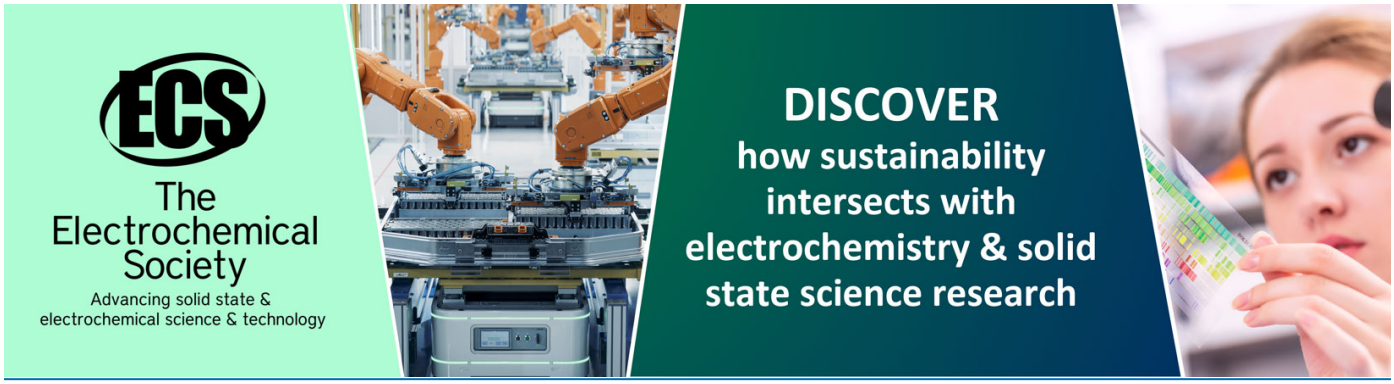
Design of Screw Type Automatic Apple Juicer



Design of Screw Type Automatic Apple Juicer

Changzhong Wu[1,*], Fan Ge[2], Guangchao Shang[1], Guitao Wang[1], Mingpeng Zhao[1], Liang Wu[1], Hengshuai Guo[1]

[1]School of Mechanical Engineering, University of Jinan, 250022, China

[2]Qilu Normal University, Jinan, Shandong 250013, China

[*] Corresponding author's e-mail: me_wucz@ujn.edu.cn

Abstract: Based on the actual juicing test, aiming at the problems of low juice yield, easy jam of fruit dregs and difficult cleaning of juicer, a series of researches on automatic Apple Juicer were carried out, and the structure and function of main components were designed and optimized. It mainly includes the design of screw structure for the juicer, the structural design and parameter calculation for the screw rod to increase the pressing force on the fruit during juicing and improve the juicing rate; the design of separable structure for the extrusion cylinder to solve the problem of unsmooth slag discharge and realize the effective cleaning of the internal structure of the juicer. The design can automatically extract apple juice, effectively improve the juice yield, realize the separation of fruit dregs and juice, and automatically carry out effective cleaning, which is suitable for the automatic sales system.

1. Introduction

After entering the 21st century, with the substantial increase in fruit production in my country and the gradual saturation of the fresh market, the "difficulty in selling fruit" has become more and more intense. In addition, due to the enhancement of my country's economic strength and the improvement of people's living standards, the juice processing industry has entered a new period of development. The juicer is an important part of the fruit industry. Therefore, with the research on juice extractor equipment, it is of great significance to design and develop a simple structure, low cost, and high efficiency juice extractor.

2. The Overall Design of Screw Type Automatic Apple Juicer

The screw type automatic juicer is mainly used for the automatic juicing of apple, pear and other fruit. In different processing stages of apple, it can correspondingly realize the processing of apple in different degrees such as cutting, conveying, pressing and separating. Screw type automatic juicer is required to realize the functions of automatic feeding, conveying and juicing, slag juice separation and juice collection. It is mainly composed of feeding device, conveying device, juicing device, slag device, cleaning device and other parts. The work flow chart is shown in Figure 1. below.

