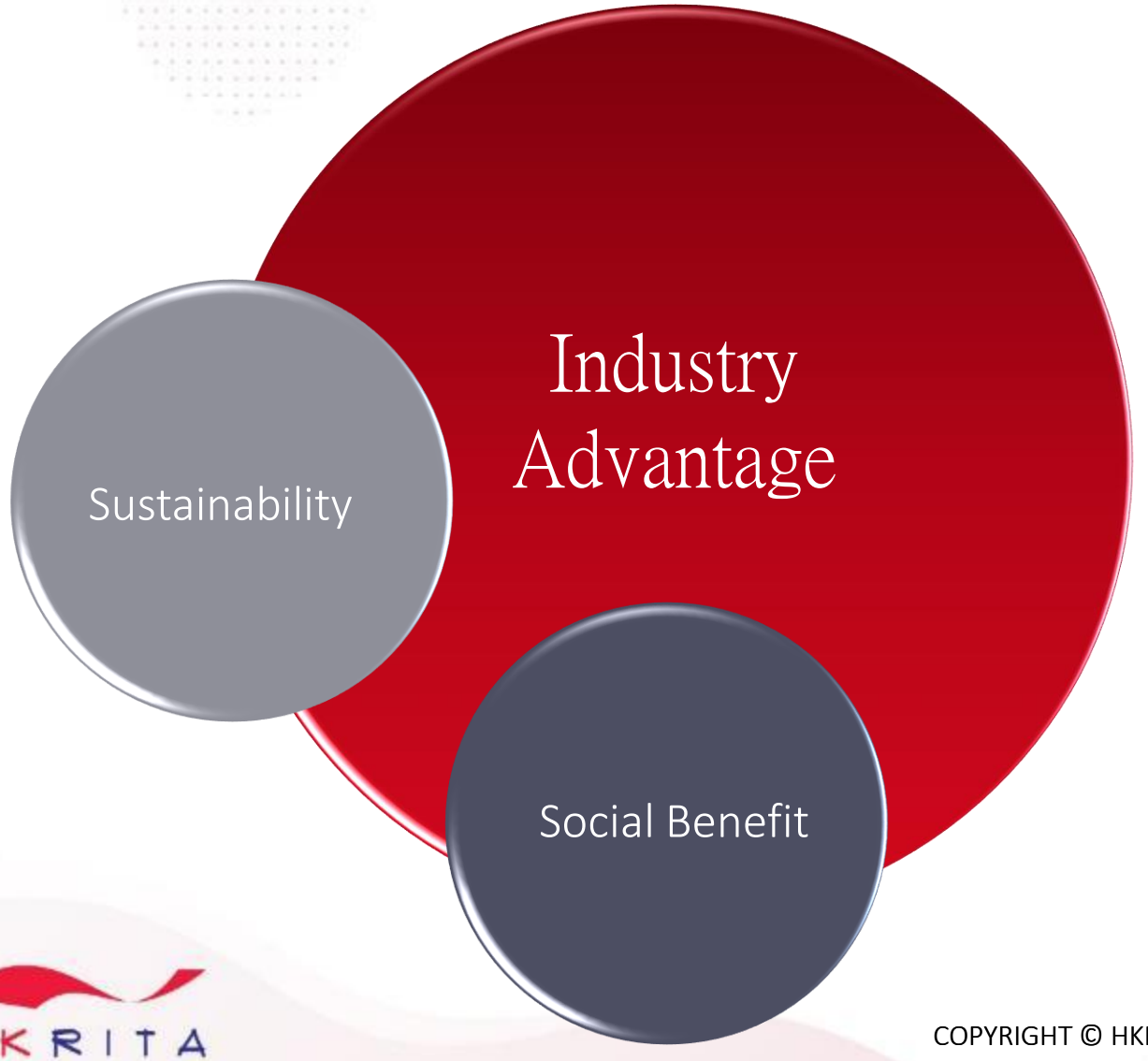
Research Themes



- Industry 4.0
- Smart Manufacturing
- Demand Predictives & Analytics
- Manufacturing Technologies
- Materials Science
- Enterprise & Supply Chain Solutions
- Resource Optimisation
- Agile Supply Chains

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Manufacturing technologies and Materials

1. Bio-based PHBV/PLA anti-bacterial textiles
2. Far infra-red reflective textiles for thermal management

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1. Bio-based PHBV/PLA anti-bacterial textiles

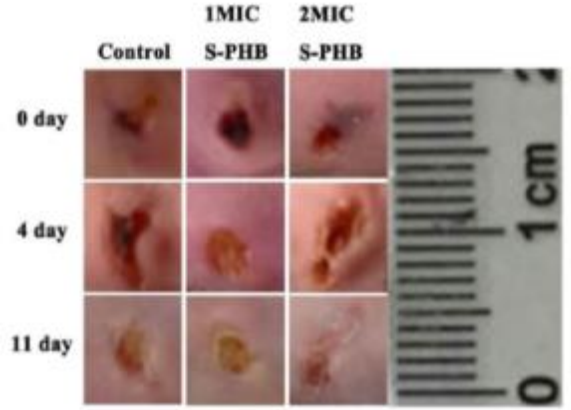
The bio-based PHBV/PLA antimicrobial fibers possess advantages of both natural and artificial antimicrobial fibers. The fibers are biodegradable and eco-friendly, as well as effectively antimicrobial and anti-mite.

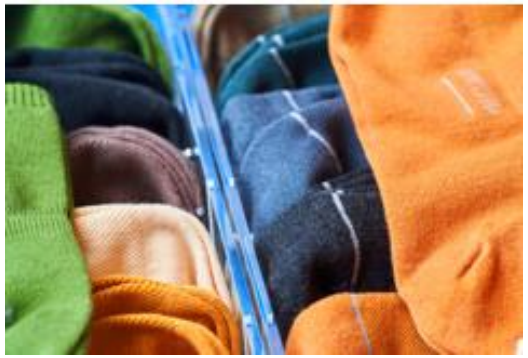
- PHB-Oligomer extract from PHBV is naturally anti-bacterial (>99%) with wound healing property
- 100% bio-based and biodegradable – while other artificial antimicrobial fibers may release chemical or silver particles that leads to environmental pollution
- Applicable on both filament and staple yarn
- Originally developed for medical & healthcare, also suitable for apparel & accessories (socks, shoe uppers) and home textile application

PHBV PLA

1. Bio-based PHBV/PLA anti-bacterial textiles

- PHBV/PLA – Bio Based & Bio Degradable Material
  - PHB-Oligomer extract from PHBV is naturally anti-bacterial and the material has wound healing property
  - Also Anti-dust mite property
  - PLA is bio-based and bio-degradable material
  - Combination of PHBV and PLA gives good hand feel, durability, easy to handle in production





