Spray Drying of Microalgae

Case Study
PTC Japan & ASEAN



Microalgae such as Chlorella, Spirulina, Euglena and Haematococcus are rich in proteins, lipids, pigments and antioxidants. Spray drying is the proven step that turns harvested algae and their extracts into stable, easy-to-use powders. **We design spray drying processes that protect sensitive components such as carotenoids and keep colour, moisture and particle size consistent** for food, supplement, cosmetic, feed and fertiliser applications.

Background

Microalgae are single-celled organisms of about 1 µm to 1 mm that produce about half of the oxygen in the Earth's atmosphere. Their cells are rich in lipids, carbohydrates, proteins, vitamins, minerals and dietary fibre. Chlorella, Spirulina, Euglena, Labyrinthula and Dunaliella are used commercially as functional foods, and astaxanthin from Haematococcus is used in cosmetics and supplements for its antioxidant and UV-protective properties. Microalgae are also used in livestock feed, fertiliser, soil conditioners and colourants, and are being developed as a source of next-generation fuels such as sustainable aviation fuel (SAF) and renewable diesel.

Process Flow

The microalgae production process involves:

1. Cultivation – open outdoor systems or closed photobioreactors.
2. Harvesting – collecting the algal biomass from the culture.
3. Concentration, Filtration & Extraction – refining the biomass or target components.
4. Spray Drying – converting algae or extracts into stable powders.
5. Final Products – food, cosmetics, pharmaceuticals, feed, fertiliser, biofuel and bioplastics.

Spray Drying Challenges

- Heat Sensitivity – carotenoids, pigments and proteins can degrade or discolour.
- Oxidation – lipids and antioxidants such as astaxanthin are sensitive to oxygen.
- Feed Properties – viscous, high-solids slurries affect atomization and particle size.
- Powder Recovery – fine, cohesive powders can deposit on the chamber wall.

Solutions

- Process design and operating conditions set for the required powder quality.
- Low-temperature drying, with inert gas (nitrogen) where oxidation must be limited.
- Freeze granulation as a no-heat alternative for the most sensitive materials.

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Key Quality Parameters

- Particle Size Distribution – flowability and dosing.
- Bulk Density – packaging and blending efficiency.
- Moisture Content – shelf life and stability.
- Colour & Active Content – retention of pigments and nutrients.

Track Record

PRECI spray dryers have been delivered to many major Japanese companies for drying microalgae, including members of the Algae Industry Creation Consortium. Customers use them to:

- Powder microalgae for food, supplements and cosmetics.
- Produce high-value powders rich in fucoxanthin, EPA, DHA and GABA.
- Scale up from research to demonstration and commercial plants.

POWDER TECHNICAL CENTER

With experience in microalgae spray drying, we provide:

- Tailored process design for each strain and product.
- Three Powder Technical Centers (Japan & ASEAN) for R&D and scale-up.
- PTC2 (2023) – one of the largest collections of analytical equipment in Japan.
- Powder trials in spray drying, spray cooling and freeze granulation.
- Pre- and post-processing – wet pulverizing, mixing, molding, sintering and freeze-drying.

Technology by PRECI Co., Ltd., Japan

Specialist in spray drying, spray cooling and freeze granulation, with Powder Technical Centers in Japan. T.S.K. Engineering is PRECI's exclusive partner in Thailand, and PTC ASEAN in Chonburi runs trials with PRECI know-how.