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Sticker Applying Machine

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ABSTRACT

This research aimed to develop a machine applying a sticker on fruit surface. The machine comprised (i) 3/4" - 11/2" steel frame (ii) 10 plastic cups lined by sponge to protect fruits from mechanical damage, (iii) conventional sticker-applying equipment and (iv) power transmission operating the sticker applying machine (SAM).

Testing of sticker application on mandarin fruits showed that the macine could place a sticker well at low speed while at higher speed its sticking capability dropped. At the chain speed of 17.69 cm./sec., the SAM could perfectly place stickers upon 84% of the fruits. 4% of the fruits were not applied and the rest 12% were applied more than one sticker per fruit. Average capacity of the SAM was 214.89 kg./hr. For the chain speed ranging from 17.69 to 31.57 cm./sec. every increasing percentage of the speed incurred a 0.44% reduction of perfect sticking. Manual sticker application showed that on the average, a man could apply stickers on every fruit at the capacity of 144.46 kg./hr. Stickers applied manually did not contact well with fruit surfaces. For each fruit two ends of each stick were all out of contact.

Keywords : sticker, packaging

INTRODUCTION

Packaging and applying sticker on the products which produced for distribution to public are necessary production processes in the production line, as packaging and sticking provide protection and advertisement to the products and also assure the products quality.

Loss in agricultural product quality can cause by a varieties of means which made the consumers disappointed. Applying sticker and logo of the company are good trademark for consumers to create confidence in the products quality and believe that if the products have been disrupt it might be possible to claim.

In post harvest handling and packaging of agricultural products such as paddy, require intensive labour force. At mechanical threshers and combines have been used widely over the country (Jarimopas and Sihawong, 1989). Paddy is packed in the sacks before transporting to the rice mills. As in paddy, the post harvest handling, packaging and applying stickers for fruits and vegetables, also required huge labour to operate. Since, the labour in agricultural sector has been expensive and scarce, sticker applying machine should be developed to use.

DESIGN AND TESTING

Design Criteria

1. The mechanism of prototype should be simple (the same level as power tiller, rice milling machine or pump).
2. Use materials and equipments available in the local market.
3. The structure should not damage to the fruist or minimum mechanical damage.
4. Safety first in operation.
5. Practical operating without special tools to adjust various parts of the machine.

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6. Machine performance should be more efficient than by manual labour.

Components of Sticker Applying Machine (SAM) (Figure 1)

The sticker applying machine comprised of:

1. Power engine part : electric motor of variable revolution speed of 2.5 HP. and 220 Volt.

2. Power transmission part :

2.1 Speed reducer. The reduction ratio of mooley from motor and engine was 3.3 : 1

2.2 Reduction gear set acted as power transmission unit from axle of back axis to the secondary axis and drived the off-center cam shaft to rotate at reduction gear ratio of 25 : 11 tooth. The attached axle to this cam shaft was connected to the chain

