Method of Storing Green Tea Leaves

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As green leaves do not cease respiration even after they have been plucked away for tea material, their substances are decomposed, causing so much loss of freshness that they become inadequate as raw material for tea. The rapidity of the decomposition depends much on respiration; especially high temperature ends to accelerates respiration and causes the leaves to lose more in freshness. In case of vegetables and fruits which should be kept in fresh condition for a long time, the cold storage (not under 0°C) method is applied.

The freshness of tea leaves, too, can be enhanced through this method and studies are well under way to make it applicable to tea leaf storage. However, how to cut down on the space and labor requirement in tea processing is a matter of greater importance today than how to preserve tea leaf freshness for a longer period. This is partly because thanks to the improved tea factory efficiency, only a period of 24 to 48 hours is now needed to keep green leaves fresh in storage and partly because the tea factory's space and labor requirement for preservation of tea leaf freshness has been increased with the enlargement of its operational scale.

Described below is a newly developed storing system for green tea leaves featuring a through-flow mechanism. It is designed to drastically cut down on the storing space requirement. Green tea leaves in use for tea processing are fast-growing tender sprouts respiring a large quantity of air. As such, it has been impossible to preserve their freshness in storage for long otherwise than by laying them in a small heap about 20 centimeters in thickness or 10 to 15 kilograms per square-meter. Now thanks to this newly developed storing system, these leaves can be piled up in a heap many times greater or up to kilograms per square-meter. And in addition, this mechanism can save labor by enabling fresh leaves to diffuse their respiration heat without lowering their freshness.

The air is difficult to flow through a heap of green leaves in a natural ventilatory condition even when they are spread considerably thin. However, if they are thoroughly and directly exposed to a flow of air through their heap with the aid of a blower, the accumulation of their respiration heat can be dissipated. Of course, the tea leaf freshness can better be preserved through this "through-flow" method if the air to be blown in is low in temperature and high in hymidity. But even when the air is of normal temperature, the freshness will not decline noticeably within a short period so long as their respiration heat is continually dissipated through a flow-through process.

Now gaining acceptance here are two methods of dissipating green leaves' respiration heat; one using a container for this purpose can be employed to advantage by smaller tea factories and the other in which leaves are piled up directly on the floor of the tea leaf storeroom by larger factories.

Mechanism of Storing System

The two systems will be outlined hereunder in terms of the structure, efficiency and operational procedure, as follow:

1. System using the Container

Among the main components of the system are a train of several green leaf containers, an air pressure chamber, a fan, at air duct connecting the chamber with the fan and a time

relay to switch on and off the motor. Each container has a damper to regulate the intake of air pressure (see Figure 1). The fan is use is of an axial-flow type with a blade span of 480 mm and capable of blowing in 48 m³ per minute of air and generating 26 mmAq of static pressure at 1,500 rpm. When reduced in size and weight, the system can be mounted on a truck and kept in operation while it commutes from the tea farm to the factory.

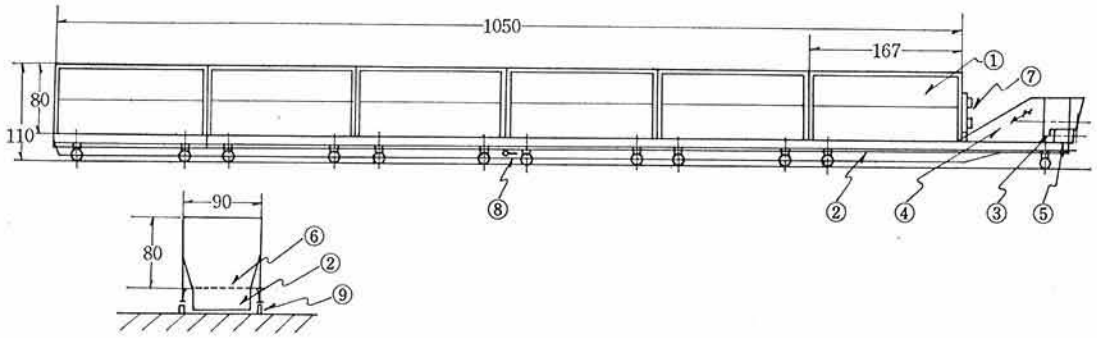

Fig. 1. Container for Storing Green Leaves (unit; cm)

Explanatory notes: (1) Container of green leaf (2) Wind pressure chamber (3) Blower (4) Duct (5) Motor (6) Punching metal (7) Time relay (8) Shutter (9) Wheel

