

Bioforsense – From Waste to Value

Utilizing Bio-based Side Streams to End the Increase of Industrial Waste

CH-Bioforce, based in Raisio, Finland, strives for a cleaner world. With their revolutionary technology, side streams from the manufacturing industry can be converted into high-value consumer products in an economically profitable way. These biomasses are fractionated into their main components: hemicellulose, lignin, and cellulose, with high purity and yield. These biopolymers can replace oil-based raw materials and cotton as binders, fillers, emulsifiers, textile fibers, and even as components in medical applications. CHEManager talked to Petri Tolonen, CEO of CH-Bioforce, about the company's innovative technology and how the team wants to continue its success story.

CHEManager: Mr. Tolonen, how did the idea for CH-Bioforce come about?

Petri Tolonen: Back in 2011, wood chemistry specialists Sebastian von Schoultz, Lari Vähäsalo and Nicholas Lax discovered that by using vacuum and ensuring precise chemical control, it was possible to extract hemicelluloses in high yield and purity in their native polymeric form. They started to develop their findings further and, after a few years of experiments, established CH-Bioforce in 2016.

What makes your Bioforsense technology unique?

P. Tolonen: This Bioforsense technology is the only solution available that gently extracts all the main components of biomass in one process. The resulting biopolymers—dissolving cellulose, polymeric hemicellulose, and sulfur-free lignin—are extremely pure and close to their natural form. It is possible to replace oil- and cotton-based materials in the manufacturing of consumer goods completely with these biopolymers.

What problem do you solve?

P. Tolonen: The world is drowning in non-renewable waste. Our seas, rivers, and lakes are full of microplastics, greenhouse gases are changing the climate, and our fragile nature is being overexploited. We dream

of a world without plastic waste and oil-based consumer goods that end up destroying the planet.

In our vision, a circular bioeconomy ensures the utilization of industrial side streams, and natural renewable biopolymers are a sustainable alternative to non-renewable raw materials.

Modern consumer industries use tons of fossil-based raw materials in their production. At the same time, many agricultural side streams, like straw, end up being burned.

Burning valuable biomaterial side streams causes billions of tons of greenhouse emissions globally, whereas they could be used to replace various harmful or fossil-based components in the manufacturing process.

This doesn't have to be the status quo. We want to change that. We want to turn waste into high-value raw materials for our and the globe's sake. This is what our technology solves, and it is already in use.

Our technology produces more environmentally friendly raw materials for consumer goods, and industrial side streams will be used as efficiently as possible.

Can you give us an example?

P. Tolonen: Together with one of the world's largest brewing companies, we investigated how the side stream from the brewing process that currently ends up as waste can be utilized. We collect the brewer's spent

grain and the straw waste from farms, and by using our Bioforsense technology we turn the waste material into high-value biopolymers—lignin, hemicellulose, and cellulose.

Cellulose, for example, can be used as a sustainable alternative for textile fiber production, replacing cotton-based textiles. We have been partnering up with Spinnova, for example, which makes sustainable materials for clothing brands like Adidas, The North Face, and Marimekko.

What's more, farmers that grow the initial cereal—wheat, oat, rye, rice, you name it—earn income by selling the “waste” to a producer that utilizes Bioforsense technology as I described.

How strong do you anticipate the demand for your technology to be?

P. Tolonen: Consumers demand more sustainable goods and apparel. At the same time regulations and legislation, such as the single-use plastics directive, drive manufacturers to find renewable, bio-based raw materials for their products.

Bioforsense technology is not limited to any specific raw material—quite the opposite. Our technology can extract biopolymers from wood, and also from other lignocellulosic feedstock, such as agricultural and industrial side streams. By 2025, it's estimated that the market size of industrial biomass waste will be tens of billions of US dollars annually, and this estimate is increasing rapidly.

At the same time, consumers want to use even more sustainable and environmentally friendly products in their everyday lives, whether we are talking about clothing, cosmetics, or food packaging. The problem is any oil-based raw material in the manufacturing process of these consumer goods, and the solution to make them more sustainable, and better, is CH-Bioforce and Mother Nature.

How do you see the future development?