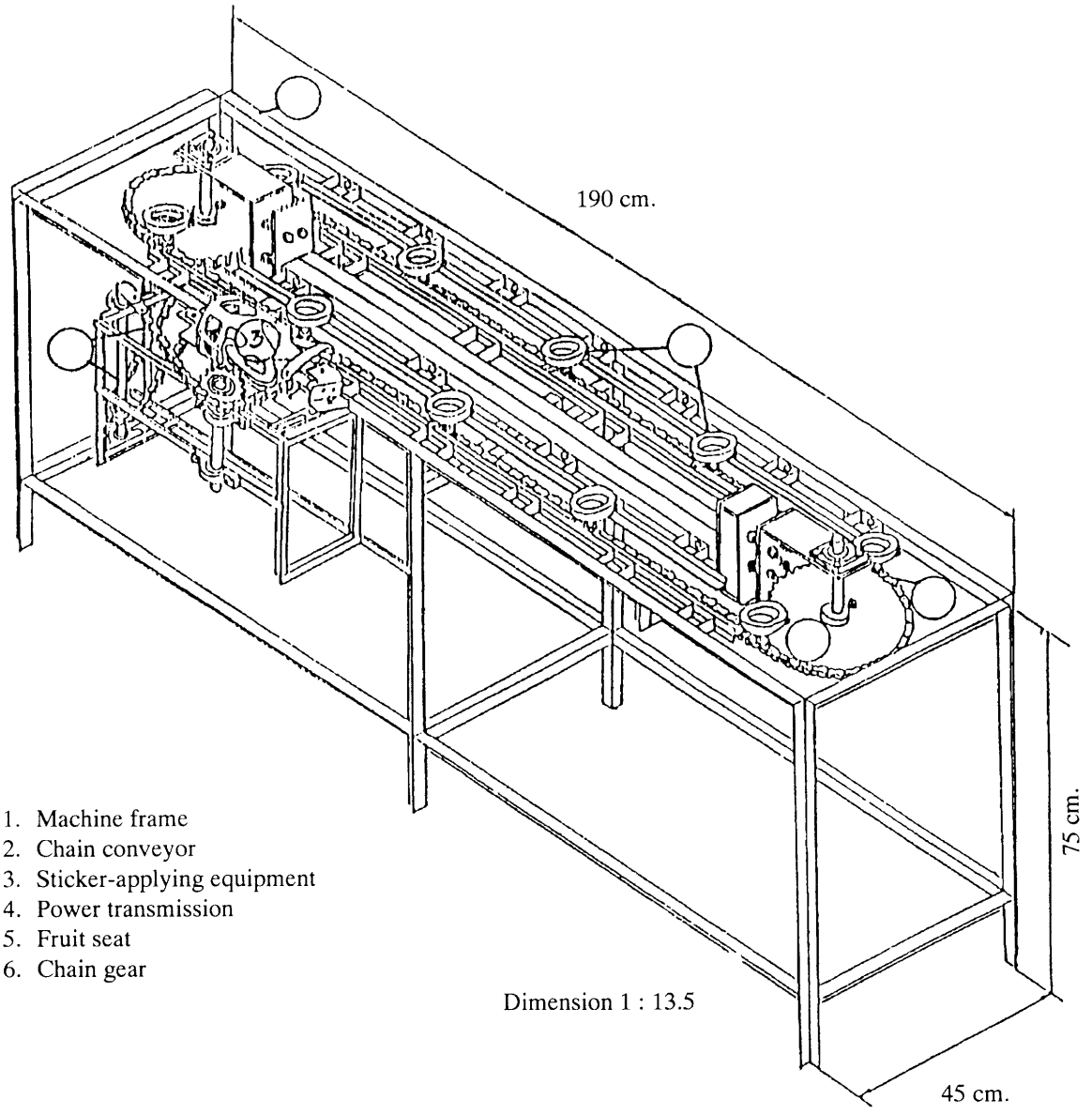

Figure 1 Three-dimension schematic diagram of the sticker-applying machine.

No.35 for pulling and controlling the applying sticker equipment in the forms of compression and relief by passing another gear for controlling the chain to stay in horizontal axis. The distance of off-center of cam shaft was half of the distance between the compression and relief of the applying sticker equipment

3. The applying sticker part utilized the conventional sticker-applying equipment available in the department stores for primary step of design.

4. Fruits conveying part (conveying into applying sticking area) composed of :

4.1 Conveying chain of size No. 60, 382 cm. long, and the chain was drived by two sets of gear of 42 tooths and radius of 13 cm. The gear was locked by axle of 3/4 inch

4.2 The cup for placing the fruit was made by cutting the bottom of drinking water plastic bottle (Polaris) and lined by sponge to protect fruits from mechanical damage and control the fruits to move as little as possible. The cups of 10 sets were seized with T shape steel made from flat steel. Each set of cup was 38.2 cm. apart.

5. Frame : dimensions of 45 cm. wide, 190 cm. long and 75 cm. high. Frame was the base attached with other equipments such as conveying set, applying sticker set and power transmisson set. Frame structure made from variuos size of steel such as perpendicular shape steel of $1^1/_2$ inch $\times$ $1^1/_2$ inch and $^3/_4$ inch $\times$ $^3/_4$ inch, flat steel of 4 inch wide $^1/_4$ inch thick.

Performance

When the machine was switched on, the SAM worked periodically in stamping and relieving periods. In stamping period, the sticker would be stamped by ink and then the cam shaft would rotate until reaching relief period which the sticker would be pushed to wait in front of the equipment. The fruit was placed opposite to the applying sticker part and the size of the fruit should have the diameter of 5-8 cm. of any kind of fruits. The fruits for applying sticker should pass the sizing process, so that the position of sticking application could be adjusted, and stickers were in the position ready for stamping. When the fruits were passed the sticker applying equipments, the surface of the fruit would contact with the sticker which caused the sticker contacted with the fruit's surface. But the stickers were not contact well with fruitûs surfaces, so the stamper should be applied. After sticking, the conveyor would circulate the fruit to the beginning point again, at this point the sticked fruit would be picked out and the unsticked one would be placed instead.

