

## Research Article

### Design of Sugarcane Peeling Machine

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**Abstract:** In order to solve the problem that appeared in hand peeling sugarcane, the sugarcane peeling machine is designed, the sugarcane peeling machine includes motor, groove wheel, cutting room, slider crank mechanism, reducer (including belt drive, chain drive) and so on. The designed sugarcane peeling machine is simulated, the results show that the sugarcane peeling machine can peel sugarcane successfully with convenient, fast and uniform.

**Keywords:** Peeling, sugarcane, sugarcane peeler

#### INTRODUCTION

There have many countries and area planting sugarcane in the world and there have been 3000 years since planted sugarcane in China (Nong and Lin, 2011). Sugarcane production in Guangxi is more than half output in China (Li *et al.*, 2014), sugarcane planting area and output in Guangdong is the third in China (Zhang *et al.*, 2014), in recent years, sugarcane planting area and output in Guangdong Province has been steadily rising, but mechanization degree is low (Peng, 2012; Chen and Tang, 2012). China is a big country of planting and consuming sugarcane, direct consumption is in a large proportion in consumption patterns of sugarcane and peeling is need when direct consuming. At present, sugarcane peeling is mainly by hand, Laborious, low efficiency, uneven. Peeled sugarcane with machinery is proposed instead of manual for this situation, the earliest sugarcane peeling machine is developed by Cai and obtained a patent. The machine he designed mainly contains motor, rolling wheel guiding to enter, tool apron, rolling wheel guiding out, fixed pressure rod and framework. The design considered automatic feeding and cutting action is continuous, labor time can greatly be shortened and labor intensity can be slowed down significantly. However, the design is not fully considering degree of sugarcane bending, if the bending degree of the whole body is large, it is difficult to achieve ideal peeling effect. Full automatic sugarcane peeling machine is developed by Jiangsu Qizhi automation limited company, slider crank mechanism is used and longitudinal cutting technology is taken, but in the axial feed, manual to plug inside is needed and strenuousity. Automatic sugarcane peeling machine is developed by Hangzhou Dianzi University and belongs to small. The design idea is also considering axial movement and cutting movement and the design idea is different to before, sugarcane is peeled by rotating tool. But peeled

by rotating tool is contrary to fiber growth direction of sugarcane, cutting, peeling is not clean or large peeled phenomenon is appeared, it is easy to destroy sugarcane peeling. In order to improve the efficiency of sugarcane peeler, peeling uniform and avoiding waste, improved the existed sugarcane peeler and designed a new automatic sugarcane peeling machine, the results show that the designed sugarcane peeler can peel sugarcane uniformly and fast.

#### MATERIALS AND METHODS

**The composition of the sugarcane peeling machine:** Sugarcane peeling machine structure as shown in Fig. 1 and mainly contains motor, the feed groove wheel, cutting room, discharging groove wheel, slider-crank mechanism, reduction gearing (including belt drive, chain drive) and so on. The start button is pressed when start working, the motor is running, sugarcane is put on entrance, a pair of feed groove wheels installing in front of the machine directed sugarcane to cutting tool place by friction. When cutting, the multi-faceted blade mounted on turret is start to peel. Where the turret is mounted on the slide, with the slider on the rail, relative movement of tool and sugarcane is achieved and peeled is good. Then at the exit, under the friction effect of the other pair groove wheels, the peeled sugarcane is sent out, finally, collection is OK.

**Design calculations of the sugarcane peeler components:** Based on the humanized design and the height of the machine and peeling speed are taken into account. First, the length of the crank link is selected and then adjusted according to actual slide stroke, the cutting speed. Components involve selection and calculation include: motor; belt transmission parts (pulleys, belts); chain transmission parts (sprockets, chains); ear transmission parts (gears modulus, teeth); slider-crank mechanism (length of links, range of

