Transforming the Scale-Up of Biobased Molecules

Toll-Processing Service for Scaling Up Chemically Modified Natural Polymers Production

Producing industrially relevant quantities of material for application testing has been a continuous challenge for scaling up new biobased products. The solution offered by Finnish start-up company Mega Cellulose is a kiloton-scale open-access toll-processing service. The founder Jere Koskinen and the idea originator Ali Harlin explain the idea and the strategy behind Mega Cellulose.

Ali Harlin

Jere Koskinen

CHEManager: When did you found Mega Cellulose, how did it all start?

Jere Koskinen: The company was started in 2019 and pitched for the first time at the European Chemistry Partnering event in Frankfurt in February 2020. We were able to complete a number of smaller customer projects. But due to the pandemic, we put the project on hold for the remainder of 2020 and started operations again in early 2021 with revitalized vigor

What is the idea and driver behind Mega Cellulose?

Ali Harlin: During my career, I have seen a number of good chemical inventions that never made it out of the laboratory or small-scale pilot. Many of these inventions were lacking proper industrial demonstration. The facility that would be needed to produce sufficient volumes for industrial product validation require significant investment in terms of time and money. If this is done for each project, molecule or material, the costs are just too high. Ground-breaking novel concepts, where the process differs from the traditional platforms are especially challenging. This is why a multipurpose factory is needed, which is large and flexible enough to share the fixed costs between several projects. Natural polymeric materials, especially from lignocellulose origin, are in our focus. This makes the Mega Cellulose facility one-of-a-kind.

What is the USP or differentiating feature of Mega Cellulose? What makes your technology unique?

J. Koskinen: We are not working on our own products. Our concept is to offer scale-up for chemically modified natural polymers as a toll processing service. A kiloton-scale industrial demonstration plant of this kind will easily require €40–60 million in investment. Also, it will require some years to build. Moreover, one needs to recruit and train a team of specialists to operate the plant. When all this is available as a service, our customers will save time, capital and the effort of recruiting at the demonstration stage. This lowers all the risks associated with the industrial application testing and product validation. If they are not successful, there is nothing to write off the books later on. If there is success, the customer can move on to preparing the full-scale investment. This is the first time when the customers will need a larger dedicated in-house investment project team and a larger investment of their own capital. We estimate time savings of some 5 years and CAPEX savings of some €50 million to validate each molecule or material. When realized, this should accelerate the creation of a true bioeconomy in Europe.

Which obstacles did you have to master so far and what challenges are you seeing to get your start-up company up and running?

A. Harlin: There was a big push this year to get the first small-scale assignments from customers from order to delivered results. Prior to its main investment, Mega Cellulose is still working with borrowed and rented equipment. It needs to rapidly grow our operation in meaningful but prudent steps. The next step will be increasing the annual capacity to approximately 200 t. The site selection for this is under way in Finland and Germany.

Mega Cellulose is adopting novel processing technologies and process concepts, targeting compact, flexible and economically viable solutions. According to our vision, the future biorefineries should be simple to start up, and as easy to scale up when the initial market ramps up. This requires an interactive way of working with several parties, including customers, equipment suppliers and other partners.

What are the next steps for the company?

J. Koskinen: The next steps will be: Building a pipeline of customer cases. Building the 200-t installation in either Finland or Germany will start in 2022. Planning the larger 1,000-t plant with the experience from the preceding step will already require a steady workflow from customers. Moreover, we need to grow the team beyond the initial five members to some 25 by the end of 2022. In addition to building successful business cases for our customers, we will continue talks with potential investors. Securing financing for the growth path is the third leg we need. The fourth one is to create a network of collaboration to in- and outsource services. The fifth element will be marketing existing intellectual property rights from our partners to customers to enhance their commercial and industrial development in bioeconomy.

Personal Profiles

Ali Harlin studied chemical engineering at Helsinki University of Technology and earned his doctor in science (DSc) degree while working as a process development manager at Borealis. He is a materials scientist and research professor at VTT Technical Research Centre of Finland, and has previously acted as a professor at Tampere University of Technology and adjunct professor at Lappeenranta University of Technology. He is an inventor of several patents and also involved with several start-ups in circular and bioeconomy, most recently in Infinited Fiber Company and Rester.