Testing

Materials and equipments in testing

1. Sticker applying machine
2. Digital tachometer
3. Watch
4. Basket for fruits container
5. Electric weight of size O-10 kilogram
6. measurment tape.
7. Ninety mandarin orange fruits of equal size.

Testing methods

1. Select first group of 25 mandarin oranage fruits for testing
2. Set the revolution speed of motor which the shaft speed adjusted at 43 rpm or chain speed of 17.69 cm./sec. When obtaining the required speed, then pausing the engine for a while.
3. Switch on the engine and wait until the fruit cup no. 1 was in the position for feeding.
4. Feed the orange fruit into the cup one by one and record the time until the last one.
5. While feeding the fruits, the ink was stamped on the sticker and the stickers were pushed out about 5 pieces. A control system is needed to save this 5 pieces of stickers, however the operator should take them out before the first fruit reaching the sticking position.
6. After feeding the fruit of no. 10 and the positon of no. 1 fruit cup was at the feeding position at the same time, there was a sticked fruit which was picked out and later on the new one of No. 11 was fed in the cup until reaching the feeding of fruit no. 25. Record the total time of feeding.
7. Examine each of the sticked fruits according to the number provide to check the completeness.
8. Record the testing results and the problems occured in the test and after the tests finish.
9. Remove the stickers from the fruit surfaces of the same group and test again at the same speed for twice times from step 3 to 8.
10. Select the second group of 25 mandarin orange fruits for testing at shaft speed of 60 rpm or chain speed of 24.18 cm/sec. Test again from step 2 to 8 respectively.

11. Select the third group of 25 mandarin orange fruits for testing at shaft speed of 80 rpm. or chain speed of 31.57 cm./sec. Test again from step 2 to 8 respectively.

12. Weigh each group of orange in kilogram

13. Measure the diameter of orange fruits in each group according to the number.

14. Estimate the percentage of contacted stickers by well sticking, unwell sticking and sticking more than once from 25 fruits of orange.

15. Estimate the performance tests in amount of fruits per hour or kilogram per hour of each chain speed.

Testing of sticking equipment application by manual operation

Remove the conventional sticker-applying equipment from the machine together with 2 performers and record the time of sticking by manual application of each performer. The steps of testing were as follows:

1. Take the fruits from the previous testing of 3 groups by machine of 75 fruits together with another 15 fruits of total 90 fruits

2. The first operator sticked the fruits by conventional method which operated the same speed as other people who used the conventional sticker-applying machine.

3. Record the time from sticking the first fruit until the last one of 90 fruits

4. Examine the results of sticking and also the problems occured in the test or the problems of sticking.

5. The second operator sticked the same group of oranges from steps 2 to 4

6. Estimate the percentage of stickers on the surfaces of fruits and the characteristics of sticking and amounts of stickers.

7. Estimate the performance tests in amount of fruits per hour or kilogram per hour.

RESULTS AND DISCUSSIONS

Figure 2 showed the sticker-applying mahcine. Table 1 and 2 revealed the results of test and evaluation of the sticker applying machine. Tesing of sticker application with mandarin fruits resulted that the machine could put a sticker well at low speed with

