

Joint Development and Introduction of Quantitative Evaluation Method for Sake Brewing Process Using Gas Sensing Technology

— Using the IoT Service "D-Fire" for Visualization to Ensure Consistency in the Quality of Sake —

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Daigas Energy Co., Ltd.

Kizakura Co., Ltd. (President: Shinji Matsumoto, hereinafter "Kizakura") and Osaka Gas Co., Ltd. (President: Masataka Fujiwara, hereinafter "Osaka Gas") have jointly developed a method to quantitatively evaluate the *koji* (rice malt) making process, which is a key process in sake brewing, by using Osaka Gas's gas sensing technology. Today, this method is integrated into the IoT service "D-Fire" provided by Daigas Energy Co., Ltd. (President: Masayuki Inoue, hereinafter "Daigas Energy"), a wholly owned subsidiary of Osaka Gas, and introduced into the *koji*-making site of Kizakura. The introduction of this new evaluation method will make it possible to visualize the conditions of the *koji*-making process in real time, which will contribute to ensuring consistency in the quality of sake.

The process of sake brewing usually consists of rice polish (polishing brown rice, the raw material of sake), rice wash (washing polished white rice), soaking (soaking white rice in water to have it absorb water), rice steaming (steaming rice), *koji* making (making *koji*), fermentation (mixing *koji*, yeast, steamed rice, and water and fermenting it into moromi, an alcoholic intermediate), squeeze (squeezing moromi to separate it into sake and sake lees), filtration, pasteurization, storage, and bottling.

Koji making is a process to make *koji* by propagating *koji* mold on 20% of the steamed rice used in the sake brewing process. It is an important process that influences the subsequent processes and the quality of sake; therefore, there is a saying that expresses the important factors of sake brewing, "first *koji*, second *moto* (yeast mash), and third brewing."

Usually, in the *koji*-making process, the conditions of *koji* are checked by brewers using their qualitative senses of smell, appearance, taste, and touch, and then various tasks, such as the adjustment of temperature and humidity, loosening rice, and the ventilation of the *koji*-making room, are performed based on their perception. Therefore, brewers' know-how and experience are very important. In addition, as the growing environment for rice, the raw material of sake, becomes unstable due to the impact of recent climate change, it becomes more difficult to make *koji* with consistent quality.

In FY2017, Kizakura and Osaka Gas started joint research on the quantification of conditions for sake brewing. As a result of repeated technical verifications at the production site of Kizakura using Osaka Gas's gas sensing technology, the two companies have jointly developed a method for estimating the quality of *koji* by quantitatively evaluating slight changes in the amount of carbon dioxide (hereinafter "CO₂") released from *koji* mold during the *koji*-making process and applied for a patent. It is expected that it will become possible to carry out various operations in response to evaluation results from an early stage in the *koji*-making process and therefore produce high-quality *koji* more consistently.

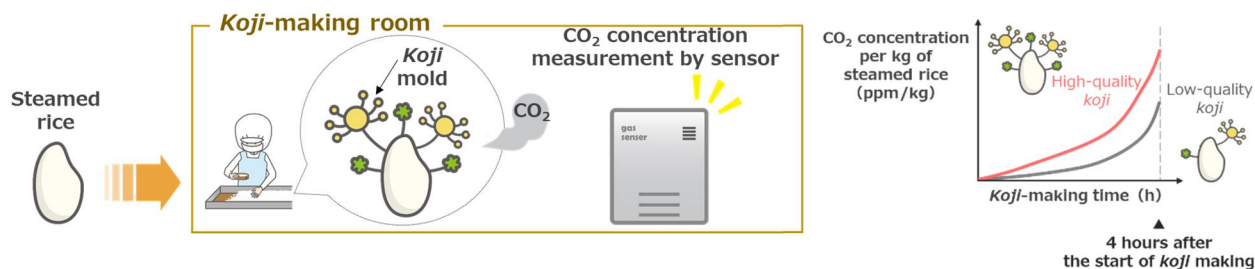
Today, Daigas Energy will introduce the method to the *koji*-making site of Kizakura by installing relevant sensors and applications for data management in the system for the IoT service "D-Fire." The introduction of the method will make it possible to acquire necessary data, such as CO₂ concentration and *koji* temperature, display them in real time on the "D-Fire" screen, and digitize information related to *koji* making, therefore helping brewers make appropriate decisions and pass on their skills to younger generations. The companies aim to use "D-Fire" for digitization and visualization even in processes other than the *koji*-making process.

The three companies will contribute to high-quality sake brewing by applying new methods to sake brewing, developing new evaluation methods, and promoting digitization and visualization.

1. A new evaluation method for the *koji*-making process using gas sensing technology

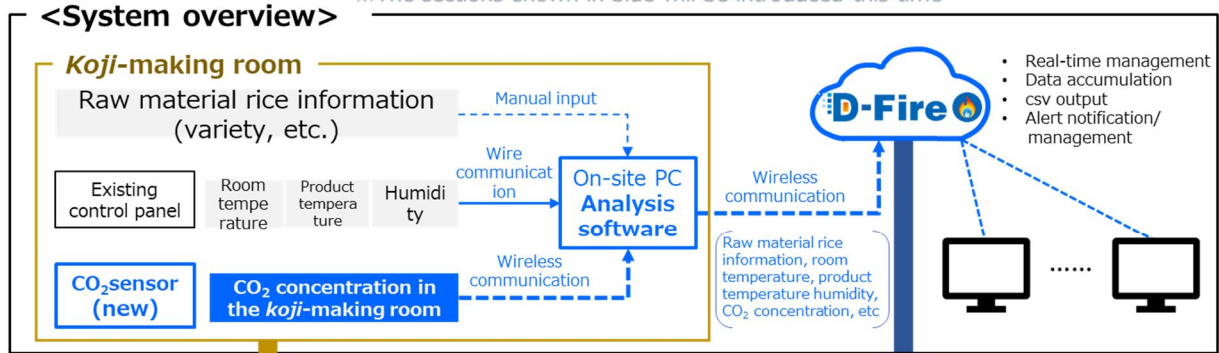
- *Koji* mold emits CO₂ because it is a living organism.
- It was found that the amount of CO₂ released by *koji* mold correlates with the final quality of *koji* (= amount of glucoamylase).

⇒The quality of *koji* can be estimated from the CO₂ concentration measured by the sensor.



2. Visualization of *koji*-making process using the IoT service "D-Fire"

※The sections shown in blue will be introduced this time



<Work in the *Koji*-making room>

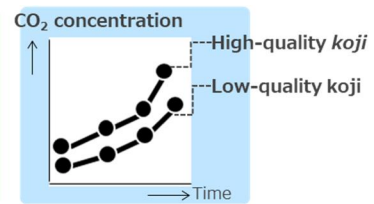


<What D-Fire enables>

- Digitization of information related to *koji* making
- Acquisition of data such as CO₂ concentration and koji temperature, real-time display on the D-Fire screen



Data storage



D-Fire screen (image)