Sapporo’s Pilot Brewery for New Brewing Technology

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ABSTRACT

Sapporo’s pilot brewery, which started its operations in 1989, is an experimental brewing facility with capacity of 4 hL as wort per batch. Its major functions are the developments of (1) new brewing technology, and (2) new type beers. The ratio of the second assignment has been increasing particularly there. Its production system is designed to permit successive expansion in quality based on the results of pilot brewery. In this report the following three topics will be discussed: (1) the function and merits of the new product and technology department division, (2) the various facilities for the pilot brewery, and (3) some recent research themes and newly developed products on the market.

FUNCTION AND MERITS OF PILOT BREWING

Our company’s breweries produce 14 million hL of beer annually. This production is not only for the domestic market but for overseas markets all over the world. To accomplish this, we have 10 plants deployed across Japan spanning the country from north to south (Fig. 1). These domestic production centers make it possible to supply fresh beer to nation-wide markets as quickly as it is needed. Among these plants, the Shizuoka and Chiba plants provide large-scale, state-of-the-art facilities and are the backbone of our company’s high production facilities. Among the small-scale breweries are the Micro Brewery at the Shizuoka plant and the Pub Brewery at the Saitama plant which make various types of limited production beers. The pilot brewery presently describing is located at the brewing research laboratories adjacent to the Shizuoka Plant, a production mainstay for our company (Fig. 2).

The micro brewery also located at the Shizuoka Plant works cooperatively on the development of new products and new technology prior to actually starting beer production at the factory. This micro brewery, being located near the metropolitan area, also handles production of custom beers in limited quantities to meet the demand in metropolitan areas.

SINTÉSIS

La planta piloto de Sapporo que comenzó sus operaciones en 1989 es una planta experimental con capacidad para 4hL de mosto por parada. Sus funciones principales son los desarrollos de (1) nuevas técnicas cerveceras, y (2) nuevos tipos de cerveza. El énfasis en la segunda función ha estado incrementando particularmente. El sistema de producción está diseñado para la expansión en calidad basados en los resultados de esta planta. Los siguientes tres temas serán tratados en este reporte: (1) las funciones y méritos del nuevo departamento de desarrollo de productos nuevos y tecnología, (2) las diversas instalaciones para la planta piloto, (3) algunos nuevos temas de investigación y productos recientemente desarrollados que se encuentran en el mercado.

Figure 1
Location of Sapporo's Plant

Mitsuhiko Oda is a researcher of Brewing Research Laboratories of Sapporo Breweries Ltd., Japan. He has been engaged in research and development of new types of liquors using pilot scale plants. He graduated from Kyushu University in 1990 with M.Sc. degree in food processing, and joined Sapporo Breweries Ltd.
Fig. 2  
The View of Breweries

Fig. 3 shows a simple explanation of the brewing research laboratory’s structure. These labs are grouped into six sections. First is the microbiology department where research is constantly done ranging widely from the basic study of beer yeasts to actual applications. Second is the biochemistry department where research is performed centering on the constituents of the beer foam. Third is the quality assurance department where the main duties are quality control of the ingredients and the beer as well as improving the flavor and physical durability of the beer. Fourth is the chemical research department where chemical analysis and analyses requiring unique technical methods are performed. Fifth is the foods and by-product department where research on effective utilization of beer by-products is performed. Finally is the brewing technology department run by the pilot brewery, where development of new products and new technology is performed.

In contrast with the pilot brewery which produces about 400 liters, the micro brewery can produce 5 kiloliters or roughly 12 times the pilot brewery output. The Shizuoka Plant is built to manufacture 100 kiloliters or 20 times the micro brewery output (Fig. 4). The production system is designed to permit successive expansion in quality based on results of the pilot brewery.

Pilot breweries yield the following merits and special features. First of all, starting with beer, experimental production licenses for many types of alcoholic beverages are obtained. In other words, except for a limited portion of refined sakes and shochu (a Japanese distilled liquor), test production of all types of alcoholic beverages is allowed domestically under Japan’s alcohol taxation laws. Secondly, since the brewery facilities are small-scale they are versatile in adopting to radical changes to new production methods, and also allow separate testing of troublesome, new type raw materials at the factory. Third, the brewing research laboratories’ links with other sections make it easy to have quality inspections performed and custom beer analyses made. A further plus is that superior yeast varieties can be selected from the yeast bank. Thanks to these kind of advantages, pilot breweries can act in advance of the micro brewery and main plants to carry out wide-ranging development of new products and new technology.