2. System Heaping on the Floor

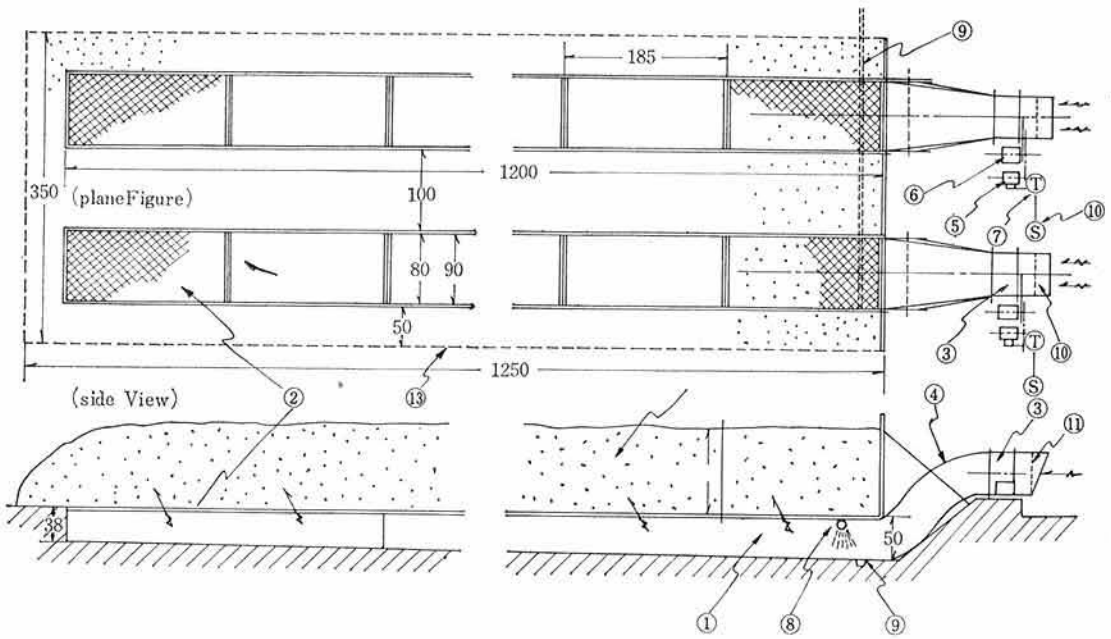

Fig. 2. Storing System by Heaping Up (unit; cm)

Notes: (1) Pit (2) Punching metal (3) Blower (4) Duct (5) Motor (6) Transmission (7) Time relay (8) Humiditying device (9) Draining hole (10) Switch (11) Wire-netting (12) Green leaves (13) Limits of heaping

As shown in Figure 2, this system consists of a pit acting as the wind pressure chamber, a through-flow plate serving concurrently as the chamber cover and the bedding for green leaves, a blower, an air duct connecting the blower with the chamber, the blower's transmission gear, a time relay to switch on and off the motor, shutters to allot and adjust floor space and a humidifying device.

The standard design of the system is explained hereunder;

(1) Wind pressure chamber

The chamber must be of commensurate depth with the diameter of the blower and proportionately long and wide to the output of the blower. The bottom of the pit is given an upward inclination of 1/100 and a draining hole bored at the deepest point so as to facilitate drainage.

(2) Through-flow plate

The plate is made of an anti-corrosive punching metal which is 2 to 3 mm thick with holes of about 2 mm in diameter. The plate must be mounted flatly on the frame so as not to fall into the pit and kipt removable as well.

(3) Blower

In case tea leaves are heaped up less than one meter high, the blower could be of a low pressure type. As to how to adjust the through-flow plate space with the size of the blower, three examples are given in Table 1.

Table 1. The through-flow Plate space and the blower

Through-flow plate space (m^2)	Airing (m^3/min)	Blower			
		Type	Revolution (rmp)	Axial hp (ps)	Static pressure (mmAq)
5 (C)	25	FH-330	2,000	0.15	22
10 (B)	50	FH-480	1,500	0.55	26
20 (A)	100	FH-580	1,400	1.00	20

(4) Duct

The duct connecting the blower and the pit must have as dull a curve as possible so as not to let the air leak out.

(5) Transmission

The gear box must be laid in between the blower and the motor in such a manner that the air-flow rate can readily be adjusted when the storing area is narrowed with the shutter or when green leaves are heaped thinly.

(6) Time Relay

The time relay must be kept readily switchable so as to ensure a systematic intermittent air supply.

(7) Shutter

The shutter is a device to divide into two or three parts the whole length of the storing floor so as not to let the air flow to any part beyond. Thus only half or one-third the full amount of green leaves in storage can be exposed to the air at a time wherever necessary.

(8) Humidifying Device

To keep green leaves properly moistened some spraying holes are bored at the entrance of the wind pressure chamber or somewhere inside that chamber. This device must be so designed that it may work with the aid of a magnetic bulk only while the blower is in motion.

Usage of Storing Systems

1. System Using the Container

The green leaves are stored away in a container, and cooled with the aid of an air current in this system. After about 30 minutes of air blowing, their temperature will drop to the same level as that of the air supplied. Afterwards the air may be supplied intermittently with the aid of the time relay.

The spell of intermittence varies according to the amounts of stored leaves and the atomospheric temperature as well as the leaf quality. But the standard procedure is to run the fan for 20 minutes and stop it for the following 40 minutes.