P. Tolonen: The demand for sustainability from consumers is rising expo-



Petri Tolonen,
CH-Bioforce

PERSONAL PROFILE

Petri Tolonen, CEO of CH-Bioforce since 2021, has more than 30 years of international business experience at UPM, Valmet, and Wärtsilä, in sales, marketing, business development, and leadership. Tolonen holds an M.Sc. (Eng.) in Paper Technology and Production Economics. He stated when joining the firm that “We are on the crest of the wave when it comes to green technology. To slow down climate change and conserve natural resources, the necessary direction is to process all possible industrial and agricultural by-products into useful end products instead of being incinerated or landfilled – globally.”

nentially and multinational brands need to take action to respond to this. They want solutions that maintain their products, and one no-brainer solution is to make the products and processes more natural and environmentally friendly without decreasing product useability or durability.

Our technology's products maintain the features of face lotions, shirts and jeans, and food packaging. At the same time, the brands—if nothing else changes—produce way less CO₂ emissions in the production, emit fewer microplastics into the world, decrease the demand for oil-based raw materials, and use much less water—especially in the clothing business.



BUSINESS IDEA

Biomass Fractionation Technology

Finland-based CH-Bioforce provides the world's only technology which extracts all of the main components of biomass in one process. The resulting biopolymers—dissolving cellulose, polymeric hemicellulose, and sulfur-free lignin—are extremely pure and close to their natural form.

The proprietary Bioforsense technology can utilize almost any kind of biomass as feedstock: wood species and non-wood, such as straw, which has become one of the most important raw materials. We provide a new feedstock option to multiple industries.

Renewable raw materials for sustainable living

With our technology, multiple oil-based products can be replaced in consumer goods with natural biopolymers while still maintaining the products' quality, durability, and useability.

At the same time, more environmentally friendly goods will be produced, and the industrial side streams will be used efficiently rather than ending up as waste or being burned. Using natural raw materials is an action for nature's

well-being. Fewer harmful emissions will be produced, and fewer oil-based raw materials will be needed in the future.

Anticipating the future carbon-neutrally

We will build a next-generation biorefinery, which fractionates over 90% of biomass to produce biopolymers. Thanks to our revolutionary technology, a multitude of biomasses can be valorized on an industrial scale. Our process is carbon-neutral or even carbon-binding when renewable energy sources are being used.

The combination of technologies we use preserves the natural properties of all the main fractions better than any other technology. The unique quality of these biopolymers opens up a plethora of possible valorization routes.

Our competitors in the biorefinery industry mainly use wood-based raw materials, and in the bio-based chemical industry food-based feedstock. We strongly believe that nutritional resources shouldn't be wasted like this. Fortunately, there is already a solution—CH-Bioforce and Bioforsense technology.

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Fig. 1: Wood chemistry specialists Nicholas Lax, Sebastian von Schoultz and Lari Vähäsalo are the founders of CH-Bioforce.

ELEVATOR PITCH

A World Without Waste

The world is drowning in non-renewable waste. Our seas, rivers, and lakes are full of microplastics. Oil-based raw materials are commonly used to make consumer goods. That is a huge problem, and the situation can't continue like this.

Luckily there's a solution: CH-Bioforce's unique Bioforsense technology extracts all of the main components of almost any biomass in one process. The resulting biopolymers—dissolving cellulose, polymeric hemicellulose, and sulfur-free lignin—are extremely pure and close to their natural form, and can be used to replace non-renewable raw materials in the production of consumer goods—oil in cosmetics and plastics in clothing, for example.

The company's technology is founded on a deep understanding of fundamental biomass chemistry. Broad academic and industrial collaboration and networking enable us to create state-of-the-art technologies where ingenious chemistry is combined with innovative reactor design and processing.

The idea behind our innovation is to find sustainable raw materials which can replace non-renewable, oil-based raw materials by using industrial and agricultural side streams as feedstock—converting waste into value.

Milestones

- 2011**
 - Discovery of fractionation technology
- 2016**
 - CH-Bioforce established
- 2017**
 - Small-scale plant in Finland with a capacity of 1 ton per batch
- 2019**
 - Construction of automated plant in Finland begins
 - EU Horizon SME funding
- 2020**
 - Technology develops and CH-Bioforce enters global rankings
- 2021**
 - Several partnerships and new collaborations locally and globally
- 2022**
 - Bioforsense technology used in real applications

Roadmap

- 2025**
 - First plant to be commissioned with a capacity of 20,000 t/y



Fig. 2: CH-Bioforce has developed Bioforsense, an innovative biomass fractionation technology.