BREWING FACILITIES

Fig. 5 shows a flowchart of the pilot brewery operation. One unit can produce 400 liters of wort. This wort is next fermented in a 400 liter tank. The wort from a 400 liter brewhouse is normally fermented in a 400 liter tank and stored in 300 liter or 160 liter tanks, but it may also be fermented and stored in 30 liter tanks. The pilot brewery has twelve 400 liter fermenting tanks, four 300 liter and four 160 liter storage tanks, and about ninety 30 liter storage/fermenting tanks. The beer is then filtered. Since the pilot brewery is not designed for commercial production, the final product is bottled in quantity which permits analysis and sampling uses, and the rest is usually discarded.
Brewhouse

Fig. 6 shows a 400 liter brewhouse unit comprised of a mash kettle, a mash tub, a lauter tub, a wort kettle, a whirlpool and a wort cooler. Each process is automated. However, the filling of each tank and kettle is done by hand through a manhole cover.

Settings of brewing conditions are made by computer for the process items and a sequence-controlled operation proceeds in a largely automated process. Besides the 400 liter brewhouse, the pilot brewery also has a 40 liter brewhouse but this is only used for special cases in which the sample ingredient quantity is too small to be handled by the 400 liter brewhouse.

Fermenting and Storage Tanks

The wort and yeast are added through a hose at the bottom of the tank (Fig. 7). The fermenting temperature is automatically controlled throughout the entire process by a computer. The tank is cleaned-in-place (CIP) by means of a hose in an automatic process.

Test Filter

After aging of the beer is finished, it is filtered in the test filter (Fig. 9). The filter machine has a diatomaceous earth filter element using a sintered metal support member and is largely similar to the bulk primary filter at the company factory. However, since injection of specific small amounts of filter booster pulp is difficult because of the small size of the filter, a surge tank is employed using a pre-weighed amount of filter booster.
booster, in a method where 30 liters of beer is fed at one time from the surge tank. This permits approximately 30 liters of beer to be filtered per hour.

Once filtering is complete, the beer is filled into bottles by the filler and, to prevent oxidation during filling, the air in the bottles is replaced with carbon dioxide gas.

Sensory Test Room

The product made in the pilot brewery is then subjected to sensory tests such as taste tests in this room (Fig. 10). The taste tests are performed in this specially designed room of the brewing research laboratories by a panel of specially selected members. Data collected for statistical processing. Besides routine beer analyses, various special methods are employed for analyzing the test product beer.

Main Targets of Pilot Brewing

As already stated, the main targets of the pilot breweries are first, new technology for beer brewing and, second, development of new types of beer. We are currently trying various approaches in developing new beer brewing technology and have put these successes to work in our beer production plants. I will limit myself to just an introduction here but will report on our results in depth at future conferences.

The 50 liter plant started operation in 1980 and the 400 liter plant commenced operation in 1989. Here are shown the total figures (Fig. 11) for one year of facility operations along with a grouping of categories and, as you can see, they are increasing year by year.

Here in Japan along with fierce competition among domestic manufacturers, low-priced imported beer is penetrating the market showing that consumer needs and preferences are becoming more diverse, thus making new product development an area of critical importance.

New Product

The “Sapporo Drafty” is a new product recently developed at the pilot brewery. It has been brewed and sold in Japan since April of this year and is showing good sales results. Besides this “Drafty” alcoholic beverage, we have also developed many other beers, continuously adding to our company’s product line. We offer Kuro Raberu (Black Label) and Kissui as our main
standard beers and Yebisu as our premium beer with 100% malt, and also producing limited beer editions locally at locations throughout the country. The main sales products in the lower price region include items such as “Drafty” alcoholic beverage.

Other alcoholic drinks we produce are wines, western liquor and liqueurs. Soft drinks also are proving to be popular sales items. We use this varied product lineup as a sales strategy to satisfy diverse consumer tastes. Our company is now looking towards a dual management starting from this product group centering on beer.

We are setting for ourselves a “long-term management concept” oriented to the year 2001 and consisting of an “individualistic type enterprise contributing to improved lifestyle based on two pillars: one being beer and the other real estate - urban development.” This other pillar supporting us besides the beer industry is our real estate business which built the “Yebisu Garden Place” by urban development of the remains of the old Yebisu factory. The grand opening of the Yebisu Garden Place was held in October of last year and is steadily proving to be a success. This has spurred us on towards the 21st Century and setting our sights on becoming a “trillion yen business.”