

## Formosa Plastics Group

### Formosa Circleverse - Formosa Plastics Corporation' s Circular Recycling Universe

Formosa Plastics Group's exhibition theme for the 26th Taipei Innovative Textile Application Show (TITAS 2022) was “**Formosa Circleverse - Formosa Plastics Corporation' s Circular Recycling Universe.**” Combining the concepts of circular economy and the Metaverse, Formosa Plastics Group focuses on using technology to harness a wide variety of different renewable and recyclable technology materials from the sky, sea, land, and even deep in the ground. Through these efforts, the Group has improved its product mix, creating a circular economy and allowing carbon reduction and green energy to truly become a part of people' s lives.

The Formosa Plastics Group Pavilion at TITAS 2022 features a collaborative exhibition put on by Formosa Chemicals & Fibre Corporation, Formosa Plastics Corporation, Nan Ya Plastics Corporation, and Formosa Taffeta Company. The Pavilion is composed of seven main areas, each based on a single theme: Schoeller, Fashion and Feathers, Popular Sports, Outdoor Sports, Environmental Protection and Recreation, Industrial Materials, and Protection. These exhibits display how Formosa Plastics Group's main products are utilized in multiple fields, including fashion, sports, outdoors, protection, and industrial materials, while highlighting the latest developments in yarns and fabrics. Formosa Plastics Group' s vertically-integrated production line produces seven different fibers: rayon fiber, polyester fiber, raw nylon yarn, polypropylene fiber, elastic fiber, carbon fiber, and functional yarn, all of which are combined by Formosa Taffeta under the name of Formosa Taffeta Fabrics. We look to showcase our close vertical collaborations with other companies through displaying these eight different products at the Formosa Plastics Group Pavilion. We have led the market with our innovative new materials, protecting the environment, achieving carbon reductions, and building a high-quality product image for our series of fiber products.

Formosa Plastics' Key Exhibition Items for TITAS 2022:

#### A. Formosa Chemicals & Fibre Corporation

1. Formosa Chemicals & Fibre Corporation is one of the few companies in the world that has used chemical dispersion technology to successfully mass produce recycled nylon 6 pellets. Marine pollution caused by trash has been a serious issue in recent years, and a significant proportion of fishing nets are made up of products derived from nylon 6. Formosa Chemicals & Fibre Corporation has adopted recycling technology at marine debris cleanup

areas to chemically extract recycled CPL with quality similar to that of newly-produced CPL. From 2018 onwards, the Corporation has collaborated with Vietnamese companies and brands to recycle and re-use discarded fishing nets. After the recycled raw nylon yarn produced has been approved by brand owners, the materials are handed over to Formosa Taffeta, an affiliated company, which turns this yarn into dyed fabrics. These fabrics are then provided to other brands for the production of ready-made garments, creating a vertically-integrated production line for outdoor sports clothing. Additionally, in 2020 the Ocean Conservation Administration launched the 2020 Local Government Trial Initiative to Recycle and Reuse Fishing Nets and Oyster Ropes. In particular, the oyster farming industry in Chiayi County generates 1,375 tons of nylon 6 waste each year in the form of discarded oyster ropes. For a long time, this waste had not been effectively reallocated and handled, due to the low prices for recycled materials on the market. Formosa Chemicals & Fibre Corporation thus built a production line in Chiayi's Xingang Township to recycle and reuse these materials. By processing these materials locally, the Corporation is able to cut down on energy use and carbon emissions by reducing the need for transportation, as well as eliminating marine debris produced by the oyster farming industry. This project looks to protect the beautiful coastlines of Chiayi; it began mass production of recycled materials in April 2021. In order to expand the scale of recycling nylon 6 from marine debris, Formosa Chemicals & Fibre Corporation has continually invested in enhancing its production capacity. The Chiayi Xingang facility is planned to have its capacity expanded to 750 tons/month in the fourth quarter of 2022, while the Corporation's Vietnam facility has had its capacity expanded to 500 tons/month in the fourth quarter of 2021, allowing the Corporation to produce 1,250 tons/month of recycled nylon 6.