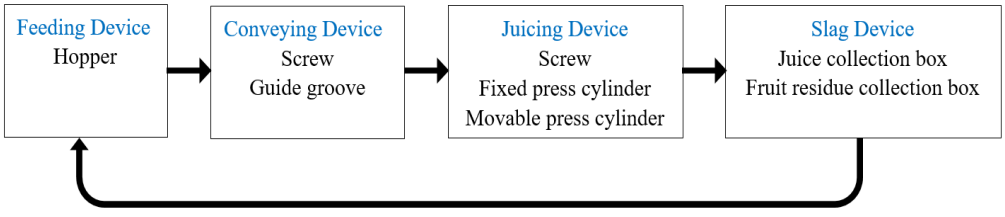


Figure 1. Working flow chart of juicer

3. Mechanical Structure Design of Screw Type Automatic Apple Juicer

3.1. Design of spiral juicing structure

The working principle of screw juicer is that through the continuous rotation of the screw rod, the material is constantly chopped, and the screw can play a guiding role in continuously conveying the material to the end of the extrusion cylinder; the material is constantly gathered and squeezed between the cylinder wall and the screw, producing the squeezing effect, increasing the juice pressure in the cells of fruits and vegetables, crushing the cell wall, and separating the juice and fruit residue [1].

The spiral of the spiral juice structure adopts the design method of the combination of equal diameter spiral and cone-shaped spiral. The spiral part of the feed is of equal diameter design, and the screw pitch is gradually reduced, which is convenient for the material to enter into the spiral, so that the material is initially cut and dispersed after rotating with the spiral in the feed barrel. The screw part of the press is designed as a conical structure, the diameter of the screw gradually increases to the same as the inner diameter of the extrusion cylinder, the pitch remains unchanged, and the pressure force on the material is increased.

The screw on the screw is divided into three sections (Figure 2.). The first stage is feed screw 1, which is mainly used for conveying materials, preliminary cutting and extrusion; the second stage is press screw, which is mainly used to increase the pressing force on materials, completely extrude materials, and force the water in materials to be extruded, so as to improve the juice yield. The third section of constant pressure screw is mainly used to provide constant pressure environment and keep the residual water rate of the treated material basically uniform, so as to facilitate the separation of juice and fruit residue in the subsequent process [2].

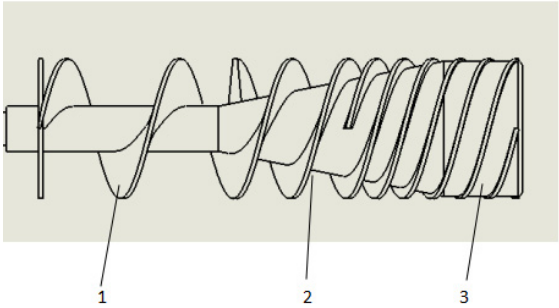


Figure 2. Structure of screw

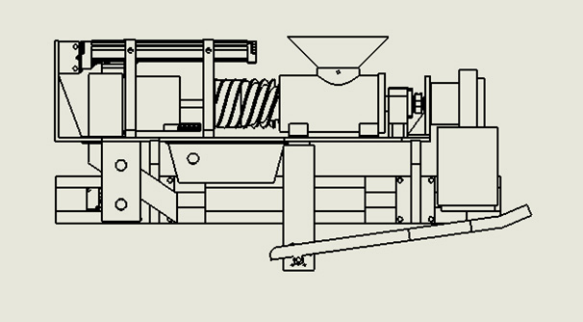


Figure 3. Overall structure installation diagrams

3.2. Design of extrusion tube structure

When apple is taken as an example for juicing test, the screw outlet was blocked. This phenomenon will cause more materials and moisture to stay in the middle and front end of the screw, unable to transport backward[3]. As a result, the juice discharge process is not smooth enough.

Effective automatic cleaning of the automatic juicer is an urgent problem to be solved. The extruding cylinder is designed as a separable structure. When juicing, the right part of the extruding cylinder is driven by the upper guide rail and is embedded with the left part. The right part of the extruding cylinder forms a closed juicing space with the rubber pad and the end cover to extract juice. The juice is filtered from the bottom of the left in extruding cylinder through the filter screen and flows into the juice guide groove. When cleaning, the extruding cylinder is on the top Driven by the square guide rail, it moves back to the right side, the fruit dregs fall into the collection box, and the cleaning nozzle cleans the screw, the extrusion cylinder and the internal juicing screw structure in an all-round way.

