Algae are being tapped as a new resource to make fibres, finishes and dyes for the textile industry. Algae bloom can provide cellulose or proteins, and in microalgae form, the species can produce non-petrochemical oils.

The power of algae

The food, pharmaceuticals and biofuels industries have been harnessing the ability of microalgae to produce compounds on an industrial scale for years. Now, a new generation of companies is set on putting this quality to use in developing materials and supplies for textiles, apparel and footwear.

Many of the projects involving algae and textiles are still in research phase, but the landscape is changing fast. The first garments treated with a wicking finish based on a microalgae-derived chemistry will be in stores in March at Tchibo, says Beyond Surface Technologies CEO, Matthias Foessel. This company, based in Muttenz, Switzerland, has been working with biotech start-up Checkerspot for the past three years to develop a textile finish using algae-generated oils. The first fruit of this partnership is a moisture management, wicking and quick drying finish for textiles, which is said to have attracted the attention of several major sports, athleisure and outdoor brands. The new finish offers the same level of performance as conventional chemicals, is a drop-in technology, and is cost-neutral compared to the company’s plant seed-based chemistry, says Mr Foessel. Founded in 2008, Beyond Surface Technologies (BST) has built a portfolio of plant seed-based finishes for textiles for wicking, softening or water repellency.

“Plant seeds were our first step away from crude oil,” says Mr Foessel, but he believes algae are better yet. “Microalgae are an incredible base for new materials and chemicals. There are only 14 to 16 different types of industrial plant seeds available, whereas there are hundreds or even thousands of different strains of microalgae that could produce different kinds of oils.”

For its part, Checkerspot was founded in 2016 and is based in Berkeley, California. The biotech company grows microalgae in steel tanks, via fermentation, and engineers various types of heterotrophic microalgae, thus named because they grow in the dark to convert carbon (or...
sugar) into oil or triglycerides, company CEO and co-founder Charles Dimmler tells WSA. The team at Checkerspot has drawn on its previous experience at Solazymes, now a part of Corbion of the Netherlands.

The company seeks specifically to make materials that are not available from other bio-based sources or from crude oil. “Our touchstone is to develop better products with regards both to sustainability and performance, not alternatives to existing ones,” insists Mr Dimmler. This is why he says the company was incorporated as a Public Benefit Corporation. It is also now a B Corp.

Its manufacturing process is similar to that of other biotech start-ups that are brewing new polymers or pigments, such as Spiber and Tinctorium, but these use genetically modified yeast or E. coli, says Mr Dimmler. Checkerspot, he says, “is just coaxing microalgae that already make oil to produce a specific type of lipid.”

Checkerspot has launched two commercial products. In addition to the BST finish, it has developed a PU-based composite with dampening properties for WNDR Alpine, a backcountry ski brand it launched with freeskier (and industry veteran) Matt Sterbenz. It is also working with Japanese company DIC, a supplier of pigments, that invested in the start-up in 2018. A new research project was launched with BST late last year to develop a PFC-free DWR finish for WL Gore. Mr Dimmler expects more partnerships to be announced soon.

There is, however, little chance that Checkerspot will develop alternatives to petrochemical synthetic fibres. “Our mission is rather to engage with designers. We invite them to start from a blank slate, imagine a product and then work backwards to develop it,” says Mr Dimmler. He also mentions the daunting issues of scale and price: “We would be competing against 50-year-old supply chains that have based their businesses on petroleum. We intend rather to grow slowly and organically, like the first plastics did in the 20th century.”
Fibres and dyes

AlgaLife, a start-up based in Berlin and Israel, is making fast progress towards developing algae-based materials for the fashion and textile industries. The two-year old company has won several prizes, including H&M’s Global Change Award in 2018 and was incubated by Fashion For Good, also in 2018. It has filed two patents and has successfully completed commercial tests, with four pilots in 2020, it claims. This has been possible, notes AlgaLife CEO and co-founder, Renana Krebs, thanks to a partnership with Israel biotech company Algatech, a supplier to the cosmetics industry and investor in AlgaLife. The company grows the raw materials in a bioreactor plant located in the south of Israel.

Founded by a former fashion designer, the young company seeks to develop cleaner and greener dyes and fibres from microalgae. “The manufacturing process of growing the algae takes place in a closed loop, is powered by solar energy, has no negative impact on nature or on workers, and doesn’t even require freshwater as saltwater is used,” says Ms Krebs. The company expects to produce a fibre that has some of the properties associated with algae, including releasing vitamins, proteins, antioxidants, or presenting antibacterial or anti-inflammatory properties, without the addition of any chemicals.

AlgaLife plans to launch its fibres in second-skin clothing, such as underwear, activewear and athleisure. The start-up is in contact with a handful of brands and Ms Krebs says the first products will be in stores in 2021. In the future, she aims to develop yarns for home textiles, hygiene products and the automotive industry.

“We know what active materials we have in the biomass. We are currently conducting biological tests. Later on we will launch clinical tests,” she says. The young company states it has already been able to produce a dyed yarn. “We offer colour and yarn together, with zero waste,” she adds.

