Research and Application of Improving the Whole Cut Tobacco Rate in the Mixing Cabinet

Guanghui Chen[a], Haodong Wei[b], Yue Long[c], Bin Zhu[d*], Jun Zhu[e], Liwei Shen[f], Yuhai Zhang[g], Mingde Chen[h]

[a]360763721@qq.com; [b]657509658@qq.com; [c]15639722060@163.com; [d*]402335233@qq.com; [e]devaloka@sina.com; [f]930494948@qq.com; [g]312632566@qq.com; [h]704469672@qq.com

Ningbo Cigarette Factory, Zhejiang Tobacco industry co., Ningbo China

Abstract: In order to solve the problem of damaging the physical structure of tobacco during the operation of the feeding roller in the mixing cabinet, the mixing cabinet feeding roller was improved. The results showed that compared to the unmodified tobacco storage cabinet, the reduction of the whole cut tobacco rate in the storage cabinet with the modified feeding roller decreased from 1.72% to 0.07%. This proves that the modified feeding roller can effectively avoid the the damage of the physical structure of cut tobacco, alleviate the adverse consequences caused by radial rake nails on the loose feeding of cut tobacco, inhibited the reduction of the whole cut rate of tobacco in the storage cabinet, improved the quality of cut tobacco, and was conducive to the subsequent processing and production of cut tobacco.

Keywords: mixing cabinet, picker roller, whole cut rate of tobacco

1. Introduction

The whole cut tobacco rate is an important index to evaluate the physical characteristics of cut tobacco, reflecting the quality of silk processing [1], directly affecting the filling ability of cigarettes, and also affecting the quality indicators of cigarette weight, suction resistance, short head rate and other quality indicators[2-5], There are many factors affecting the whole cut tobacco rate [6-8].In addition to the physical properties of the cut tobacco itself (moisture, temperature, etc.), the effect of the whole cut tobacco rate of the mixing cabinet after flavoring is the most significant.

The tobacco mixing cabinet is the last process of the tobacco production process. It can not only make the cut tobacco fully absorb essence and flavoring, fully mix various components of the cut tobacco, make the process indicators of the cut tobacco meet the requirements of the cigarette process, but also balance the production capacity of the previous and subsequent processes, playing a buffer role[9-10]. When discharging, the bottom belt of the mixing cabinet runs at a constant speed according to the set frequency, while the feeding roller and rake nail rotate at a constant speed. However, the contact area between the rake nail and the cut tobacco is small, and only a small amount of cut tobacco is rotated and pulled down by the rake material nail. Most of the cut tobacco is deposited and squeezed between the bottom belt and the feeding roller before falling down. During the extrusion process, the physical structure of the cut tobacco is damaged. Therefore, in the current stage of production, there is a problem of a decrease in the

IDEE 2023, November 24-26, Zhengzhou, People's Republic of China

DOI 10.4108/eai.24-11-2023.2343461

overall wire rate at the discharge end of the wire storage cabinet, which has affected production quality and caused problems that urgently need to be solved.

The structure of the feeding roller configured for the discharge system of the wire storage cabinet and stem storage cabinet in the tobacco industry at this stage is shown in Figure 1. At present, the feeding roller used in the tobacco industry's tobacco storage cabinet has a slow operation of the bottom belt, while the rake nail rotates in contact with the tobacco, in order to forcibly pull out the tobacco. Zheng Yuzhong et al.[11]pointed out that there are many reasons for the increase of cut rag scrap rate and the decrease of whole cut rate in the leaf storage cabinet, but the most important reason is due to the feeding roller. The rotation of the existing feeding roller rake nail cannot immediately pull the cut tobacco out of the conveyor belt, resulting in the repeated pulling of the cut tobacco by the rake nail to damage the physical structure of the cut tobacco, which directly affects the quality of the cut tobacco.