2. Formosa Chemicals & Fibre Corporation has sought to improve its management structure in order to better protect the environment, allowing it to more effectively conserve energy and water and reduce carbon emissions. In doing so, the Corporation has also addressed the issue of wastewater produced by the downstream weaving and dyeing processes. The Corporation started developing pre-dyed industrial yarn in 2014; furthermore, it has worked with major fishing net manufacturers, Ching Fa and King Chou, and rope manufacturers, Nian Shan and Zhen Kuan, to make fishing nets and ropes for marine recreation activities. Formosa Chemicals & Fibre Corporation is able to reduce the amount of wastewater generated by its clients in the weaving and dyeing processes as a result, reducing its environmental impact. In 2019, these efforts were further expanded to the clothing industry. Formosa Chemicals & Fibre Corporation has worked with Formosa Taffeta Company and other weaving factories to supply fabrics for the production of ready-made garments and shoes/packing materials, in order to better fulfill its responsibilities as an environmentally-friendly business.

The amount of resources saved by using pre-dyed fiber from the Formosa Chemicals & Fibre Corporation to produce 1 ton of finished fabric:

Water conserved: 116 tons Percentage: ↓ 85%	Electricity conserved: 127 kWh Percentage: ↓ 64%	Reduced carbon emissions: 3,319 kg Percentage: ↓ 84%
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3. Since 2016, Formosa Chemicals & Fibre Corporation has sought ways to make clothing lighter, softer, more breathable, and more comfortable in response to the extreme high and low temperatures caused by extreme weather. The Corporation has developed long-efficient low-denier functional yarn by polymerizing cool and heat-retaining functional materials using synthesis and dispersion technology, and has worked together with professional brands to expand into the European and US markets. In 2021, the Corporation collaborated with the Taiwan Textile Research Institute to develop moisture absorbing and elongatable functional yarn with fiber tows that would elongate and form curves after absorbing moisture, making the fabric surface more porous and less likely to stick to the skin. These materials are used in fabrics for making outdoor sports or recreational clothing, further increasing their breathability and comfort. The Corporation has already established a consensus on collaboration and market expansion with other brands, and looked to develop organic hydrophilic cooling and functional nylon pellets, providing fiber spinners with directly-spun fibers, and developing various functional fabrics. Through these efforts, the Corporation is aiming to adapt to climate change, and better meet the needs of consumers for fashionable, comfortable, and healthy clothing.
4. Apart from working together with Nan Ya Plastics Corporation to develop recycled yarn from plastic bottles, Formosa Chemicals & Fibre Corporation has also developed biodegradable environmentally-friendly recycled polycotton, aiming to protect the environment. This polycotton is mainly produced from GRS-certified high-quality recycled pellets, and a unique traceable identifying agent is added during the production process. Besides being used for sports, recreational, and indoor clothing, this polycotton can also be used to produce high-quality GRS-certified environmentally-friendly low-hairiness yarn for braided belts, shoes, accessories, and outdoor cloth materials after being processed by a MVS machine.
5. In order to promote personal health protection and environmental sustainability, Formosa Chemicals & Fibre Corporation has developed graphene rayon fibers. Graphene, when used in fibers, has the unique characteristic of being an extremely good conductor of heat, and is also able to release long-distance infrared rays. In addition, the Corporation's rayon is also produced from FSC-certified natural wood pulp, making it silky to the touch and biodegradable, among other advantages. This allows the material to meet consumer health needs, helping the Corporation contribute to global sustainability.
6. Formosa Chemicals & Fibre Corporation is turning polypropylene (PP) plastic into gold - physically recycling and reusing materials to produce green fibers. In collaboration with downstream businesses, Formosa Chemicals & Fibre Corporation has recycled its PP plastic products to produce recycled PP pellets made from 100% recycled PP. The Corporation then

produces PP made up of different proportions of recycled PP based on each customer' s requirements. At the moment, the Corporation is already able to use its unique PP production techniques to provide customers with a wide variety of different choices based on their requirements: The Corporation has also collaborated with Far Eastern New Century to produce PCR staple fibers, worked with Hung Chi Staple Co., Ltd. to develop PCR upholstery fabric, and cooperated with Formosa FCFC Carpet to develop PCR square carpets. We are determined to do our part to protect the Earth, lower environmental pollution, reduce carbon emissions, and promote the concept of a circular economy. By adopting the attitude of "We Produce, We Recycle," let' s create a win-win situation together!

## B. Nan Ya Plastics Corporation

In the face of today' s trends towards environmental sustainability and greater awareness of Environmental, Social and Governance (ESG) issues, Nan Ya Plastics Corporation' s fiber business department has long begun developing new sustainable polyester fibers. The Corporation has developed a wide variety of polyester fibers that can help reduce plastic waste, marine microfibers, conserve water during the dyeing process, or serve as biomass materials. Apart from being environmentally-friendly, these various fibers also possess various functional characteristics, such as being flexible, bacteria-resistant, and sweat-absorbent, further increasing their product value.