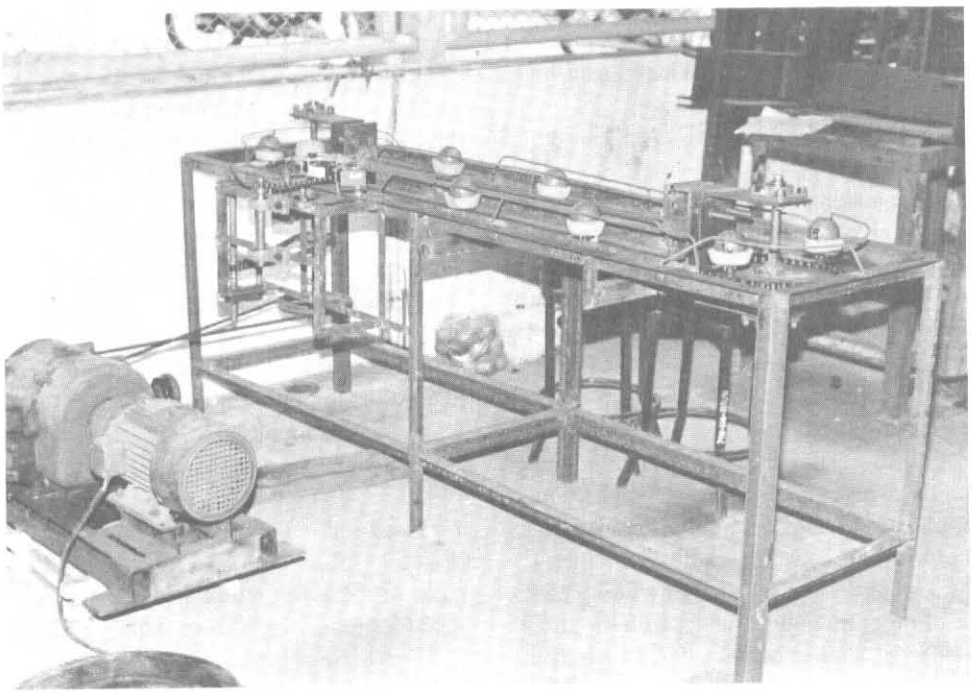

Figure 2 Sticker-applying machine.

minimum fruits of either no sticker contact or more than one sticker on fruit's surface. While at higher speed its sticking capability dropped with the decreasing of perfect-contact sticking and the increasing of incomplete contact sticking and more than one stickers on fruit's surface. At the chain speed of 17.69 cm./sec. the sticker applying machine could perfectly place stickers upon of 84% of the fruits (Figure 3). About 4% of the fruits were not applied and the rest of 12% were applied more than one sticker for each fruit. Average capacity of the SAM was 214.89 kg/hr. at the chain speed of 24.18 cm./hr. At the chain speed of 24.18 cm./sec., the SAM could prefectly place stickers upon of 72%, not applied about 13.32% and applied more than one sticker for each fruit about 14.68% at the capacity of 281.45 kg./hr. or 2377 fruits/hr. After increasing the chain speed to 31.57 cm./sec., the SAM could perfectly place stickers upon of 54.68%, not applied about 26.68% and applied more than one sticker for each fruit about 17.32% at the capacity of 348.01 kg./hr. or 3107 fruits/hr. Manual sticker application showed that a man could averagely apply stickers on every fruit at the capacity of 144.46 kg./hr. or 1212.96 fruits/hr. per person which was lower than the machine. However, the stickers by manual application were not well contancted with fruit surfaces (Figure 5).

The reasons behind decreasing of sticking capability when increasing the SAM capacity.

a) The fruit surfaces were not applied with stickers, for the following reasons:

- no sizing or screening of tested fruits so there was difference in size of each fruit and this caused no contact of stickers on the fruits surfaces,
- some fruits were out of shape because of over piling during transportation,
- the operator fed the orange on the cup without fitting the position which cause no cantact of stickers on the fruit surfaces,
- for test at the chain speed of 31.57 cm./sec., the chain was moved too quick so that the time of contact between the stickers and the fruits's surfaces was too short, which caused no contact of stickers on the fruits' surfaces.

b) The fruit surfaces were incomplete contact sticking of small opening at the middle and at the ends of sticker, for following reasons:

- the chain speeds were too quick and,
- the fruits had round surfaces.

c) The fruit surfaces had more than one stick-

Table 1 Efficiency of sticker-applying machine (SAM) at 3 chain speeds.

Chain speed (cm./sec.)	Sticking capability in percent*		
	Perfect contact	No contact	More than one sticker
17.69	84	4	12
24.18	72	13.32	14.68
31.57	54.68	22.68	17.32

* Averaged from 3 replications for each chain speed

Table 2 Capacity of sticker-applying machine (SAM) at 3 chain speeds and mannual sticking.

Chain speed (cm/sec)	Capacity	
	Fruits/hour	kg./hour
17.69	1733.01	214.89
24.18	2377.09	281.45
31.57	3107.22	348.01
Manual sticking	1212.96	144.46