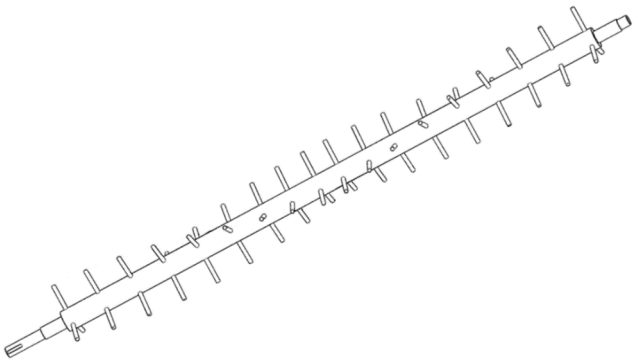


Fig.1 Improvement of the front wire storage cabinet feeding roller

2. Problem analysis

The main structural component of the existing pickle roller is a curved rake nail. When discharging, the pick-up roller at the discharging end of the cabinet is prioritized to start, and then the bottom belt motor starts to send the material to the pick-up roller[12]. When the feeding roller is working, the bottom belt runs slowly, and at the same time, the rake nail rotates and comes into contact with the tobacco, forcing the tobacco to be pulled out.

Table 1 shows the changes of some physical indicators of cut tobacco before and after storage, and it can be seen that the whole cut rate before and after storage decreased significantly. Hou Jiawen et al.[13]solved the problem of decreasing the wholel cut rate by reducing the number of rake nails, setting the parameters of the bottom belt frequency converter, and reducing the speed of the feeding roller through comprehensive optimization, which has a certain effect. However, the old-fashioned processes require long-term wire storage, and for the modern tobacco processes, the factor of the feeding roller is the most important.

Therefore, under the requireents of modern technology, and on the basis of keeping the original structure and equipment parameters unchanged, this paper improves the rake nail structure of the feeding roller to reduces its damage to the material structure, improves the whole wire rate

and loose efficiency, so as to improve the level of process manufacturing and reduce the cost of scrapped shreds.

Table 1 Changes of some physical indicators after fragrance and silk storage

Physical index	After flavoring	After silk storage	Differentials
Filament rate	61.71	58.10	-3.61
Medium filament rate	20.69	22.73	2.03
Short filament rate	16.73	18.29	1.56
Shredding rate	0.87	0.88	0.01
Whole cut rate	82.40	80.83	-1.57

This article compares two ideas for improving the rake nails of the feeding roller. One solution is to install flat iron between each rake nail, and the other is to install cylindrical rod-shaped material between each rake nail. As shown in Table 1, through experimental comparison, it was found that the feeding roller connected to the cylindrical rod material has a lower degree of crushing of tobacco. The possible reason for the analysis is that the cylindrical rod shaped material has flexible contact with the tobacco, and the shear force on the tobacco is relatively small compared to the flat iron

Table 2 The Influence of two ideas the rake nails of the feeding roller on tobacco physical index

Physical index	Flat iron	Cylindrical rod-shaped
Difference in filament rate	-1.58	-0.69
Difference in medium filament rate	1.21	0.61
Difference in Short wire rate	0.94	0.32
Difference in shredding rate	0.01	0.01
Difference in whole cut rate	-0.37	-0.07

3. Improvement methods

This article aims to improve the structure of the feeding roller. The design direction is to use a steel bar to distribute the state along the rake nails, connect the top of the rake nails, increase the contact area between the feeding roller and the cut tobacco, While ensuring the uniformity of the cut tobacco discharge, and reducing damage to the physical structure of the cut tobacco.

A feeding device for the tobacco storage cabinet is preliminarily designed, as shown in Figure 2, Including shaft 1, connecting rake nail 2, the feeding device can be used in the tobacco storage cabinet, and also has a certain effect on the tobacco leaf cabinet and the tobacco stem cabinet. As shown in Figure 2.

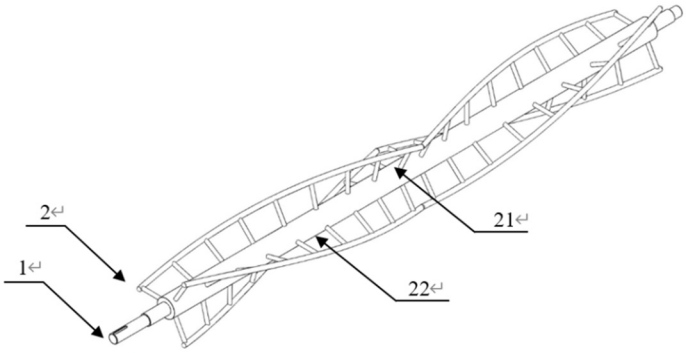
Among them, the connecting rake nail 2 is welded together by the radial rake nail 21 and the axial connecting rod 22. At the same time, shaft 1 is welded with connecting rake nail 2 to form a feeding roller.

