Rice Milling in Japan

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Characteristics of the treatment of rice in Japan

The paddy production is about 17,000,000 tons a year in Japan. Percentage of hulling is equivalent to 80~82% and milling yield of brown rice is 90~91%. Of the milled rice, about 11,500,000 tons is supplyed for consumption, about 95% of which is for edible use, excluding for storage. The milled rice consumed for edible use in consuming city area amount to about 6,500,000 tons and that for such industrial uses as brewages, rice cracker and soybean paste ("miso"), etc., about 70,000 tons.

In Japan the treatment of rice after harvest is quite different from that in other rice producing countries. Generally, threshed paddy is not stored as it is, but it is successively soon hulled by farmers with power hullers, and brown rice obtained is packaged in jute bags, straw bags or paper bags for sack storage. The rice milling does not start from paddy but from brown rice in Japan, while rice is continuously milled from paddy to milled rice in other countries in the world. The milling begins in the same way from brown rice even in the case of recently introduced bulk storage of paddy in Japan.

In addition to this difference, the Japanese rice varieties are not long grain, but all short grain and have such characteristics easy for milling as follows: the bran layers and grain texture are softer than long grain varieties: moisture content of brown rice is about 15% and sticky.

A traditional practice of commercial rice milling in Japan

The Japanese rice can be milled with a small scale rice milling machine of simple construction, because rice has the above-mentioned characteristics, and the milling starts from brown rice. It has been a special feature for a long time in Japan that rice is milled on a small scale at retail dealers' shops just before sale. This practice has relation to the fact that preference for rice of Japanese people differs from that of other Asian people and prefers fresh palatability after milling of sticky rice.

Among retail dealers numbering 56,700 throughout the country, about 37,000 shops have milled with their own milling machines till recently, besides of the machines more than 90% are of small scale ones equipped with motors below 10 H.P. (milling capacity per 10 H.P. was about 0.6 ton of brown rice per hour).

Concentration and enlargement of rice milling

As food industry in Japan remarkably developed in recent years, rice milling has been noticed to be behind. And there has been a tendecny to concentrate the rice milling enlarging its scale for modernization mainly since 1961, resulting in establishment of about 200 rice mills in consuming city area throughout the country. Scale of these mills are over 50 H.P. and the milling capacity is more than 25

tons a day (per 8 hours) in basis of brown rice (30 tons in basis of paddy). In Japan, marketing and selling of rice are yet under the governmental control, such scale mills can supply the rationed rice to about 100,000 consumers based on present rice consumption. In especially large consuming cities as Tokyo and Osaka about 30 large scale mills over 200 H.P. were established under a financial subsidy of the government for modernization of mills. Among those mills the largest one has modern equipments for all such processes as carrying in of raw rice, milling, plastics film packaging of milled rice and carrying out of products, and its capacity is 240 tons a day (per 8 hours) in basis of brown rice (300 tons in basis of paddy). The capacity of milling equipments of over 50 H.P. rice mills in total is equivalent to about 50% of the total rationed rice in Japan.

Rice milling machines in Japan

The milling machines, fundamental for rice milling, are classified into three types in Japan as follows.

1) Pressure type and the same type with blower
2) Emery roll type
3) Combination equipment of emery roll type and pressure type with blower.

1) *Pressure type*

This type was the main machine of rice milling for a long time in Japan, but its place was taken by the improved one equipped with a blower at present. The pressure type originated from the Engelberg rice milling machine imported from U.S.A., and was improved for milling Japanese rice at the beginning of the 1900's. It is a horizontal type machine with a chilled stell roll covered with a casing. The rice grains are milled by frictional function putting pressure on the grains originated between roll and casing. In Japan, this type is equipped with a weighting device at the outlet of casing, regulating the flow of grains and pressure on it to prevent the breakage of grains. In case of small scale milling, rice grains are circulated several times through the machine to finish the milling. These points may be said to be special practices of milling in Japan.

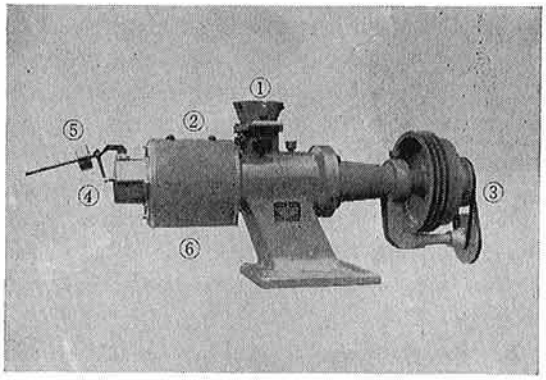

Fig. 1. Small scale rice milling machine of pressure type with blower.
1) inlet of rice; 2) milling chamber; 3) turbo blower; 4) outlet of rice; 5) weighting device (adjustable); 6) bran outlet.
(Courtesy of the Satake Engineering Co., Ltd.)