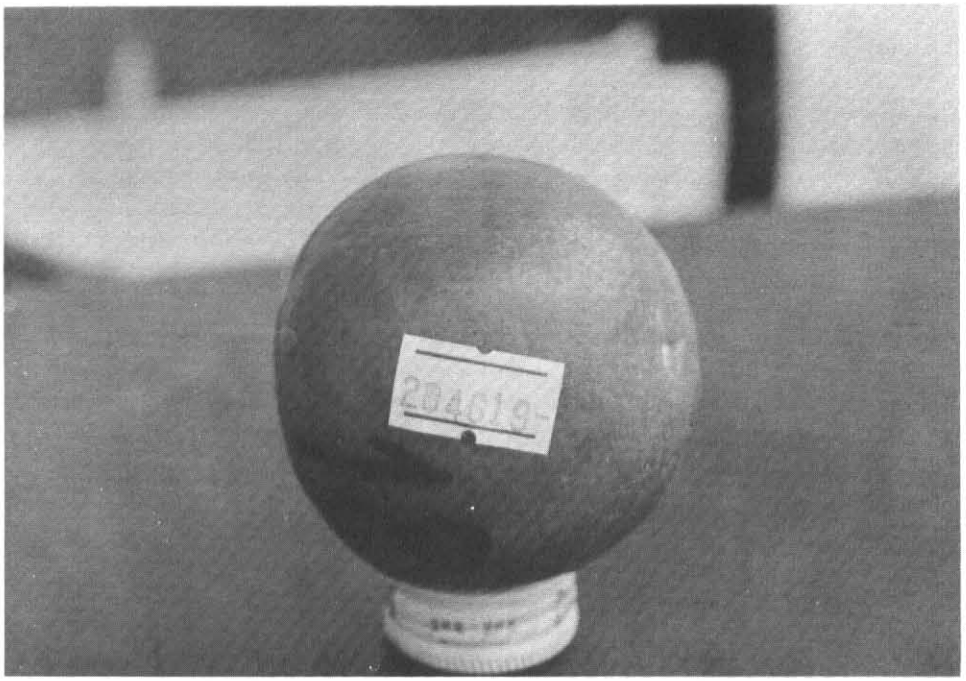

Figure 3 Perfect-contact sticking.

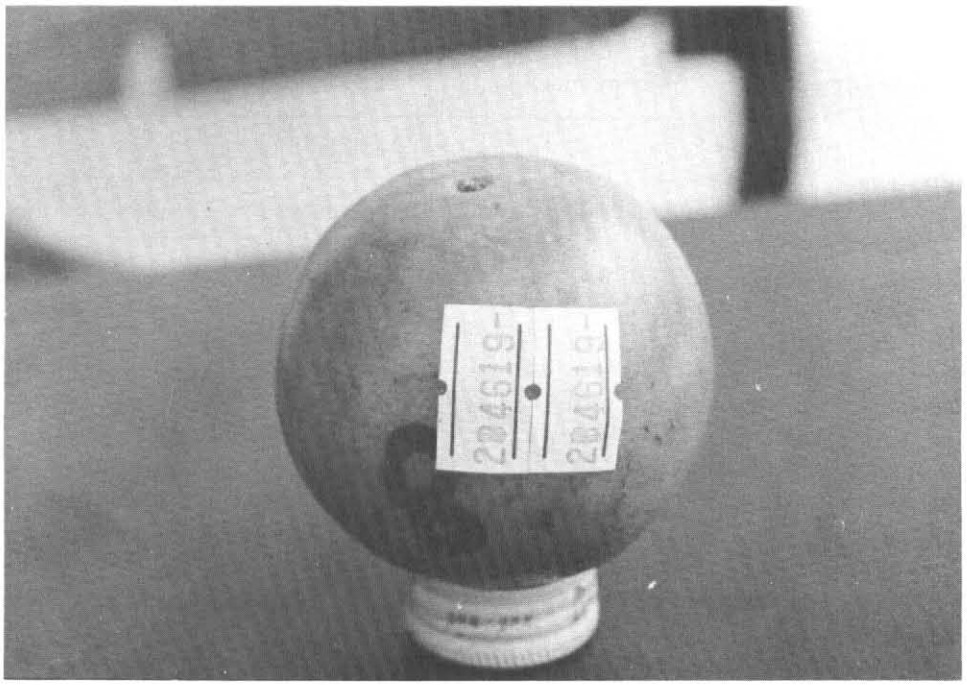

Figure 4 More than one stickers on a fruit.