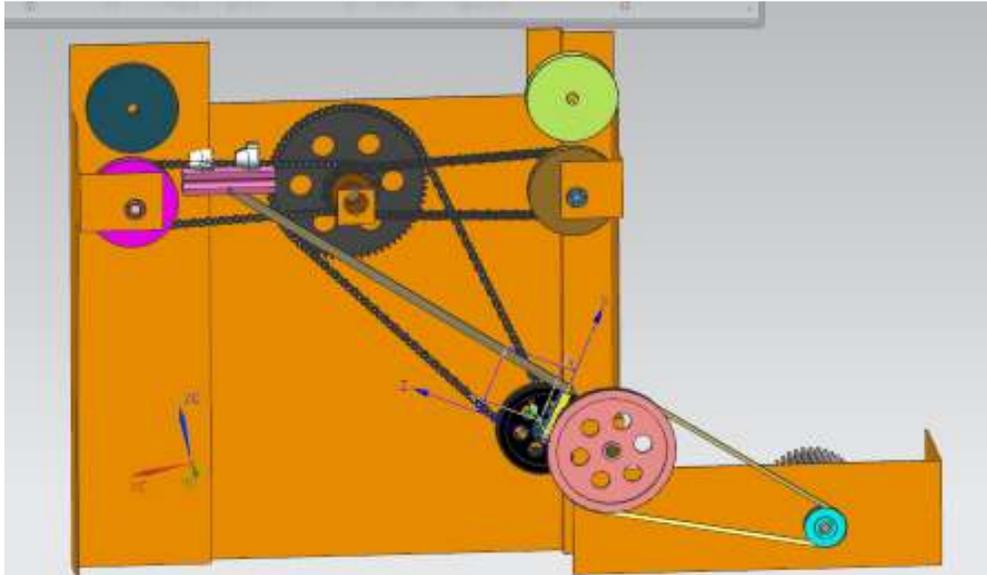


Fig. 1: Overall structure of sugarcane peeler

Table 1: Motor model and technical parameters

Motor models	Rated power (KW)	Speed r/min	Rated current (A)	Efficiency%	Vibration speed (mm/S)
Y2-711-2	0.37	2820	1.0	70	1.8
Y2-712-4	0.37	1380	1.0	67	1.8
Y2-801-6	0.37	900	1.3	62	1.8
Y2-90S-8	0.37	700	1.5	62	1.8
Y2-90S-6	0.75	910	2.3	69	1.8



Fig. 2: Schematic diagram of slider-crank mechanism

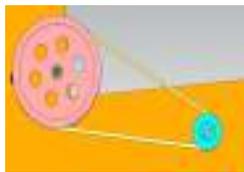


Fig. 3: Belt drive diagram

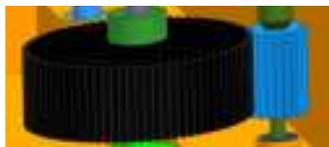


Fig. 4: Gear sketch

motion, slide stroke); axis; groove wheel; keys; bolted.

**Design slider-crank mechanism:** By actual and crank exist condition in four-bar mechanism, the slider travel

is set to 500 mm, take crank length  $AB = 120$  mm, link  $BC = 900$  mm, the specific structure is shown in Fig. 2.

**Select motor:** Motor selecting mainly includes power and speed of the motor, the specific parameters as shown in Table 1.

The motor model is Y2-712-4, speed is  $n_0 = 1380$  r/min, power is 0.37 kW according to the actual situation and the formed equipment.

**Calculation and selection of belt drive:** Belt drive transmission ratio is  $i_1 = 3$ , calculating and designing according to working 8 h a day. According to Mechanical Design Manual (Pu and Ji, 2012), Z-belt of transmission power 0.41 KW is determined, small pulley diameters  $d_{d1} = 90$  mm, large pulley diameter  $d_{d2} = 280$  mm by calculating. HT150 is selected as Pulley material (Guan and Xu, 2012). The small pulley structure is solid-type, the large pulley structure is orifice plate; the specific structure is shown in Fig. 3.

**Calculation and selection of gear:** Referring Table 1, the belt drive efficiency is selected as 0.95. Gear transmission power is 0.35 KW, according to the actual size, the small gear teeth is  $z_1 = 20$ , the large gear teeth is  $z_2 = 80$ , as shown in Fig. 4.

**Calculation and selection of chain drive I:** Referring Table 1, chain drive efficiency is elected as 0.94. Chain

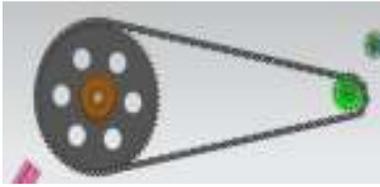


Fig. 5: Chain drive I diagram



Fig. 6: Chain drive II diagram



Fig. 7: Groove wheel structure diagram



Fig. 8: Blade structure diagram

drive transmission I power is 0.33 KW, the small sprocket teeth is elected as 17, pitch circle diameter is elected as 86mm according to the results, the large sprocket teeth is elected as 68, pitch circle diameter is elected as 343 mm; Chain pitch is 15.875 mm, the number of sections is 132, regular artificial lubrication, as shown in Fig. 5.

**Selection and calculation of chain drive II:** Referring Table 1, the chain drive efficiency is elected as 0.92. Chain drive II transmission power is 0.30 KW, the speed of input and output sugarcane should not be too high and should be consistent. Therefore, small chain shaft is placed the center of front and rear wheels. Also considering the interference during assembly, the two grooves are moved appropriate distance on both sides based on slider. Therefore, chain drive transmission ratio is selected as  $i_4 = 1.4$ . the small sprocket teeth is

elected as 21, pitch circle diameter is elected as 106 mm according to the results, the large sprocket teeth is elected as 29, pitch circle diameter is elected as 147 mm; Chain pitch is 15.875 mm, the number of sections is 86, regular artificial lubrication, as shown in Fig. 6.

**Designing and calculating of groove wheel:** Considering the cutting speed, main role groove wheel is to complete feeding and discharge and achieved automatic feeding, the specific structure shown in Fig. 7.

**Blade design:** Blade is selected with flute steel. Blade is cylindrical and evenly, diameter can be adjusted according to sugarcane thickness. The specific structure is shown in Fig. 8.

## CONCLUSION

Automatic sugarcane peeler is used slider-crank mechanism, the slider is moving on the rail, the blade is installed on the slider and peeling is achieved by using relative motion between sugarcane and blade, the sugarcane peeler is high efficiency, saving effort and good results. Automated manufacturing sugarcane peeler is simple, easy to operate and has good market prospects.

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