Apart from developing sustainable products, the Corporation has actively attempted to obtain environmental certifications for its products. Besides the more basic certifications such as the GRS, Bluesign, and Higg Index certifications, this year the Corporation has also become one of the first in the industry to obtain a Life Cycle Assessment (LCA) certification for its recycled plastic bottle products from the company TÜV Rheinland. It has also actively applied to participate in the Science Based Targets initiative (SBTi) in order to provide scientific evidence showing the effect of its carbon reduction efforts, proving its genuine efforts toward sustainability.

### 1. SAYA recycled yarn

SAYA is a new brand launched by Nan Ya Plastics Corporation to reduce the amount of plastic waste. The name "SAYA" is derived from the Taiwanese Hokkien pronunciation of "cotton yarn" and includes three main product series: SAYA365, SAYA Rscuw, and SAYA Garma. SAYA365 is a recycled yarn produced from plastic bottles. The Corporation wants all polyester fiber to be able to be produced from recycled fiber, such as low-denier, ultra-fine fibers, twisted yarn, mechanical elastic yarn, and bi-shrinkage yarn, which all have recycled versions. SAYA Rscuw is created from waste materials produced during the fabric production process, and is made from fiber recycled from leftover greige fabric, dyed fabric, or ready-made garment scraps. The new SAYA Rscuw recycled fiber undergoes a water dye-removal process where solvent dye is removed;

subsequently, these fibers are mixed together with recycled bottle flakes in a 1:4 ratio to produce new pellets that are then turned into fibers. The product is safe to use and environmentally-friendly, and has already been GRS certified. Finally, SAYA Garma fibers are produced from old clothing. An AI sorting system is used to sort through pieces of old clothing, selecting pieces made out of pure polyester or with a polyester content above 65%. These pieces are then used to produce fibers through a mechanical process, or through advanced chemical depolymerization. Additionally, in order to speed up the recycling of old clothing, the Corporation has actively developed modified polyester pellets that can be used to produce buttons, zippers, and buckles, allowing us to achieve our design philosophy of using only one single type of raw material to produce complete ready-made garments.

## 2. GREENONE: biodegradable polyester fiber

Synthetic clothing takes 450 years to decompose after being buried; furthermore, microfibers produced when clothes are washed are also released into the ocean, placing a significant burden on the environment. Nan Ya Plastics Corporation has developed a polyester fiber that can fully decompose in approximately 4 years—GREENONE. GREENONE contains special additives that allow microfibers in the ocean and the old clothing buried in landfills to be degraded by microorganisms, converting them into carbon dioxide and methane. Determined using the ASTM D5511 method (modeling the conditions in a landfill), the degradation rate is 89.8% in 3.5 years. Using the D6691 method (modeling ocean degradation), the degradation rate is 69.9% in 27 months. Currently, GREENONE has already been integrated with plastic bottle recycling technology, showing how GREENONE fibers are environmentally-friendly in a myriad of ways.

## 3. CHROMUCH: new solution dyed polyester fiber

Traditional methods of bath dyeing consume 60kg of water to dye 1kg of fabric, requiring a significant amount of water resources. Using solution dyeing to directly dye fibers removes the need for traditional dyeing, reducing the amount of water consumed in the dyeing process by 97%. However, the traditional dope dyeing technique relies on adding pigment dye to fibers as a coloring agent. This results in colors that are less vibrant, and limits the color palette, meaning that this technique cannot be widely used. The new CHROMUCH fiber uses a unique weaving technique that combines both solvent dye and pigment dye. It is also able to fasten dye securely onto the fabric, allowing it not to easily fade out even after heat treatment. Not only is the color gamut 82% larger compared to traditional fabrics, color fastness is also maintained at around Level 4. This year, we launched the new Black Magic CHROMUCH. This new product carries a blue tint and does not damage knitting needles, winning the approval of brands and weavers. Another newly developed product is the Original Sea-Island Fiber, which has a suede-like texture

after sanding. The fiber also has good color fastness and can be used to produce seats, sofas, and ready-made jackets.

