Streamlining of Asahi’s State-of-the-Art Brewery

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ABSTRACT

Asahi’s Shikoku Brewery is our ninth brewery and the first in the Shikoku region. It was completed in June 1998 in Saijo City, Ehime, to respond to the growing demand for our Super Dry in that area.

The brewery was at first designed to be operated with fewer personnel by adopting a central control layout, central monitor system, emergency stop system, and other systems that can help the streamlining of operations. Furthermore, in the brewing section, one-person-shift operations from Brewhouse to Aging Tank has become possible this year without cutting out necessary steps for quality checks by implementing measures to lessen the regular operations, such as: (1) automatization and modification of the software; (2) reduction of non-regular operations through performance improvement activities; and (3) process irregularity detection using cellular phones in the brewery and establishment of a safety control system. Through these efforts we have achieved a more efficient operation with fewer staff members than the number of personnel expected to be required at the beginning of the brewery construction.

Keywords: Asami Brewery, streamlining, Shikoku Brewery, communication system

INTRODUCTION

The Asahi Shikoku Brewery has been operating for about two years since its completion in June 1998. While ensuring the stability of our product flavor, we have been focusing efforts on streamlining the production processes at this brewery.

Nobutoshi Imaizumi was born in 1961 in Kawasaki City, Kanagawa Prefecture. He graduated from Kyoto University in 1987 majoring in agricultural Chemistry and joined the Asahi Brewery brewing section. In 1992, he transferred to the Ibaragi factory mini brewery and in 1993 studied at the VLB in Berlin, Germany. He transferred in 1992 to the Nagoya Brewery brewing section, and in 1997 to the new brewery design office. In 1998, Mr. Imaizumi was transferred to the Shikoku Brewery brewing section after the plant was complete.

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Last year the total production volume amounted to about 950,000 hL. The brewery obtained ISO9002 certification last year. It is designed to achieve high levels of product quality and environmental friendliness, and is now being audited for ISO14001 certification.

The streamlining measures introduced in this paper are limited to the brewhouse and fermentation operations of the Brewing Department. The processes examined for streamlining the brewing and fermentation operations include the acceptance of raw materials, milling of malt, brewhouse operations, wort cooling, fermentation and storage cellar operations, including management of beer during fermentation and storage, transfer of young beer from the fermentation tanks to storage tanks, yeast recovery, storage and pitching, and CIP operation of fermentation tanks, storage tanks, and pipes. Since the streamlining project was completed, all these operations have been performed by a single person in each of the three work shifts. (Figure 1)
RESULTS AND DISCUSSION

The Aims of the streamlining

The aims of the streamlining project were higher efficiency and cost reduction. These two objectives are now as important as quality assurance for the beer production industry.

To improve efficiency and reduce costs, productivity must be increased. As no dramatic increase in production volume is expected in the near future, it is necessary to promote labor-saving efforts to boost productivity. At Asahi Breweries, the previous year’s average production volume per person was 16,700 HL.

The Ibaraki Brewery recorded the largest volume of 26,040 HL, while the Shikoku Brewery produced 10,050 HL, which is relatively small compared to those of other breweries. The equipment and number of employees are about the same in all Asahi breweries. (Table 1)

The production volumes vary among our breweries because the operating hours are adjusted according to brewery scales and seasonal demand fluctuations. The brewing process is usually handled by one or two persons per one brewhouse shift, and two to four persons work in each shift in most of our breweries. Although two persons can work on two lines with relative ease, it is difficult for one person to complete one line. I will describe the reasons for this later. Since the Shikoku Brewery is not large in scale, we initiated a project to improve the productivity of this brewery by expanding the scope of work in the brewing process to include the fermentation operation. Furthermore, we embarked on the challenge of enabling a single person to perform all necessary work.

The Potential Problems of Streamlining

At eight other Asahi breweries, process automation is underway. More than 90% of the processes are now automated. However, none of our breweries adopts a one-person-per-shift system for the brewhouse and fermentation operation. When there is only one person working on these processes, we must consider the following potential problems:

1) can one person handle all workloads for quality assurance and quality check?
2) can we provide adequate rest periods for the operator?
3) can we ensure the highest levels of safety in case of an accident?
4) can one operator take adequate response measures in emergency situations:

Unless these problems are solved, it is not possible to adopt a one-person-per-shift system.

The purpose of our streamlining project was to solve these problems and establish an effective one-person-per-shift system for the Shikoku Brewery.

In the early stage of our project, we examined and analyzed the actual work conditions at the Shikoku Brewery as well as those at other breweries to find how we could solve the prob-

TABLE 1
Productivity at Asahi Breweries.
1999 Data Hectoliters

<table>
<thead>
<tr>
<th>Brewery</th>
<th>Annual Production Volume</th>
<th>Annual Production Volume per Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shikoku Brewery</td>
<td>955,000</td>
<td>10,050</td>
</tr>
<tr>
<td>Ibaraki Brewery</td>
<td>4,531,400</td>
<td>26,040</td>
</tr>
<tr>
<td>Average production volume of nine Asahi Breweries</td>
<td>2,827,600</td>
<td>16,700</td>
</tr>
</tbody>
</table>
lems. We extracted several requirements involved in accomplishing our objectives. To achieve these goals, we decided to focus on three key points:

1) Establishment of a brewery layout that allows easy access to critical sections of the process
2) Development of innovative program
3) Establishment of a communication system to ensure safety and provide rest time for the operator.

Each of these three points are discussed as follows.