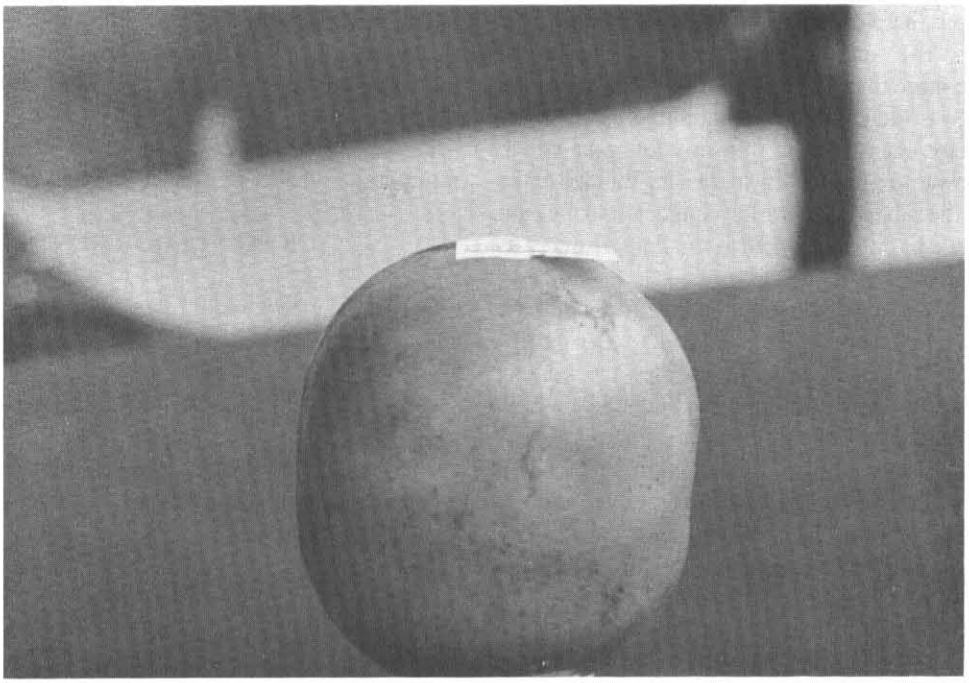

Figure 5 Incomplete contact sticking.

ers applied upon, due to the following reasons:

- before the orange of No. 1 reached the SAM, five pieces of stickers were pushed out and the operator forgot to take them out,
- error from the mechanism of sticker applying machine which operated more than one sticker per one orange and
- when the former fruit had no sticker contacted the surface, tehn the later fruit would have more than one sticker on the surface.

CONCLUSION

Testing of sticker application with mandarin fruits showed that the machine could put a sticker well at low speed of 17.69 cm./sec. and the sticker applying machine could perfectly place stickers upon 84% of the fruits with the error of 16% at the average capacity of 214.89 kg./hr. While at higher speed, its stickin capability dropped. For the chain speed at 31.57 cm./sec., the perfect sticking was only 56% at capacity of 348.01 kg./hr. Manual sticker application showed that a man could apply stickers on every fruit at the average capacity of 144.46 kg./hr. but stickers by manual application were not contacted well with fruit surfaces. For the chain speed ranging from 17.69 to 31.57 cm./sec. of every increasing percentage of the speed incurred a 0.44% reduction of perfect sticking and no mechanical damage of fruits was found.

RECOMMENDATION

1. Since the position for feeding the orange into the cup was far from the sticker applying equipment, so five pieces of stickers were lost before the no. 1 orange reaching for stamping. The point for feeding the fruit should be on the same side as the sticker applying part and the distance should be the same as the range between the cups of fruits of 37.2 cm. or a little bit more than this length. Thus, it would be no loss of stickers before the no. 1 cup of fruit reached the stamping equipment.
2. Each set of testing the stickers applying machine, the fruits should be sized and graded before the tests, so that the problem of no sticker contact could be reduce.
3. The fruits which were out of shape from over loading of piling, should not be tested because

they caused the problem of no sticker contact.

4. The amount of cups for placing fruits should be more than 10 cups, thus the capacity of the machine was increased. The method to increase the cup was by changnig the transmission gear which passed power to cam shaft by increasing the size of the gear and the related gear which connected to the cam shaft should be either changed to smaller size or left as before.

5. The mechanism to feed the fruits into the cup by machine should be developed.

6. The mechanism to transfer the contact sticking fruits from the cups by machine without mechanical damage should be developed.

7. While adjusting the revolution speed of motor, the SAM should be stopped to reduce the loss of the sticker pieces. The method to pause the machine was by adjusting the slacking of the chain. Whlie the chain was slacked, the revolution speed of motor should be adjusted according to the requirement and then continue to operate the machine by thightening the chain again.

8. The key pad should be changed from number to alphabet of Thai or English versions.

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