Based on experience, for a wire storage cabinet with a width of 3 meters, the number of radial rake nails is set to 15 to ensure the loose pull-out effect of the feeding roller.

The installation of the front and side of the dial roller of the feeding storage cabinet is shown in Figures 3 and 4. The feeding roller is installed at the outlet of the wire storage cabinet, and the

center connection of the discharge feeding roller forms a 75 degree angle with the bottom belt. The rotation direction of the feeding roller is controlled counterclockwise in the observation direction of Figure 4, that is, the feeding roller drives the tobacco to roll upwards.

During the discharge work, wait for the rear end equipment of the wire storage cabinet to complete the startup, the feeding roller of the wire storage cabinet starts. And then the bottom belt of the wire storage cabinet will drive the tobacco to move towards the discharge port of the wire storage cabinet



1. Shaft 2. Connecting rake nail 21. Radial rake nail 22. Axial connecting rod

Fig 2. Improved wire storage cabinet feeding roller

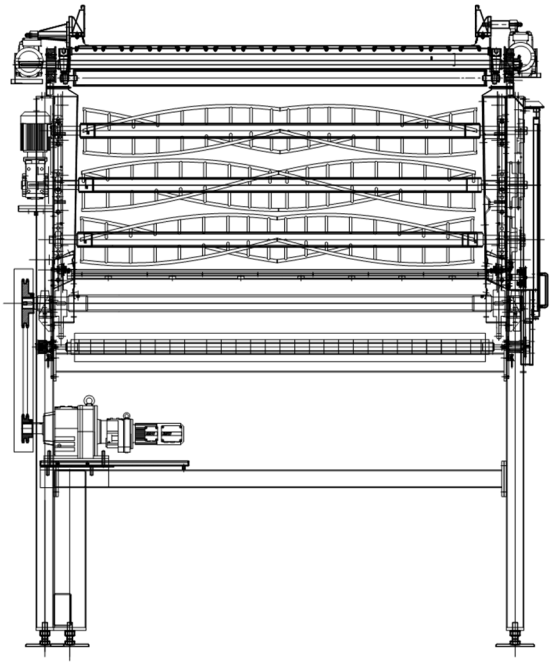


Fig.3 The drawing of the front installation of the wire storage cabinet feeding roller

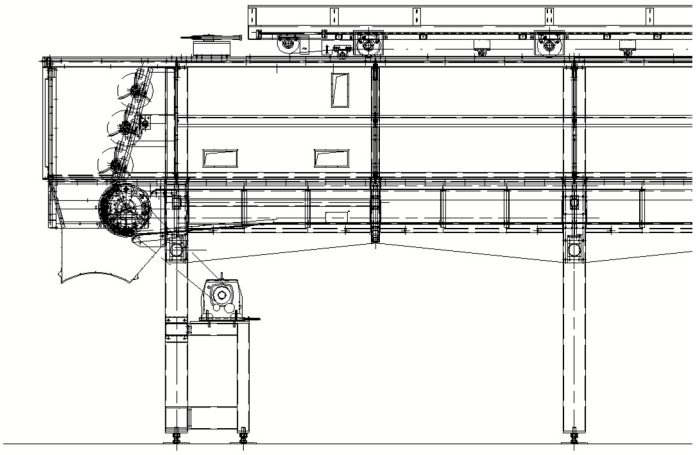


Fig.4 The side installation diagram of the wire storage cabinet feedingl roller

4. Application effect

4.1 Experimental Design

In order to verify the improvement effect, the improved feeding roller was installed in the tobacco production line of Zhejiang Zhongyan Ningbo Cigarette Factory, as shown in Figure 5, and the actual effect of the device was compared by using the physical object. The physical indicators of the tobacco before and after the improved and unimproved tobacco storage cabinets were recorded, and six groups of parallel tests were conducted to take the average value, so as to analyze the effectiveness of the application of the tobacco block loosening device.