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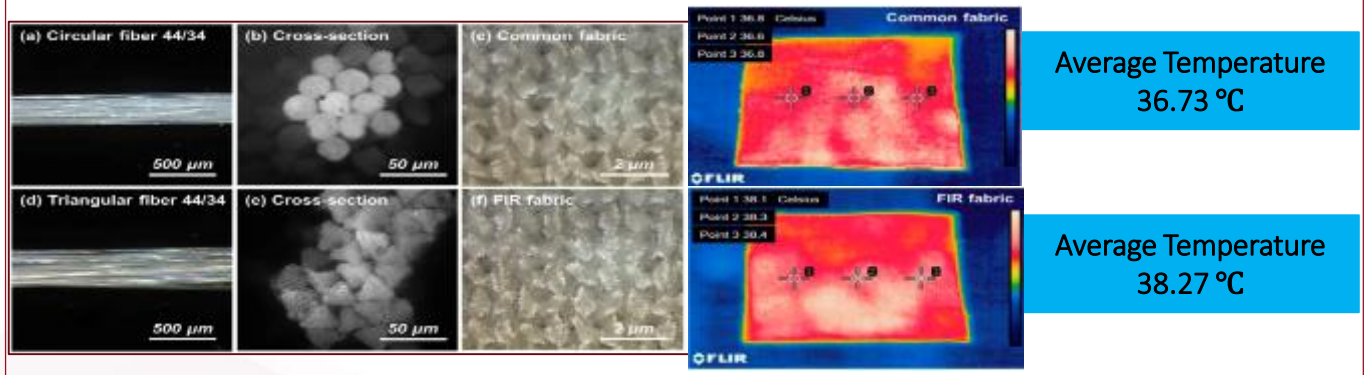
2. Far infra-red reflective textiles for thermal management

Testing Result on Thermal Performance

1) GB/T 30127-2013

- Emissivity **91.85%** (>88%)
- Temperature Difference **2.11℃** (>1.4 ℃)

  Which is ascribed to the enhanced far-infrared radiation absorption efficiency.



Average Temperature 36.73 ℃

Average Temperature 38.27 ℃

Applications

- Home Textiles
- Medical & Healthcare
- Apparels (e.g. Sportswear)
- Cosmetics
- Veterinary

Advantages

This Green Physical Modification Method is :

- More cost-competitive & eco-friendly, zero chemical addition;
- Permanent FIR function, never washout or breakdown;
- Higher spinnability and better quality and physical performance;
- More diversities in terms of color, fineness, cross-section shapes, to be multi-functional and etc.

Microplastic Fiber Separation System by Sweeping Acoustic Waves

Microplastic Fiber Separation System by Sweeping Acoustic Waves

- Concept:
  - Using sweeping acoustic waves to separate and collect microplastic (MP) fibers from textile wastewater system through the use of an acoustic chambers
  - Microplastic fibers collected can be agglomerated and handled easily for after-treatment.
- Key component of the chamber:
  - Transducers
  - Needle Valves
  - Sensory System

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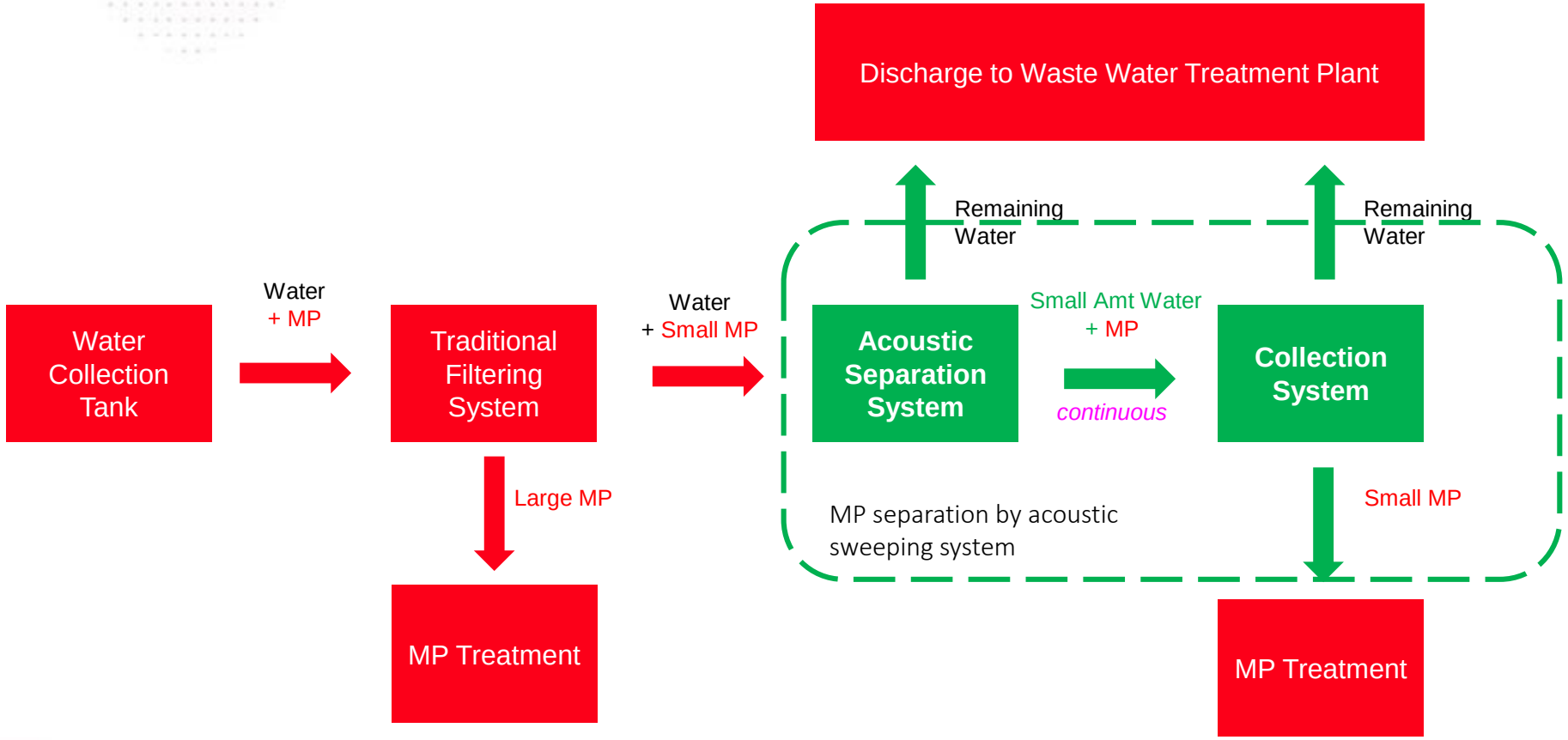
Microplastic Fiber Separation System by Sweeping Acoustic Waves

Illustration of the Pilot Separation System



PET Powder
30-200µm

Preliminary Results of Different Parameters

Amplitude (Sweeping Period: 1000ms)