2) *Pressure type with blower*

This type is invented in 1930, and has adopted by most of the mills after the war in Japan, becoming the main machine of milling at present. In this type, the horizontal roll mentioned above in the pressure type has hollowed center shaft which is aerated with a separately equipped turbo blower to remove the rice bran produced during milling out of the machine by blowing off the air through many pores of the roll. By this aeration the bran is removed, besides a rise in temperature of rice during the milling is prevented resulting in increase of milling efficiency and decrease of milling loss. The machines are usually of 2~15 H.P. Both pressure type and the same type with blower are suitable for milling short grain varieties. But they increase broken rice in long grain, because they put pressure upon the grains during the milling.

3) *Emery roll type*

There are two kinds of machines in the type, vertical and horizontal. In Japan this type of machine is not used for milling of the rice for edible use, being used mainly for

high milling of the raw rice for brewing of "sake" (Japanese brewage). The machine has a roll dressed with emery and covered with a casing. Rice grains are milled between the roll and casing by high revolution of the former. As the milling is practiced mainly by the revolution velocity in this type, less pressure is put on the grains, decreasing the breakage of grains even in long grain varieties. In addition, this type has big milling capacity. In Japan the roll is not dressed with fresh emery, but it is hardened by baking after dressing, being different from the milling cone used in the Asian countries. The machines are of 10~50 H.P.

4) *Combination equipment of emery roll type and pressure type with blower*

This type, the commercial name of which is "Compas" rice milling equipment, was developed in 1961. It is compactly designed so as to be suitable to many Japanese mills limited in mill space, being highly efficient and superior in milling ability. It may fairly be said that the above-mentioned enlargement and industrialization of rice milling in Japan were sharply promoted by the development of this equipment which is adopted by most of the rice mills at present.

This equipment is constructed by combination of one unit of horizontal emery roll type and two or three units of horizontal pressure type with blowers to make use the merits of different milling functions of both types. This is the first one which introduced the emery roll type into milling of the rice for edible use with the intention of giving big milling capacity to a compact equipment under various conditions of the hardness of rice grains. The equipment is of 50~120 H.P. in case it is composed of 3~4 units of machines. The milling capacity of this type by single passing is 3 tons per hour at 50 H.P., 4 tons per hour at 65~75 H.P. and 6 tons per hour at 120 H.P. in basis of brown rice.

Rice milling facilities constructed by combining this type of equipment with a power huller have been adopted recently by three or four model plants established in India under the Intensive Agricultural District Program.

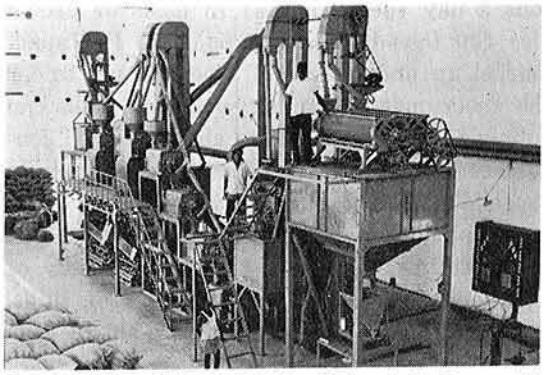

Fig. 2. Rice Milling Unit ("Satake" Type 4).
left: 2 units: rubber roll hullers
center: 4 units: combination equipment of milling
right: rice graders and hopper for measuring.
Installed as a pilot plant at Tadepalligudem, Andhra Paradesh, India. Milling capacity: 4 tons per hour in basis of paddy.
(Courtesy of the Satake Engineering Co., Ltd.)

In addition to the type mentioned above, several other types of large scale milling equipment have been developed, being composed of the pressure type with blower as the main part, with the enlargement of rice milling in Japan.

Milling machines in farms

Farmers mill themselves the rice for their own consumption. The machines used in farms are mostly single passing types which are the same function as the above-mentioned pressure type with blower. Brown rice can be milled by only one time of passing through the milling machiner. Those types are not high in milling efficiency but easy to operate. Small scale ones of 1~2 H.P. are wide use.

Installation system and equipments of large scale rice mills

The milling processes in large scale rice mills are: cleaning and separation of raw rice→milling→polishing and finishing→mixing enrichment→measuring→packaging. There are two kinds of installation systems. One is the series system in which 8~10 units of

different pressure type machines with blower are successively installed. Brown rice is milled by passing the units successively. The other is the combination equipment of emery roll type and pressure type with blower as mentioned above. Mostly used is the latter type.

Equipments for the other processes than milling are: milling seprator, grain aspirator and stone removing separator for cleaning and separation of raw rice; milled rice separator and stone removing separator for polishing and finishing process; belt conveyor going round in the opposite direction for mixing process. For measuring and packaging automatic packers using plastics film are gradually popularized. And for handling of packaged milled rice the palletization system is coming into fairly wide use.

Others

The milling yield from brown rice is 90~91% as mentioned above, and it is equivalent to 72~74% in the yield from paddy. The broken rice during milling of Japanese rice is very little, being below 5% usually 2~3%.

Parboiling of paddy is not practiced in Japan. Enriched rice with thiamine and riboflavin is popularized, forming about 30% of the rice rationed. Most of the bran produced is used for rice oil extraction. The rice oil industry has fairly advanced in Japan, producing 87,000 tons of the oil in 1967.