Under this system a relatively large heap can be made of green leaves and the air current needed to keep them fresh is only somewhere

between 0.15 m/s and 0.2 m/s. Although there is little fear of the leaves withering, care should still be used against their possible dehydration when the weather is dry. To cope with such possibility, the leaves should be exposed to the air current for a somewhat longer time than usual when the containers hold a large amount of tender leaves and when the atmospheric temperature is high.

2. Floor-Heaping System

In case green leaves are stored for a long period, if the air is high in temperature and low in humidity, it must be moistened beforehand and blown into their heap while the heap is taking shape. Care must be used to make each layer in the heap as qualitatively even as possible as well to keep it cool in temperature. On the average the appropriate height of the heap is about one meter. It should neither be taller than 1.2 meters nor shorter than 0.6 meters, however. As for the air current's velocity, somewhere between 0.15 m/s and 0.2 m/s in the heap's core is considered as adequate. But with due regard to the inevitable air diffusion somewhere along the through-flow plate, the heap's width should not exceed about two meters.

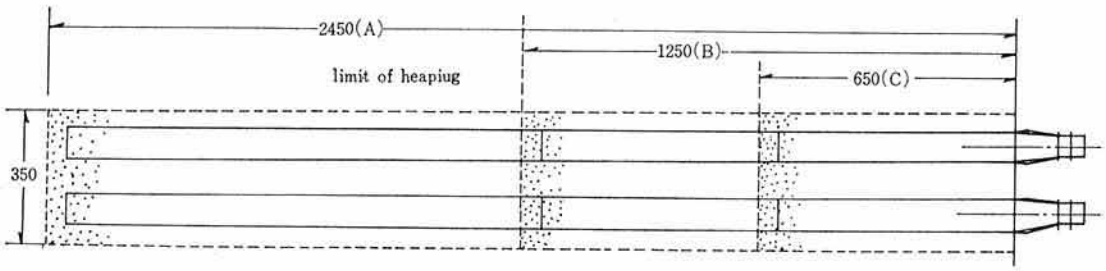

Fig. 3. Heaping limits of Green Leaves Versus Blower Capacities

Notes: (A) 86 m²; about 10 t (B) 44 m²; about 5 t (C) 23 m²; about 2.5 t

Show in Figure 3 is the extent to which green leaves are permitted to be heaped up according to the out put of the blower in use versus the area over which the heap may spread when a pair of two systems are used side by side. When adjusting the air flow, the same procedure as in the case of the system using the container may be follwed.

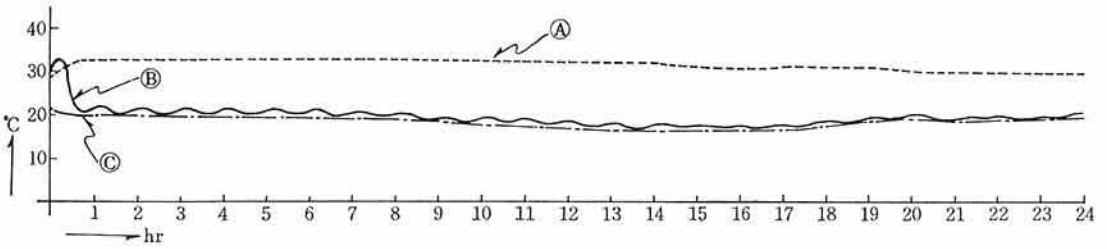

Fig. 4. Green Leaf Temperature Versus Air Flowing Program

Notes: Line (A) shows the case in which green leaves are spread thinly to an average height of 20 cm while Line (B) indicates the case in which the though-flow method is employed. Line (C) Shows the constant atmospheric temperature of 20°C.

Figure 4 shows how the temperature of green leaves will change while in storage after an initial cooling period of 30 minutes if a constant atmosperic temperature of 20°C prevails and if the air flow is programmed to last for 20 minutes an hour with a 40-minute intermission following each run. This change points to the leaves' growing refusal to rise in temperature due to the progressive decomposition of their substances with the lapse of time. Hence, it is possible

to gradually lengthen the intermission.

Conclusion

With the development of the through-flow method the hitherto experienced difficulty of laying green tea leaves in thick heaps on account of their respiration heat has now been removed. By means of this method it is now possible to reduce the storing space requirement at a tea factory to only one-eighth to one-tenth.

This new method is superior to the conventional cold-storage system also in that the leaves' freshness can be better perserved by holding their temperature itself down to or even below the storeroom temperature.

Still another merit of this method is to enable the tea factory to do away with the trouble of manually shuffling the leaves' respiration heat off their heap every once in a while. These two-fold economical benefits of this method are very great since both labor and space are major cost factors for a profitable tea factory operation.

The method's efficiency for preservation of tea leaf freshness can be considerably improved by making available an air current of a lower temperature and a higher humidity although the air so far used in Japan is of normal temperature.

References

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