Sample		Before (Sample solution injecting to the acoustic chamber)	After (Sample solution collected from the water outlet)
Condition		1mL T20 + 0.01g 20um + 500mL	
Volume (ml)		500	2300
No. of particles	No Acoustics	7,307,750	4,025,767
	175mVpp	8,379,750	2,598,233
	200mVpp	8,379,750	2,598,233
	225mVpp	7,807,750	1,908,233
	250mVpp	8,711,333	3,204,667

	Formula	No Acoustics	175mVpp	200mVpp	225mVpp	250mVpp
Overall efficiency	100% - (After/Before×100%)	45.49%	65.59%	69.28%	75.80%	63.54%

Smart Garment Sorting for Post-consumer Garment Recycling

Smart Garment Sorting System

Identify and Sort 4 categories:
Garment Type, Composition, Textile Structure

- Speed: 1 second to identify; 1 tons of garment in an hour
- Accuracy: over 90%

- Over 214 classes of fabric compositions and combinations
- Over 11 types of garment

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Electro-adhesive fabric gripper for automated garment manufacturing

To facilitate Industry 4.0 manufacturing in textile and garment industry

- → Enhancement of automation by robotics in manipulating fabric in garment industry
- → A robust electrostatic gripper will be developed to manipulate large pieces of thin and flexible fabric
- → The gripper will be able to:
  - → Selectively pick up individualize (one piece of) fabric from a stack
  - → (Quickly) Pick and (Quickly) Place
  - → Placing without wrinkles

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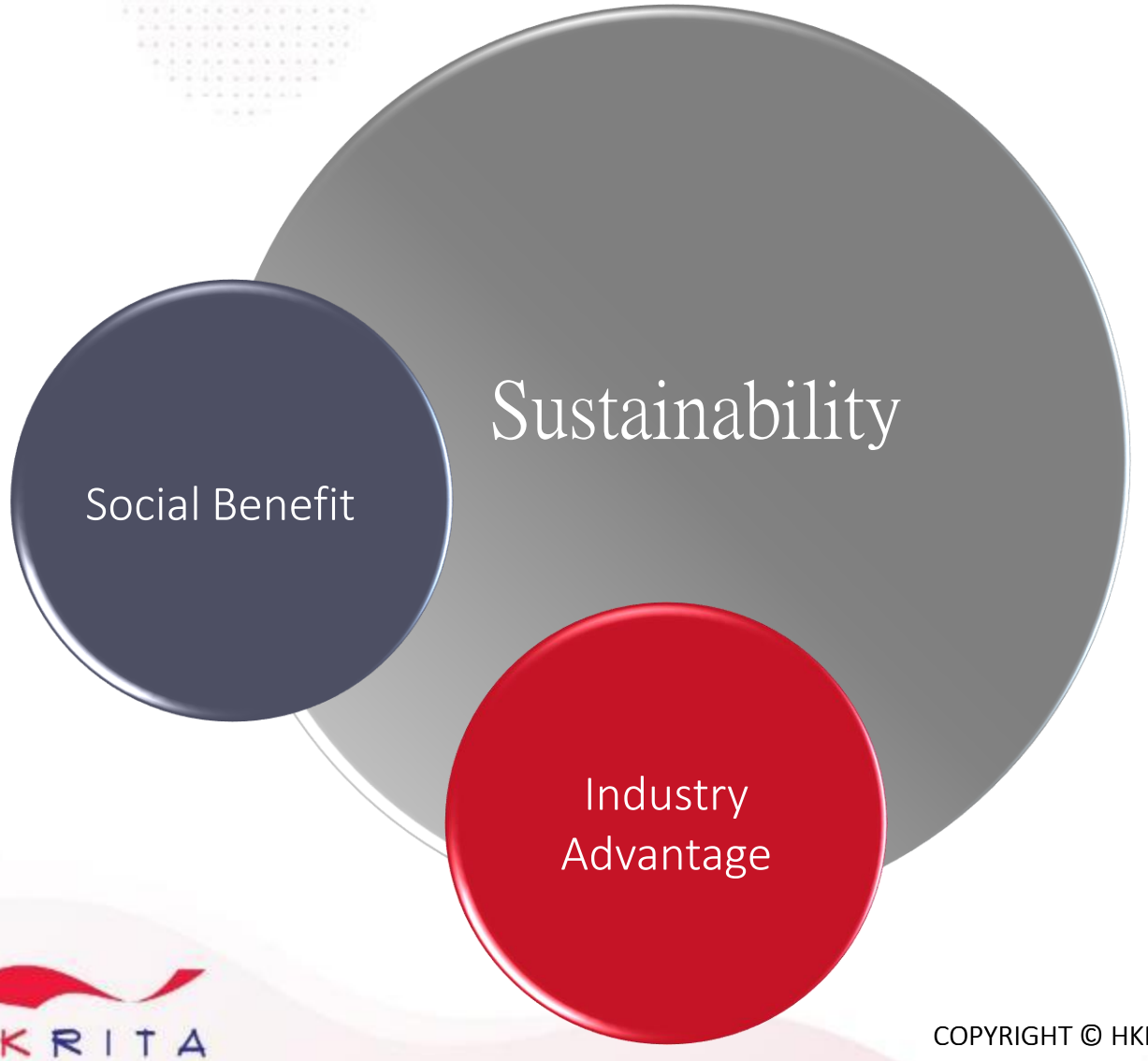
Research Themes



- Green Chemistry
- Biodiversity
- Carbon Neutrality
- Zero Discharge
- Waterless Processes
- Circularity