3.3. Design of sieve plate structure

A sieve plate structure is designed at the bottom of the extrusion cylinder of the screw juicer, and the juice squeezed out can flow into the juice guide trough through the sieve plate. The design of the mesh on the sieve plate is very important. Its main design parameters include the size and distribution density of the mesh. In order to ensure that the fruit juice residue can be separated in time and the fruit juice can flow out of the sieve hole smoothly, the porosity of the sieve hole (porosity refers to the percentage of the pore volume in the block material and the total volume of the material in the natural state) The larger is, the better; however, because the sieve plate needs to bear the strong pressure produced by the spiral extrusion rotation, the porosity cannot be too large. Generally, the selection principles of porosity are as follows: when the sieve cylinder meets the rigidity requirements, select larger; when the rigidity of the sieve cylinder is poor, select smaller. When the mesh size is large, the porosity is larger; when the mesh size is small, the porosity is smaller [4].

3.4. Design of the guide groove structure

The guide groove structure is designed on the inner wall of the extrusion cylinder, so that after the material enters the extrusion cylinder, under the guidance of the juicing screw and the guide groove, it can gradually move from the small end of the screw to the large end of the screw to fully press[5].

3.5. Design of swinging diversion structure

The design of the swing guide structure under the juice guide trough. After the sensor detects that the juice flows out of the self guide trough, the swing motor drives the swing guide trough to produce one-way deviation, and the juice is introduced into the fruit cup. When the liquid level sensor detects that the juice is full, the swing motor drives the swing guide groove to return to its original position.

3.6. Design of fruit residue collection device

The design of the fruit residue collection box: after the completion of one-time juicing, the fruit residue is mostly concentrated in the pressing screw and constant pressure screw part, and a fruit residue collection box is designed under the constant pressure screw part, so the fruit residue can be removed at any time during the juicing process. After the movable extrusion cylinder is moved back to the original position, there will be some fruit dregs. Therefore, a small fruit dregs collection box is designed under the reset position of the movable extrusion cylinder to facilitate the collection of residual fruit dregs and impurities after cleaning.

3.7. Design of sealing structure

Apple juicing is different from orange juicing. Oxidative browning is a very easy problem in the process of Apple juicing. In the design process, stainless steel or other anti-oxidation materials are used for all juicing structural parts to avoid the oxidation reaction between the equipment and the juice during the juicing process. At the same time, sealing ring, rubber plug and other sealing structures are designed to ensure the juicing process in the sealed environment.

3.8. Design of cleaning structure

In order to realize the thorough cleaning of the juicer, the pneumatic nozzle is installed on the support

of the juicer. According to the different cleaning structures required for each part, the fan-shaped nozzle, spiral nozzle and other cleaning structures are reasonably installed.

4. Electrical Control System

The control system of the juicer adopts PLC to realize the control of the whole juicing process. The action process is: extruding cylinder inlay → feeding (Apple block) → Juicer motor rotation → swinging motor rotation → Juicer motor stop rotation → swinging motor stop rotation → extruding cylinder side separation → Juicer cleaning → working cycle.

The control system can realize the real-time monitoring of the juicing process and the control of juicing speed. The system has the function of fault alarm. When there is a functional error in the system execution, the system can give an alarm and stop working, and prompt the fault location on the control panel, so as to facilitate the maintenance and processing.

5. Conclusion

Screw juicer is widely used in industrial production because of its simple structure, convenient operation and high efficiency. The purpose of this design is to solve the problems of cutting, conveying, juicing and deslagging in the process of apple automatic juicing, so as to realize the automation of Apple juicing process. Through the design of the double helix mechanism of the juicing part, the juicing rate is increased and the time required for juicing is reduced. The extrusion cylinder is designed as a separable structure, which is convenient for the cleaning of the juicer. Taking the apple as the research object, it is expanded into a feasible juicing mechanism for apple fruit.

Acknowledgments

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About the author

Changzong Wu (1977-), male, Weifang, Shandong Province, E-mail: me_wucz@ujn.edu.cn; Tel: 13698637583.

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