“Across all industries, I see a connection between algae and wellness. Algae are very interesting microorganisms that can be customised for a specific application,” she says. Among the thousands of different species of algae, AlgaLife says it has identified the ones that deliver the best properties and processability. Of the three fibres in development, one combines algae with a cellulose, or wood, fibre. Ms Krebs cannot reveal at the moment the next generation of the other yarn types owing to intellectual property rights.

Like many innovative materials, the microalgae-based fibres and dyes in development will be more expensive than their conventional counterparts. “The materials produced in pilot phase are around 25% more expensive, but the price will drop by 50% when scaled up,” says Ms Krebs.

Seaweed for wellness

SmartFiber, a company based in Rudolstadt, Germany, launched a lyocell fibre containing seaweed in 2003 under the brand name Seacell. It is made from dried and finely ground seaweed that is incorporated into a lyocell yarn, and produced in a closed-loop process by Lenzing in Austria. Smartfiber says the substances found in seaweed, such as vitamins, trace elements, amino acids and minerals, can help activate cell-regeneration, which in turn can relieve skin diseases and reduce inflammation. Seaweed’s antioxidants protect the skin from free radicals, properties that have been validated in the yarn by a third party. “The natural moisture level of the skin enables an active exchange of those beneficial substances between the fibre and the skin, providing a noticeable sense of wellbeing,” the company claims. Seacell yarns contain 4% seaweed and have a light brown hue.

An algae-based fibre called Celp appears to have similar properties and colour. The Fabric Workshop (TFW) presented the first fabrics using a regenerated cellulose and algae yarn at ISPO earlier this year. This new “boutique” supplier of textiles focuses exclusively on low-impact materials and is part of vertically integrated textile manufacturer Ashford, whose mills are based in Zhangzhou, China. “Celp is still in development with our industrial partner Chaintex,” says Six Cheung, founder of TFW and Chaintex owner. The fibre has obtained AATCC 100 certification for antibacterial functions, and it is said to emit negative ions which removes free radicals. “It is a perfect material for healing burns or wounds,” says Mr Cheung. The brown seaweed added to the yarn
gives it a dark hue, but TFW is trying out a new version, containing less algae (5%), to make heather fabrics spun with organic cotton for underwear and base layers.

**From waste to polymer**

Algix, based in Meridian, Mississippi, has also successfully brought to market its Bloom-branded algae-based foams for footwear. As its name implies, this material is made from algae blooms that pollute waterways. “We started 14 years ago with the idea of cleaning textile wastewater, which is full of phosphorus and nitrogen, with algae that supply a protein-rich biomass as a by-product,” says Ryan Hunt, company co-founder and CTO. He says the algae blooms that grow in wastewater tend to be of roughly the same strand and these tend to produce proteins more than oils. The company is recycling this “proteinaceous” material into industrial polymers.

As a 100% algae plastic was found to be too brittle for industrial use, the company mixes its biopolymer with other resins. In 2015, it found that a blend with elastomeric EVA had market potential and began production with a Taiwanese supplier of foams for footwear and other consumer goods. Five years later, 70 factories are producing the material for 63 brands, says Mr Hunt. Bloom is applying for GRS, Global Recycle Standard certification and the results of an LCA, conducted by a third party, are being shared with brands and the Higg Index.

The next step for Algix is to develop higher-value materials, such as thermoplastic elastomers (TPE), which have a better rebound and are softer and more cushiony, says Mr Hunt. Possible end markets include yoga mats and outsoles for athletic shoes.

In addition to producing a high-tech material, Algix seeks to inspire industries and municipalities or any organisation running wastewater management facilities to append an algae-transforming unit to them and “convert waste into a valuable commodity,” says Mr Hunt. In 2019, the US Department of Agriculture (USDA) registered algae as an agricultural commodity, making it a tradeable material and a feedstock for industry. This could allow the Algix process to be all the more attractive, he says. “We see algae as an untapped resource that is growing in the wrong location.”

**Algae believers**

Matthias Foessler, at Beyond Surface Technologies, believes many different chemicals can be produced from the oil-producing microalgae in development at Checkerspot, citing work on a softening agent for denim and possibly even a new DWR technology. Oils, or triglycerides, have a staggering presence in industry, Mr Dimmler points out. “We see an asymmetry in the market. We know what can be done with algae, the diversity of monomers that can be produced, but people in the industry don’t realise this yet.” This, he says, is due in part to a lack of literature on algae as opposed to the many tomes investigating yeast and E. coli.

The power of microalgae goes far back. They are said to have been the very first unicellular species to have inhabited the planet, generating the atmosphere that has made it inhabitable and they are credited with producing half of the world’s oxygen. Fast forward aeons, and building on the food, pharmaceutical and cosmetic industries, the plant and microorganism may harbour a solution to a greener and more sustainable textile industry. 😃

**A photo, magnified 600x, of oil-producing microalgae cells in development at Checkerspot.**

**The Fabric Workshop is introducing fabrics made in Celp, an algae-based fibre in development at Chaintex. Pictured here is a fabric selected by ISPO Textrends.**