

# Design and Performance Analysis of a Tea Impurity Eliminator

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**Abstract:** The present tea production technology is extensive and unsanitary as tea processing has the issues of easily mixing in hair, animal hair, and other debris problems. The production enterprises can only use a large number of workers to manually sort the tea, requiring large labor for low efficient and unideal sorting results. Hence, tea production enterprises urgently need to solve this problem to meet the product to meet the quality requirements of health food. In this paper, the design and development of the vibration motor of the key components in the tea impurity removal unit were studied. The specific work is as follows. The dynamic analysis of the movement of the material on the vibrating working surface is performed, the motion state of the tea declutter vibration machine is determined as throwing motion, and the structure scheme of the elastic link eccentric type vibration machine is designed. The structure scheme of the elastic link eccentric vibration motor was modeled by Inventor 3D design software, and the suitable parameters were selected for trial production of a prototype.

**Keywords:** Tea; Impurity removal; Vibration motor; Inventor; ADAMS

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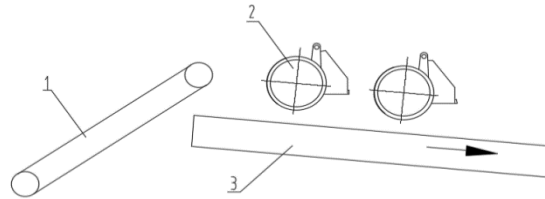
## 1. Introduction

China's tea machinery started in the 1950s, and in the early 1980s, tea production and processing machinery enterprises in the country initially formed. At present, China has a lot of tea processing enterprises, but the degree of production automation is not high. Most tea machinery cannot meet the needs of local tea processing enterprises, since the R&D and innovation ability of tea machinery and equipment manufacturing companies is not strong, so the application degree of new material and technology is generally low<sup>[1-4]</sup>. Tea processing enterprises rely on the purchase of tea machinery from foreign provinces and cities. Tea is an important agricultural cash crop in the country, the main source of economic income for farmers, and is an important source of financial income for local government departments. Therefore, to promote the continuous healthy progress of the tea industry and reduce the production cost of enterprises, it is particularly important to develop tea production equipment suitable for the production and processing of Pu'er tea with advanced technology,

improve the production process, change the backward situation of production equipment, and constantly develop the tea preliminary finishing equipment in this province.

## 2. The overall design of the tea impurity removal motor

The tea impurity removal unit is mainly composed of three parts: a feeding conveyor, friction electrostatic device, and vibration motor (**Figure 1**). After the tea enters the homogenizing conveyor, it is spread evenly and transported in front, and the conveying amount is adjustable. The strengthening magnet at the exit of the conveyor will adsorb the impurities in the iron shavings in the leaves and remove them. The tea enters the electrostatic decluttering machine<sup>[5-10]</sup>. The electrostatic roller of the decluttering machine is placed parallel and rotated, the felt pressed on the roller and the roller friction generate static electricity, the non-tea impurities in the tea passed from the bottom of the roller are adsorbed to the roller, the debris is collected by the scraper and flows out of the miscellaneous tank on the side, the adsorbed debris mainly includes thatch, woven bag silk, plastic debris and so on. The vibrating machine is set below the electrostatic roller, and the tea leaves jump forward on the screen surface, which is conducive to the debris being adsorbed by the electrostatic roller, leaving the tea leaves discharged from the vibrating bed outlet<sup>[11]</sup>.

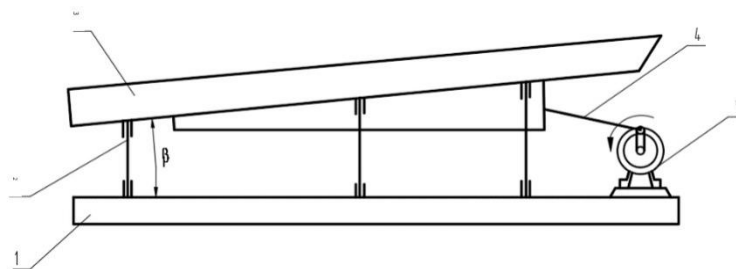


**Figure 1.** Schematic diagram of the principle of electrostatic impurity removal; 1: Conveyor; 2: Friction electrostatic device; 3: Vibration motor

## 3. Elastic connecting rod eccentric vibration motor scheme design

Combined with the design requirements of this paper, the tea has mainly undergone the movement of being thrown and moved forward to achieve the effective separation of tea and impurities<sup>[12-15]</sup>. Because the electromagnetic excitation type is greatly affected by the power supply voltage, and the tea-producing areas are mostly in the mountains and mid-levels, the power supply in these places is unstable, so it cannot meet the design requirements. According to the above index requirements, the elastic connecting rod eccentric vibration motor is designed and determined.