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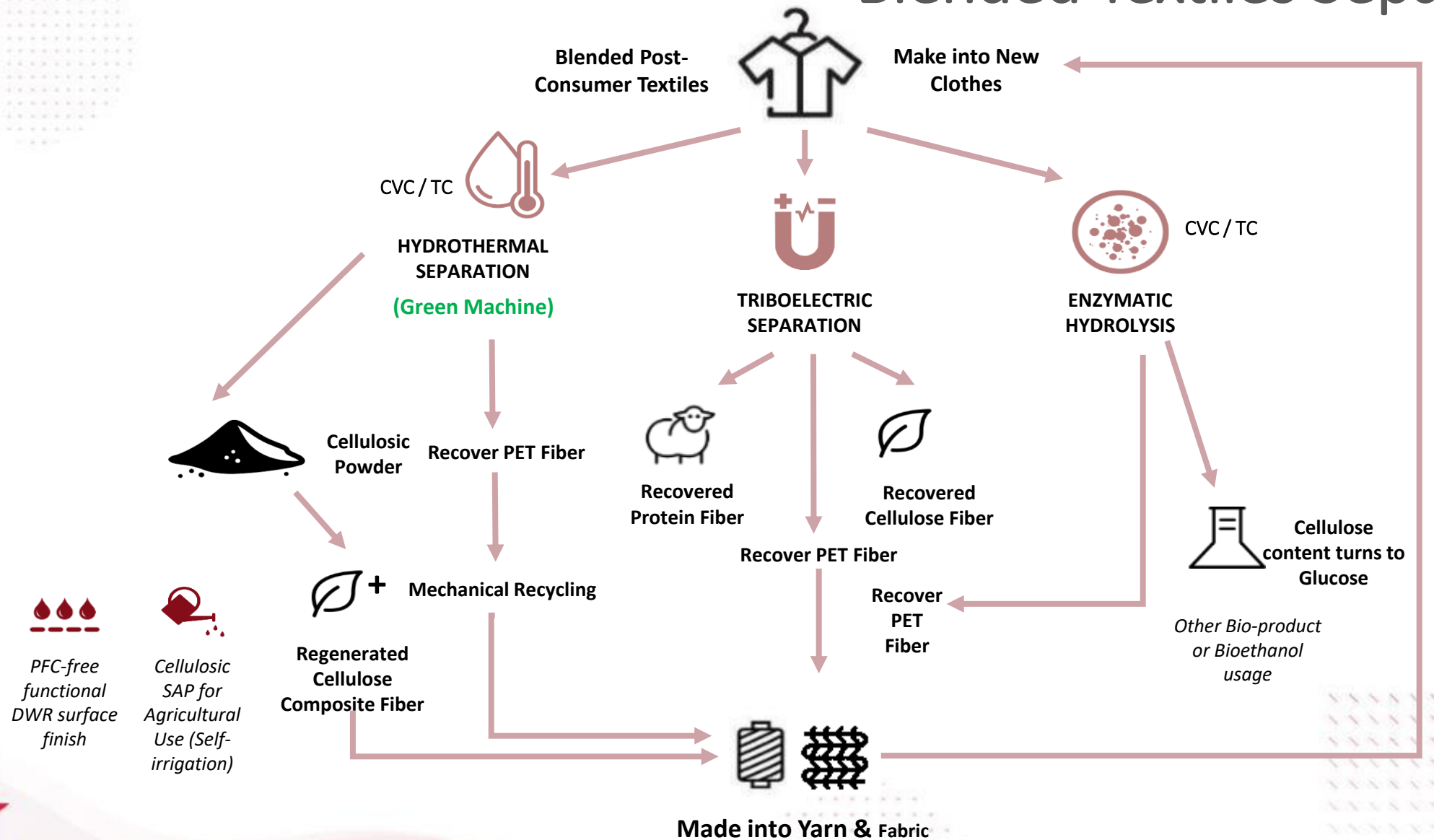
Hydrothermal Separation & Decolorization of PET (Green Machine)

HKRITA – Textile Recycling Technologies
Blended Textiles Separation



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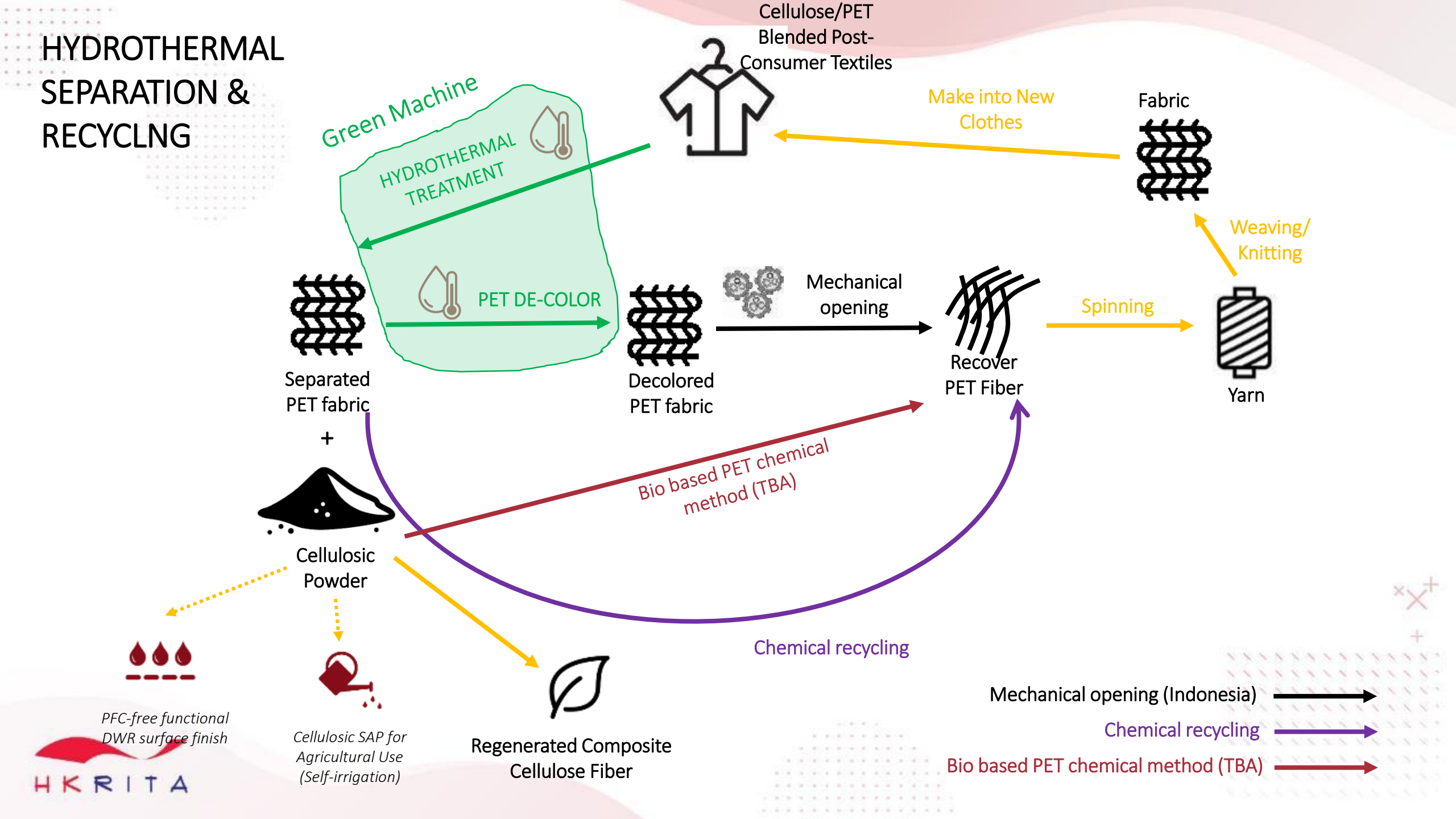
HYDROTHERMAL SEPARATION & RECYCLNG



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Hydrothermal Separation System