**ESTABLISHMENT OF THE BREWERY LAYOUT**

**The outline**

The total number of employees is 90. The Huppmann-manufactured brewing equipment with a capacity of 700 hL is operated eight times a day. The brewery has 78 cylindro-conical fermentation tanks and storage tanks. The two candle-filters perform filtration at a rate of 500 hL/hr each. The brewery is also equipped with three dedicated packaging lines for bottles, cans and kegs, each forming as a separate process line.

**The layout of the Shikoku Brewery**

Figure 2 shows the layout of the Shikoku Brewery. Arranged in a single line on a site 400 meters long in an east-to-west direction and 200 meters wide in a north-to-south direction are malt silos, brewhouse, fermentation and storage tanks, filtration room, packaging lines, warehouse, and shipping yard. Raw materials are fed from the west end and final products are shipped from the east end.

**FIGURE 2**
Overall Layout of the Shikoku Brewery

The layout of the brewhouse and fermentation areas

Figure 3 shows the layout of the brewhouse and fermentation areas. Whether to install the control room in the brewhouse or fermentation area was a critical decision. In the brewhouse, saccharification checks must be conducted for each brew and sampling for a cold wort quality check must be performed. In the fermentation area, sampling and analysis work is conducted to check product quality when a fermentation tank becomes full and also at the time of transfer. Since the frequency of work to be conducted in the brewhouse is four times higher than that in the fermentation process, the control room was established adjacent to the brewhouse. The facility is laid out in such a way that the operator can reach the bottom of the farthest tank in less than three minutes.

**FIGURE 3**
Brewhouse and Fermentation Area Layout

The layout of the control room

Figure 4 shows the layout of the control room. In a single-person-per-shift system, the person on the shift is responsible for all operations and work can be very stressful. Although the con-
The control room is primarily a place to monitor the automatic operation processes, we also made it a place to rest. The person in charge of the utility supply section also works in the control room. Since the boilers and refrigeration units operate continuously, the power equipment must be attended around the clock for maintenance and inspection. The two sections in the control room have their desks next to each other to enable smoother cooperation. The room is also spacious enough to prevent the operators from feeling cramped.

**DEVELOPMENT OF INNOVATIVE SOFTWARE**

Our development work focused on three points:

- High levels of automation
- A programmable start function
- Ease of response to troubles.

**High levels of automation**

To achieve high levels of automation, we first selected types of work to be performed manually. Then we tried to automate other work as much as possible, including the daily recording.

The types of manual work include saccharification check, cast-out wort and cold wort sampling, yeast sampling, sampling of fermented beer, and inspection of the inside of tanks after CIP. Although some of these tasks could be automated, we chose to conduct them manually to ensure high levels of quality control and assurance.

**A programmable start function**

We use two types of programmable auto start: timer-operated auto start and operation-linked auto start. For operations that need to start at certain times, such as mashing and yeast handling, the timer-operated auto start is used. For operations that are conducted immediately after processes are completed, such as CIP work, the operation-linked auto start is used.

The programmable auto start function reduces the time spent by the operator in the control room, and allows the operator to do work outside the control room or take a rest.

**Ease of response to troubles**

We have taken measures to make malfunction processing easier. While the processes are operating, the computer monitors that the valves are kept at correct positions and that the in-line instruments are working well. In case trouble occurs, the process is stopped automatically in the safest mode. If a malfunction results in a leakage of beer or wort, the designed software will close the bottom valves automatically and place the equipment on standby. If the problem can be corrected easily, the operator can restart the operation simply by pressing the process run switch again. This system allows the operator to be away from the monitor screen when necessary. Even if trouble occurs in other processes, the operator has sufficient time to respond to the malfunction. Therefore, a single person can handle any types of problems. With this software, the average time spent by the operator on manual operation — that is, work performed by moving the hands — is about five minutes per hour, making a one-person-per-shift system possible.

**ESTABLISHMENT OF THE COMMUNICATION SYSTEM**

The most important task in developing a single-person-per-shift system is the establishment of a process malfunction notification system and a communication system. For these vital safety-related functions, we use a Personal Handy Phone (PHS) system. The voice announcement system provides alarms and guidance so the operator does not have to keep an eye on the monitor screen in the control room. When the operator is outside the control room, the PHS is used to notify him of troubles. Accordingly, when a malfunction occurs, the system notifies the operator in real time regardless of the location of the operator. (Fig. 5)

**ALARMS AND GUIDANCE**

Sends signal to PHS phone (Voice warning in control room)

**FIGURE 5**

Establishment of Malfunction Warning System

A PHS is also used as part of the safety system. Antennas are installed throughout the facility to allow immediate communication from anywhere in the facility. In case the operator falls down and cannot make a call, the PHS automatically transmits a signal to indicate the operator's location on the computer screen. This function is activated when the PHS is kept tilted for 2 minutes by more than the preset angle. Based on the information displayed on the computer screen, the PHS automatically makes an emergency call to the utility supply section or the security company. (Fig. 6)

The system successfully provides malfunction warning and safety control functions.
SAFETY ASSURANCE

A PHS phone automatically triggers a call if the operator falls and is injured inside the facility.

Communication with external organizations

Indication of operator’s location

FIGURE 6
Establishment of the Communication System

CONCLUSION

Let me summarize the key points of the streamlining measures.

1) Brewery layout that allows easy access to critical sections of the processes
2) Development of innovative software
3) Establishment of a communication system to ensure safety and provide rest time for the operator.

We fulfilled these three requirements and solved the potential problems in a one-person-per-shift system. By paying close attention to these three points, it is possible to streamline operations in the brewing departments of other breweries as well as in other departments.