The elastic connecting rod eccentric vibration motor is mainly composed of the bottom frame, spring plate, shaking bed, connecting rod eccentric mechanism, motor, and other parts (**Figure 2**).



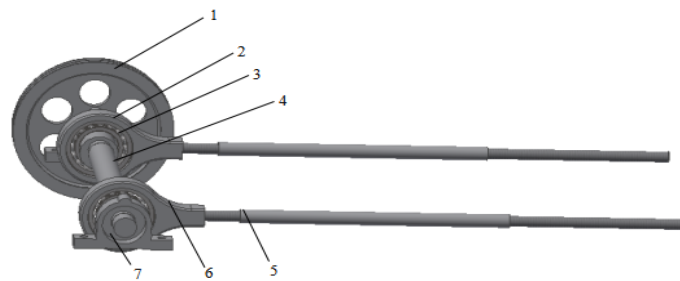
**Figure 2.** Structure diagram of eccentric vibration motor with elastic link; 1: Bottom frame; 2: Spring plate; 3: Vibrating bed; 4: Connecting rod eccentric mechanism; 5: Motor

#### 4. The elastic link eccentric vibration motor model establishment

The Inventor 3D software was used to model the vibration motor of the electrostatic de-clutterer. Its structure is shown in **Figure 3**. The vibration motor is composed of a base, transmission part, frame, and six spring support plates, each part is composed of several parts, of which **Figure 4** is the assembly drawing of the transmission part.



**Figure 3.** 3D model drawing of the vibration motor; 1: frame; 2: spring plate; 3: base; 4: transmission parts

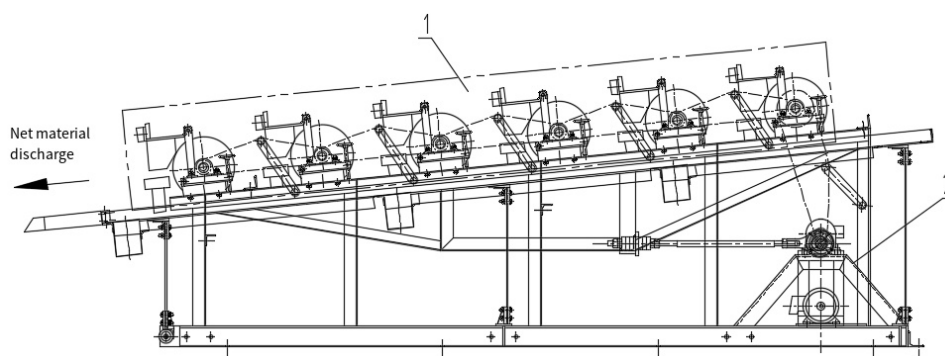


**Figure 4.** Assembly drawing of transmission section; 1: Belt wheel; 2: Bearings; 3: Eccentric; 4: Drive shaft; 5: Pull rod; 6: Connecting rod arm; 7: Bearing seat

The output power of the motor is transmitted to the drive shaft through the belt wheel, and the eccentric sleeve on the drive shaft drives the connecting rod arm through the rolling bearing. When the material is poured into the screen plate on the frame, the rod connecting the connecting rod arm and the frame drives the frame to do reciprocating cycle movement. Because the screen plate is installed high on the left and low on the right, there is a certain tilt angle, so the material will slide from high to the place. The sliding process of the material will result in an oblique throwing movement, with varying degrees depending on the material and quality of the object so that the material can be effectively selected and graded.

#### 5. Prototype trial production

The elastic connecting rod-type vibration motor is assembled on the Pu'er tea electrostatic cleaning machine, and its mechanism schematic diagram is shown in **Figure 5**. The main technical parameters of the elastic connecting rod-type vibration motor are shown in **Table 1**.



**Figure 5.** Structure diagram of Pu'er tea electrostatic declutterer with elastic link type vibration motor; 1: Friction electrostatic device; 2: Elastic link type vibration motor

**Table 1.** Main technical parameters of elastic link type vibration motor

Items	Unit	Specification parameters
Production efficiency	kg/h	P 350
Machine power	kw	1.1
Electric Source	V/Hz	380/50
Vibration amplitude	mm	12
Vibration frequency	times/s	510
Vibration bed quality	kg	265
Whole machine quality	kg	550
Overall dimensions (L x W x H)	mm	4500 * 1100 * 1200
Mounting method		Footing fixation

## 5. Conclusion

This paper takes the research and development of the tea vibration removal machine as the research object and makes a dynamic analysis of the movement of the material on the vibration surface. Through the combination of theoretical analysis and motion simulation analysis, the structural parameters of the elastic linkage type vibration machine are determined. The prototype is successfully produced, which solves the urgent needs of enterprises, meets the needs of consumers at different levels, and obtains good economic benefits.

## Disclosure statement

The authors declare no conflict of interest.

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