Cotton/PET blends
Knit & Woven,
no/minimal Lycra content

HYDROTHERMAL TREATMENT

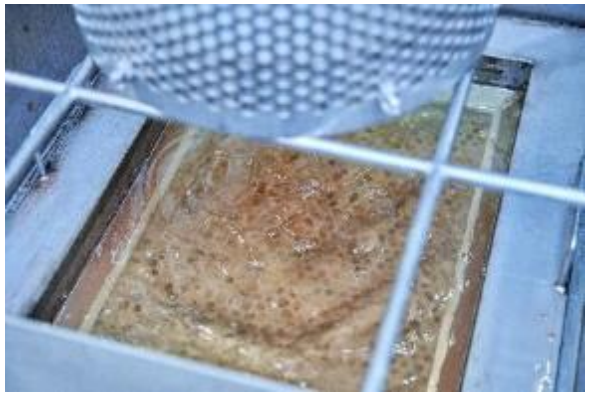
H_2O

Water & Chemical are recyclable & reusable

FILTRATION

Hydrolysate
containing cellulosic powder

Recovered
PET Fibre for spinning



Filtration process of Hydrothermal Treatment

Cellulose powder and PET fibre separated by Hydrothermal treatment

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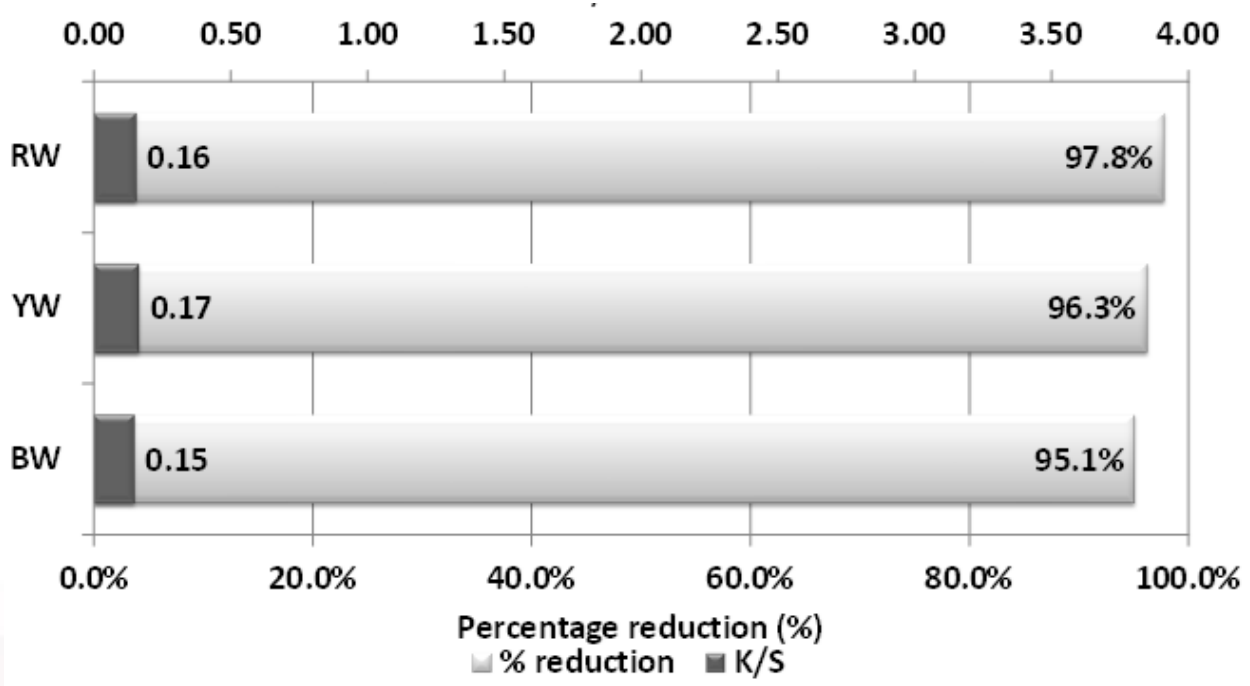
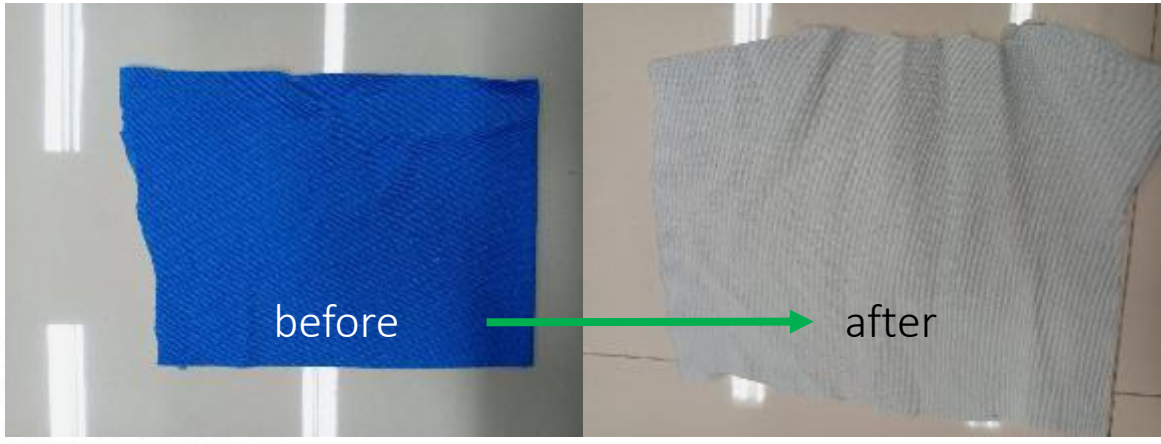
Materials and Systems for Decolorization of PET

- De-colour recycled PET before processing and re-dyeing
- A green method - using heat, water, CAC & green chemical to remove the color from polyester
- Remove more than 95% of colors





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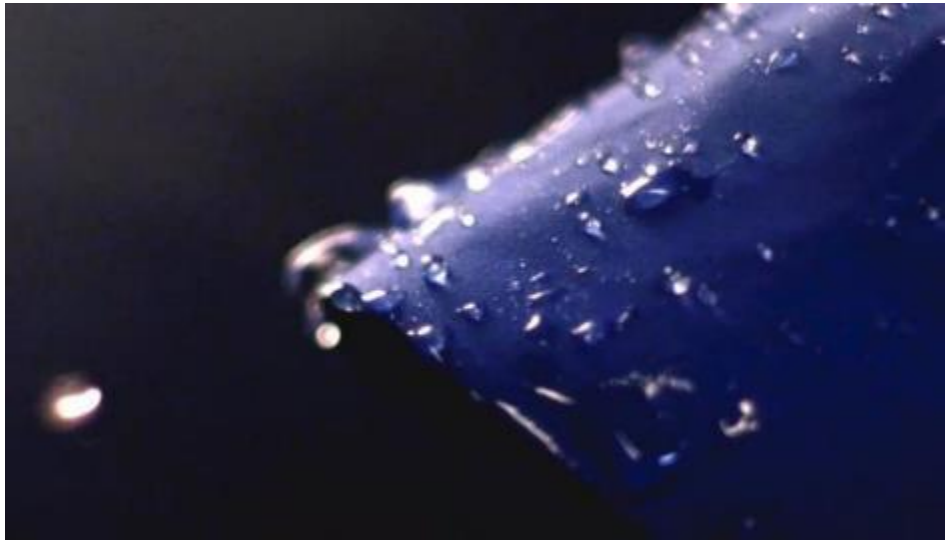
Hydrothermal Separation & Decoloring System in Indonesia

Extended technologies from Green Machine

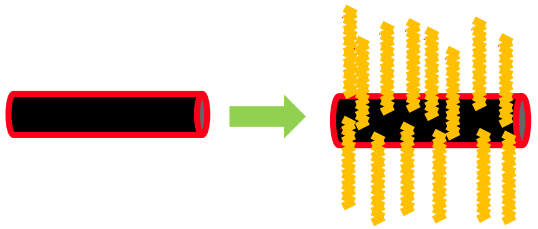
PFC-free Functional DWR Surface Finish

A PFC-free, functional DWR surface finish from recycled cellulose powder which can be applied on natural fabrics, woven cotton/cellulose products.

