ALGAE OIL TAKES OFF

As biofuel developments spread worldwide, a new type of algae-based biofuel for aircraft having one of the lowest cost and highest efficiency performance figures of any biofuel, enters the commercial market this year. Takashi Sasaki reports.

Aircraft have fallen far behind on measures to reduce carbon dioxide (CO_2) emissions compared to other transportation means such as automobiles, trains and ships. Because of restrictions on total body weight, it is hard for aircraft to carry electrically charged batteries to use as a power source and instead they have to resort to oil-based jet fuel. For this reason, institutions around the world are researching and developing aircraft biofuel to replace existing jet fuel and offer a realistic means to reduce CO_2 emissions from aircraft.

One institution producing significant results in such development is the Research Institute of Tsukuba Bio-Tech Corporation in Ibaraki Prefecture. While there are numerous source materials of biofuel, including corn, sugarcane, soybeans, palm oil, waste wood and livestock excrement, the institute is researching microalgae, a type of algae that grows in water.

"One species of microalgae we discovered and named New Strain X (NSX) lives in fresh water, multiplies rapidly, and is characterized by an extremely high oil content of 70%–80%. Extracting its oil is much easier compared to that of grains. And its elemental composition is optimal for aircraft fuel," says Dr. Takaaki Maekawa, president of the Research Institute and professor emeritus at the University of Tsukuba. "Many institutions around the world develop biofuel using algae, and most aim to reduce costs by growing algae over vast spaces. We, on the other hand, grow algae in plastic greenhouse facilities that prevent other bacteria from entering, and use sunlight in the daytime and a new type of LED at night that is optimized for algae growth. While this involves a great deal of effort and cost, we can harvest a drastically greater amount of algae for the time and area required, which enables us to produce biofuel that sufficiently offsets the cost."

TAKASHI SASAKI

Takaaki Maekawa, president of the Research Institute of Tsukuba Bio-Tech Corporation

Research on the production of algae biofuel in collaboration with the Institute and four universities started in 2009 under Dr. Maekawa as the project leader following his retirement from the University of Tsukuba. Today the project consortium includes a trading company handling aircraft fuel and agricultural corporations, and has plans to begin test operation of biofuel production at a plant in Ibaraki this June. The plant will produce 3,000 kiloliters annually, and ultimately aim for 90,000 kiloliters, and this will be supplied to Haneda and Narita airports from next January to be mixed with conventional aircraft fuel and enter into commercial use.

Dr. Maekawa envisions developing a 100-hectare cultivating facility (farm) and fuel production plant near every major airport nationwide to produce the fuel necessary for aircraft operations.

There are also suggestions of locating NSX cultivating facilities on abandoned farmland left due to aging rural populations and the Great East Japan Earthquake. Unlike grain-based biofuel, NSX production has absolutely no potential to cause food shortages and deforestation. Algae fuel extracted from NSX can be used not only for aircraft but also for applied uses such as diesel engines and thermal power plants. It is estimated that if 100,000 hectares—one-quarter of all abandoned farmland in Japan—could be transformed to NSX cultivation facilities, annual biofuel production would amount to 57,600,000 kiloliters, and the facilities and fuel production plants would create 420,000 jobs. Dr. Maekawa's project is garnering a great deal of attention not only in terms of preventing global warming and securing energy resources but also for creating new employment and vitalizing industry. HJ

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COURTESY OF RESEARCH INSTITUTE OF TSUKUBA BIO-TECH CORPORATION

One unit of NSX is extremely small, measuring 30 microns (one micrometer = 0.001 mm), and when inside a container it is almost a green liquid. In nature, it cohabits with various other algae. First, the algal seeds of NSN are separated from other algae, cultivated and mass multiplied under aseptic conditions in a thirty-five-ton tank (photo left) equipped with LED. Then, they are transferred to a cultivating device called a photobioreactor (photo right) inside a plastic greenhouse. In the photobioreactor, the algae are cultivated under LED lighting during the night and sunlight during the day. Algae oil extracted from the harvested NSX goes into a tank truck and on to a fuel production plant, where it enters a hydrocarbonizing device that uses catalysts to transform it into aircraft biofuel.