#### 4. BIOGREEN: biomass polyester fabric

Nan Ya Plastics Corporation's range of biomass products include the bio-PET and bio-PTT product series, composed of 30% and 37% biomass materials respectively. Using biomass polyester produced from plant fermentation techniques can reduce carbon emissions and decrease our reliance on crude oil. Since its physical characteristics are also similar to that of polyester fiber, it can be used as a substitute fabric without sacrificing functionality. Additionally, one concern with biomass fibers is that they might reduce the amount of food available for human consumption. However, our current bio-PET products are derived from molasses (a cane sugar byproduct), while bio-PTT is derived from industrial-use corn, meaning that our biomass sources do not compete with resources for human food consumption.

Besides showcasing newly developed environmentally-friendly and sustainable fibers, the exhibition also featured the HydroCool cool-sense polyester fiber, and G-thermal graphene fibers. The HydroCool cool-sense yarn uses fibers with an increased water content and unique added minerals to achieve a Q-max value of 0.171. The G-thermal graphene fiber is able to quickly disperse heat by rapidly transferring body heat into the environment, achieving a heat dispersal and cooling effect. The fiber also possesses a far infrared effect, which can improve blood circulation and increase oxygen saturation.

### C. Formosa Plastics Corporation

The Tairyfil carbon fiber is a carbon fiber developed independently by Formosa Plastics Corporation through subjecting original fibers to a carbonization process. The fiber is widely used in sports equipment, wind turbine blades, and industrial applications. Formosa Plastics Corporation is currently the world's tenth largest carbon fiber producer, holding a competitive advantage due to its vertical integration. From naphtha cracking to producing carbon fibers, companies in the Formosa Plastics Group are able to carry out every step of the production process. The Tairyfil carbon fiber is available as a small to large tow fiber, with sizes ranging from 1.5K to 48K, and with a standard to high modulus. It also works well with both thermosetting and thermoplastic resins. In particular the carbon fiber TC780 produced from a new "dry jet wet spinning" process possesses high strength, making it suitable for high pressure gas cylinders. This product not only anticipates future trends towards hydrogen energy, it has also allowed us to become a part of the satellite and space industry, as the fiber has been used in the production of high-pressure krypton gas cylinders used in the boosters for the Space X Falcon 9 rocket on its launch of a satellite in June 2021. Our carbon fiber has thus officially become a key material for the aerospace industry. We have also collaborated with Longterm Concept Industry Corp and He Cheng to produce lightweight carbon fiber toe safety boots, improving the well-being of employees and helping our customers successfully establish relationships of mutual success.

## D. Formosa Taffeta Company

### 1. New biomass polyester and nylon fabrics:

The B103 PET polyester fabric is produced using unique carbon capture and biomass fermentation technology. This technology turns the off gas—carbon dioxide—created during industrial production into ethanol and ethylene glycol, serving as the base materials for creating new polyester fabrics. These materials are then used to create products woven from polyester fiber through direct carbon reduction methods, which not only re-capture greenhouse gases, which are harmful to the environment, but also reduce our reliance on petroleum-derived materials, decreasing carbon emissions and pollution.

#### Recycle nylon fabric from waste tires:

Waste tires must be crushed first, then use thermal cracking to produce pyrolysis oil that is in turn converted into the raw chemical materials used to produce “environmentally-friendly nylon yarn from recycled waste tires.” This decreases environmental pollution, reduces carbon emissions, and conserves petroleum resources, thus remaining consistent with the concepts of circular economy, sustainability, and environmental-friendliness.

### 2. Recycled polyester and nylon fabrics made from marine waste

Recycled polyester fabric made from marine waste: In support of the collaboration between adidas and environmental NGO Parley, Formosa Taffeta Company has implemented efforts to recycle plastic waste polluting the oceans in the Maldives and Sri Lanka. The Company turns this recycled plastic into yarn, which is then made into Formosa Taffeta Company environmentally-friendly fabrics. From recycling plastic bottles on land to recycling plastics in the ocean, Formosa Taffeta Company continues to play a part in saving the oceans.

Recycling marine waste into nylon fabrics: The Taiwanese oyster farming industry uses huge quantities of nylon oyster ropes, resulting in marine waste such as waste fishing nets. By recycling and processing these materials through technology such as melting, dispersion, and refining, the Company can reuse them to make new raw nylon yarn.

### 3. Bio based nylon and polyester fabrics: The Company has launched a new generation of environmentally-friendly fabric—bio based fabric. Bio based nylon 56, nylon 410, and nylon 11. Bio based nylon 56 is composed of 45% plant matter, such as non-food use corn and sugar cane. Bio based nylon 410 is composed of 70% of castor oil, while bio based nylon 11 is composed of 100% extracted castor oil. These three types of biomass nylon are all produced from biomass materials refined from plant matter instead of traditional petroleum-derived raw materials. These new-generation

environmentally-friendly products allow us to reduce our petroleum consumption and lower greenhouse gas emissions, while producing fibers with the same unique qualities.