- Recycled cellulose powder → hydrophobic cellulose powder
- Development of a surface finishing dispersion with additives, e.g. photocatalyst, binder, and surfactant, stabilizer for durable water or soil repellent function

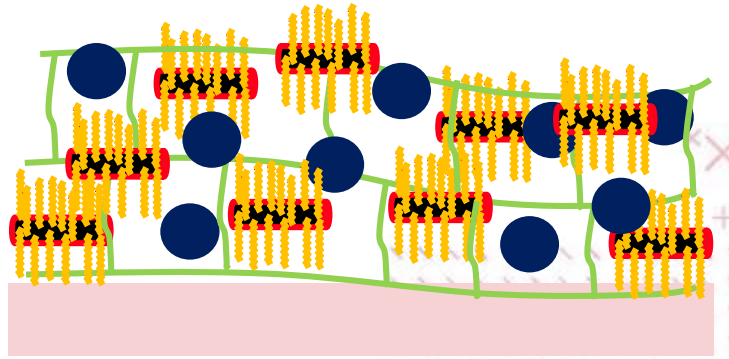


DWR function reference image



Hydrophobic cellulose

Hydrophilic cellulose



Photocatalyst

Binder

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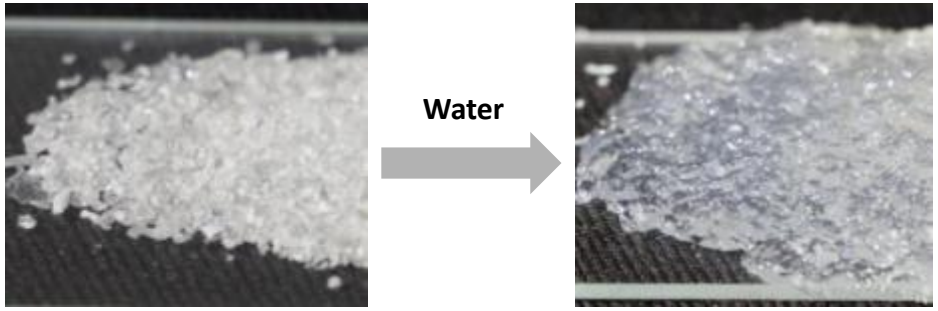
Cellulosic Superabsorbent Polymer (SAP)

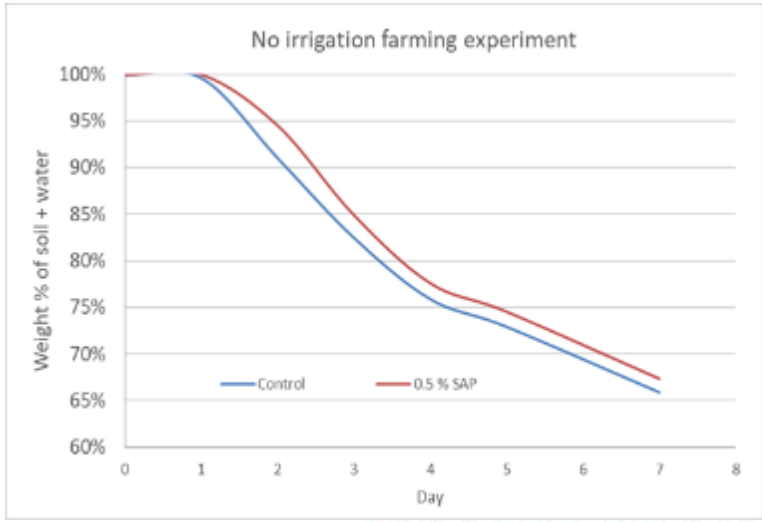
Turning the cellulose powder recovered into superabsorbent polymer (SAP) to be used as a biodegradable, water retaining aid for cotton plantation.

- SAP made from cellulosic powder is with liquid absorption capacity 31.4 (g saline solution material) and liquid retention capacity 26.6 (g saline solution/ g material)
- Preliminary experiment shows higher growth rate and yield for cotton plant with SAP applied without additional irrigation
- Introducing fertilizer (NPK) into the cellulosic SAP - fertilizer will be released with water for better yield

SAP made from Cellulose recovered by Hydrothermal Separation system



Cotton plantation experiment with Cellulosic SAP in Karnataka, India



Better soil water retention with SAP applied

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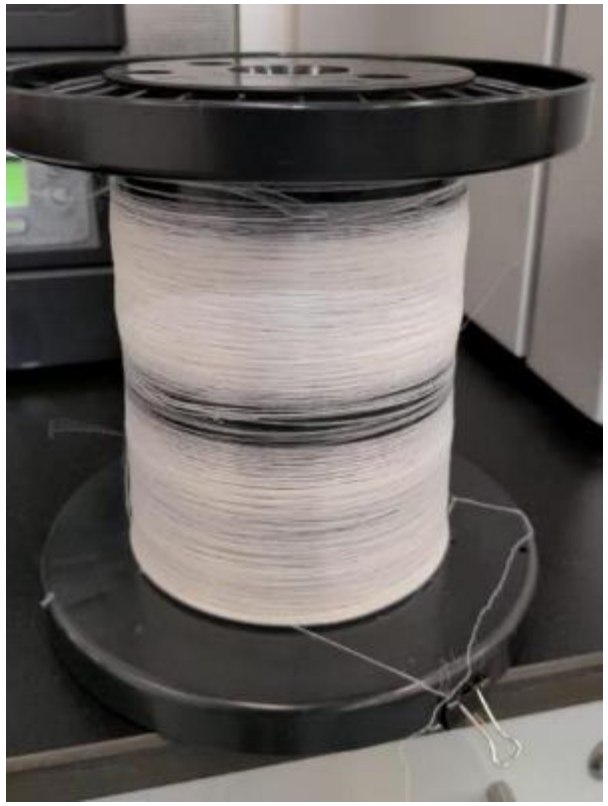
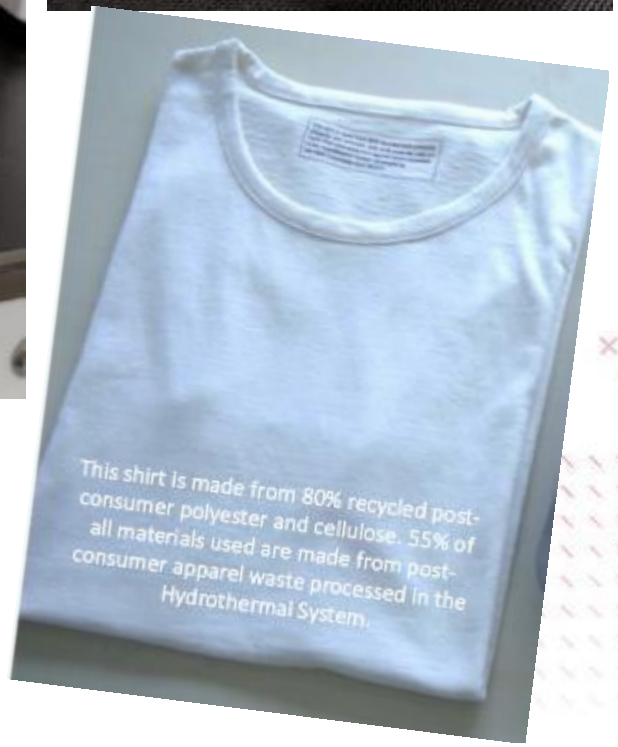
Development of Functional Cellulose Composite Fibers Based on Recycled Cellulose