Jere Koskinen earned his PhD in physical chemistry at Helsinki University, Finland. His early career encompasses academic research at Purdue University, the Empire State Paper Research Institute at the State University of New York in Syracuse, and a faculty position in paper chemistry and recycling at the Georgia Institute of Technology. For the past two decades he has worked in and with the forest and agricultural products industry. In 2014, he started off as an independent entrepreneur with Ecotradex, active in consulting circular and bioeconomy initiatives in large corporations, as well as in trading and developing new biobased materials e.g., for the packaging industry.

Business Idea

Accelerating Product Commercialization

Mega Celullose aims to accelerate bio-based product commercialization and reduce the industrial demonstration and product validation costs by half.
There are tens of thousands of working years' worth R&D work done for development of new biobased molecules in Europe alone. Many have cleared the laboratory, bench and pilot scale testing but there is no cost-efficient way to produce truckload quantities required for industrial product validation. Building a kiloton-scale demonstration plant for each molecule separately would take disproportionate amounts of time and capital. Mega Cellulose offers this step as a toll processing service along with a number of associated expert services to shorten the time and reduce the capital expenditures for scale-up.

The company's core expertise is in high-consistency chemical derivatization of natural polymers. The feedstock can be cellulose, starch, hemicellulose, lignin, chitosan or any other natural polymer. The raw materials that can be handled include industrial side streams (peels, shells and hulls), agricultural side streams (straw and husks) and recycled materials (paper, textiles, deinked pulp), and lignin and hemicellulose from new biorefineries.

Typical examples of the chemistry involved encompass cellulose hybrid ether esters, e.g. propyl hexanoate cellulose, and allylated cellulose derivatives. Similarly starch esters and ethers belong to the core menu of derivatized polymers. Hemicellulose ether esters, as well as cationic and anionic polysaccharides in general, are further examples of the type of derivatives that can be produced. Similarly modified microfibrillated and microcrystalline cellulose could also find significant industrial applications in the near future.

The company's goal is not to develop own products but to offer the demonstration plant as a service to customers. All product-related intellectual property rights would also be handed over to our customers during their demonstration campaign. Our service will also include engineering, laboratory, regulatory and IPR (intellectual property rights) service and consultation. These will be partly produced by Mega Cellulose itself but also with network partners and suppliers.

- Mega Cellulose Oy, Espoo, Finland
  www.megacellulose.com

Elevator Pitch

Toll-Processing Service for Biobased Products

Mega Cellulose was established in 2019 in Espoo, Finland. First customer projects were completed in the spring of 2021. The business is a CDMO for toll-producing chemical natural polymer derivatives. The start-up company was founded to accelerate the industrialization of new biobased products. Currently the team comprises the two founders, a business developer, a process engineer, and synthetic organic chemist with a significant amount of the work outsourced to partners and suppliers.

Milestones

2019
- Foundation of Mega Cellulose Oy

2020
- Pitch at the 4th ECP in Frankfurt, Germany (February)

2021
- First customer projects completed, also leveraging hardware from network partners for customer testing at this stage

2021
- Stepping up marketing and investor discussions
- Actively engaging customers, partners, and investors.

Roadmap

2021
- Recruiting round to complement the team
- First capital round to consolidate the status quo
- Setup of permanent laboratory facility in Finland

2022
- Site selection for 200-t/a plant (Finland or Germany)
- Financing for this first plant
- Reel in first major customer projects
- Engineering and construction of 200-t plant

2023
- Site selection for 1,000 t/a plant (10 candidates in Europe)
- Financing for 1,000-t capacity
- Developing operation of 200-t plant to a continuous pipeline

2024
- Engineering for 1,000-t capacity

2025
- Construction of 1,000-t plant
- Further financing round

2026
- Both 200 and 1,000-t plants in full operation

Mega Cellulose plans to build and operate a modular multi-product synthesis plant for chemical modification of natural polymers.

Mixed bulk reactors are particularly well suited for modification of natural polymers.