Bio based polyester fabrics: The Company turns agricultural waste materials that are easily obtainable in farms, such as corn stalks, hay, sugar cane scraps, and discarded scraps from processing fruits and vegetables, into ethylene glycol. This process involves crushing the materials before they are put through enzymatic hydrolysis, fermented, and finally combined with bio-alcohol. By using this as a source of biomass polyester fiber, we can reduce the consumption of petrochemical materials, and avoid competing for food resources.

4. Formosa Taffeta Company polyester fabrics made from recycled ready-made garments - Discarded ready-made polyester garments are decomposed through a technological process before being re-polymerized and spun. This circular use can effectively lower petroleum consumption and other finite energy sources, as well as reduce GHG emissions and waste.
5. BOOMETEX<sup>®</sup> recycled polyester and nylon fabrics: Formosa Taffeta Company is devoted to developing various different environmentally-friendly fabrics. Recycling raw materials and nylon from plastic bottles and polyester fiber products can reduce resource use, energy consumption and CO<sub>2</sub> emissions. The Company combines various sophisticated fabric designs and unique processing techniques, such as PFOA/PFOS-free environmentally-friendly water repellent and lamination processing, to create a series of high-tech and high value-added fabrics.
6. Solution Dyed Fabric: Formosa Taffeta Company launched its series of Solution Dyed Fabrics as part of its commitment to green energy, environmental-friendliness, and sustainable business operations. This product allows us to reduce water consumption, wastewater discharge, and waste gas emissions during the dyeing and treatment processes. It also reduces the rate at which we deplete finite energy sources, and adopts energy and water saving and carbon reducing production processes to alleviate the burden and impact on the environment.
7. Specialty fabric - The heat- and flame-resistant DuPont NOMEX<sup>®</sup> fabric is used in industrial safety, firefighting, and military-use garments, including arc resistant, molten metal splash resistant, fire resistant, high visibility, and police apparel. For greater comfort, the Company has also developed four-way and two-way stretchable fire resistant textiles. In addition, textiles can be made water repellent or moisture absorbent, or provided with near-infrared-resistant camouflage properties after downstream processing. In order to make safer textiles, the Company has started adopting new low-formaldehyde production methods, and will continue to use these materials in dampers.



8. High strength and abrasion resistant material: KEVLAR® is used in bulletproof helmets, shields, and water blasting suits. Applying DuPont's patents, the fabric can be processed via pre-soaking and bonding techniques to create a new generation of composite fabrics for bulletproof and stab-proof vests.
9. Antistatic textile: In response to our competitors, an additional antibacterial process to meet food industry requirements and a special composite yarn for ultra comfortable paint coveralls has been developed for the NEGA-STAT®. This direction represents a shift toward higher quality textiles. Due to being washable, the fabric is suitable for use not only in professional protective apparel, but also in ordinary windbreaker jackets. By being both hygienic and fashionable, it can help reduce environmental pollution.
10. Functional yarn BODYTEK®: A wide range of different fibers have been used to develop a myriad of innovative yarns with high added value. These fabrics have a wide range of applications, and can be divided into four types based on their function:
  - Healthcare—Fabrics need to be capable of retaining heat, promoting blood circulation, releasing negative ions, as well as providing antibacterial and deodorizing functions, protection from UV rays, and skin protection when used in products such as underwear, outdoor wear, bedding, medical materials, protective clothing, and bath products.
  - Environmental—Fabrics need to be green, reuse resources, and protect the environment. This includes underwear, sportswear, casual wear, everyday fabric products, etc.
  - Functional—Fabrics need to offer functions such as moisture absorption, heat dissipation, quick drying, anti-pilling, light weight, soft texture, cooling, abrasion resistance, and temperature regulation when used in underwear, sportswear, casual wear, and high-quality dresses, etc.
  - Protection—This includes fabrics that are fire- and flame-retardant, high in strength, cut-resistant, anti-static, shielded from electromagnetic waves, etc., when used in special clothing, work clothing, damper fabric, high strength fabric, protective clothing, furniture, and interior upholstery, etc.

Formosa Plastics Group Warmly Welcomes You to TITAS 2022!