Development of functional regenerated fibers from recovered cellulose component from Hydrothermal Separation System, using a combination of nanocomposite techniques in wet spinning process.

- Mixing high DP cellulose (recycled/virgin viscose) with cellulose powder, adding nanocellulose as reinforcement to improve tenacity
- Addition of far IR emission and UV blocking functional particles for additional function



Finished fibre – mixing recovered cellulose powder with high DP cellulose and nanocellulose



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Garment to Garment Recycling System(G2G)

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Garment-to-garment System

The Garment-to-Garment Recycling System is a mini-production line used to process post-consumer garments into clean and wearable recycled garments.

- 8 steps to recycle an used garment all fitted into a standard 40-foot container
- Anti-vibration, noise- and dust-controlled design, the production line minimizes noise and disruption for operational compatibility within community spaces
- Completely waterless process – no effluent discharge

The first Garment-to-garment recycling system located at The Mills, a revitalized art and cultural complex in Hong Kong

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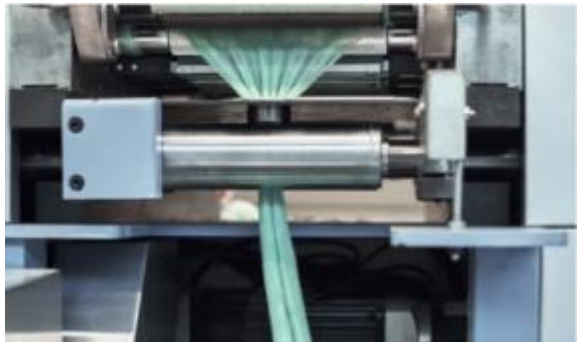
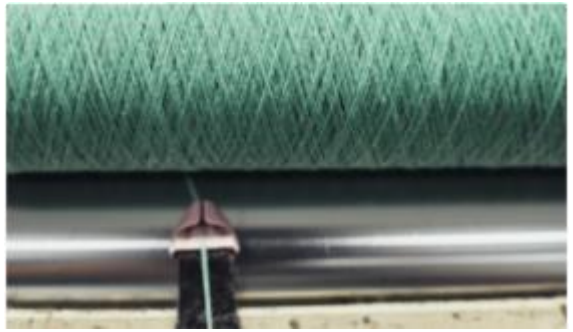
→The Mills – G2G

- 47th International Exhibition of Inventions of Geneva 2019 – Gold Medal
- Red Dot Award: Product Design 2019
- Asia International Innovative Invention Award 2019 – Gold Award
- The 2019 Innovation by Design Awards (Retail Environment) – Finalist
- 2022 iF Design Award

Garment-to-garment System



LOOOP in H&M Flagship Store at Drottninggatan, Stockholm



More information: https://about.hm.com/news/general-news-2020/recycling-system--looop--helps-h-m-transform-unwanted-garments-i.html

8 Steps in G2G Recycling:

1. Sanitization by Ozone
2. Opening
3. Cleaning
4. Carding
5. Drawing
6. Spinning
7. Doubling & Twisting
8. 3D Knitting

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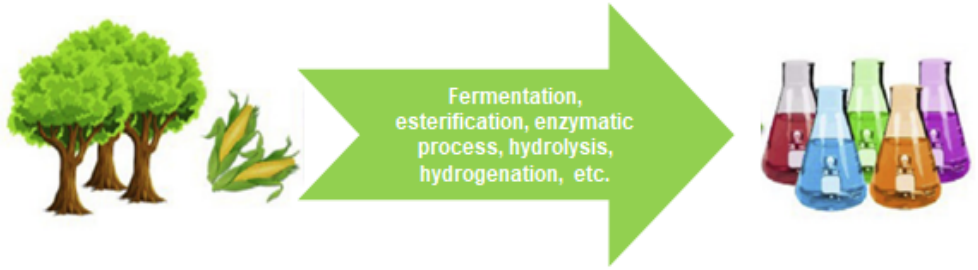
Other Blend Separation Technologies for Textile Recycling

Elastomeric Fiber Separation by a Biosolvent Dissolution Method

A biosolvent dissolution method to remove spandex (≤ 25%) from:
Polyester / Cotton / Nylon spandex blended

→Biodegradable, bio-based and renewable solvents

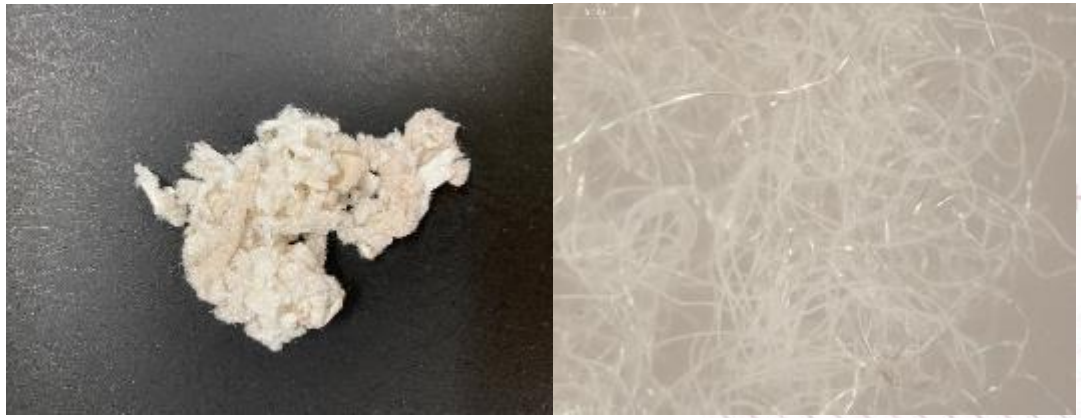
→keep the counterpart materials unchanged.



Mechanical opening → Biosolvent dissolution → Solvent recovery

83.8 % Nylon / 16.2 % Spandex

Biosolvent Treatment



100 % Nylon

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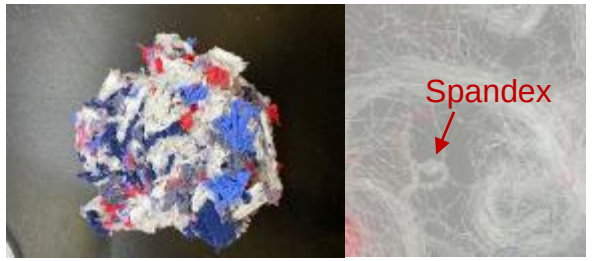
Trials with different blended fabric

Polyester/Spandex Product

Trimming

Trimmed Polyester/Spandex Fabric Blend

Mechanical Opening



84.3 % Polyester / 15.7 % Spandex

Biosolvent Treatment

100 % Polyester

Nylon/Spandex Product

Trimming

Trimmed Nylon/Spandex Fabric Blend

Mechanical Opening

83.8 % Nylon / 16.2 % Spandex

Biosolvent Treatment

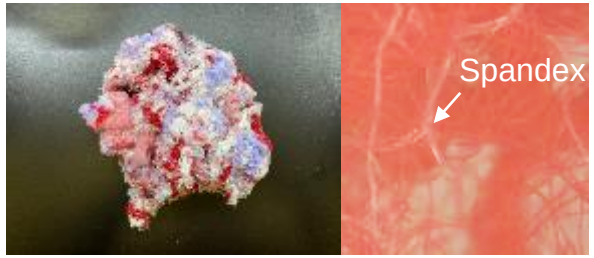
100 % Nylon

Cotton/Spandex Product

Trimming

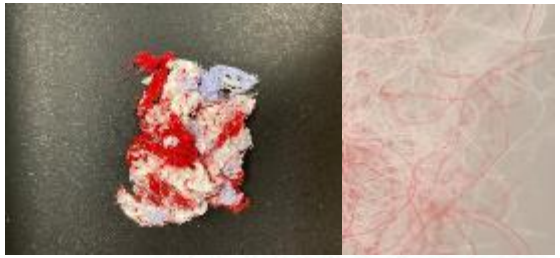
Trimmed Cotton/Spandex Fabric Blend

Mechanical Opening



94.0 % Cotton / 6.0 % Spandex

Biosolvent Treatment



100 % Cotton

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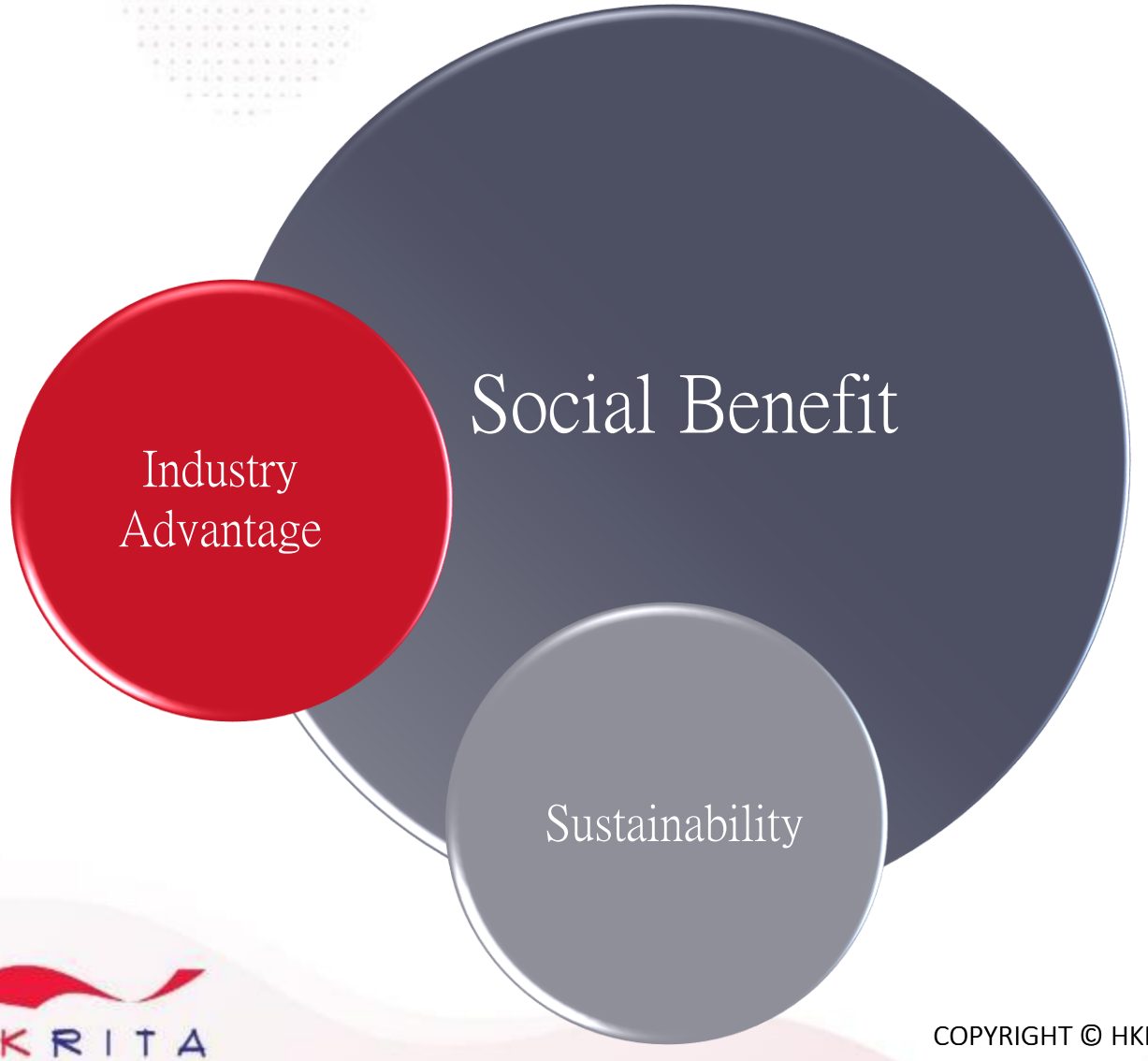
Research Themes



- Health & Wellness Materials & Systems
- Apparel based System Solutions
- High Performance Materials & Apparel
- E Apparel
- Impact Resistant Materials
- Smart Apparel

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