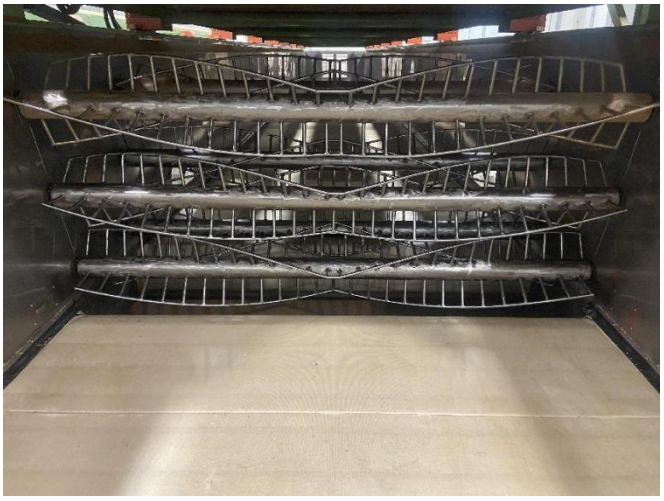


Fig.5 The improvement effect of the improved feeding roller

4.2 Data Analysis

As shown in Table 2 and Figure 6, after data analysis, it was found that the problem of the decrease of the whole cut rate before and after the transformation was significantly improved. After the transformation of the Y line, the whole cut tobacco rate decreased by only 0.07 % through the storage cabinet, far lower than the 1.72% before the transformation. The damage of the storage cabinet to the whole cut tobacco rate was almost negligible. The improvement of the reduction of the whole cut tobacco rate after the modification of the feeding roller is mainly due to the fact that it greatly inhibits the reduction of the filament rate, slightly inhibits the increase of medium filament rate, short filament rate and shredding rate, so that the physical properties of the cut tobacco are more stable after aroma, which is conducive to the subsequent processing and production of the cut tobacco. As show in table 3.

Table 3 Changes of physical indicators of cut tobacco before and after renovation

Physical indicators		Filament rate/ %	Standard deviation SD	Medium filament rate/%	Standard deviation SD	Short filament rate/%	Standard deviation SD	Shredding rate/ %	Standard deviation SD	Whole cut rate/ %	Standard deviation SD
After flavoring	X-line not modified	64.29	0.84	18.85	0.54	15.98	0.47	0.88	0.0054	83.14	0.92
	After the transformation of Y-line	64.26	0.62	18.67	0.57	16.17	0.32	0.9	0.003	82.93	0.94
Behind the storage cabinet	X-line not modified	61.1	0.71	20.32	0.64	17.67	0.45	0.89	0.008	81.42	0.67
	After the transformation of Y-line	63.51	0.47	19.35	0.62	16.64	0.41	0.9	0.009	82.86	0.85
differentials	X-line not modified	-3.19		1.47		1.69		0.01		-1.72	
	After the transformation of Y-line	-0.75		0.68		0.47		0		-0.07	

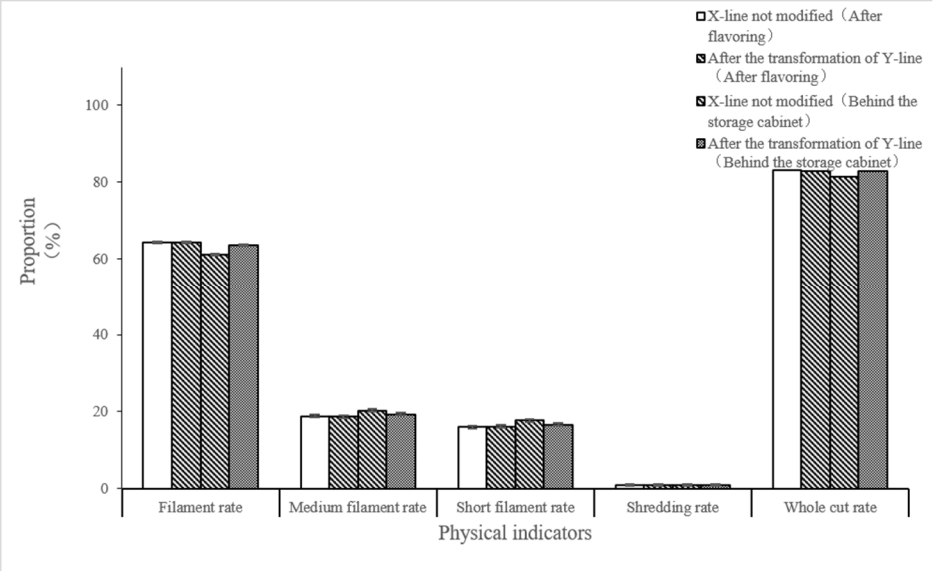


Fig. 6 Changes of physical indicators of tobacco before and after transformation

5. Conclusion

In order to solve the problem of destroying the physical structure of cut tobacco in the working process of the feeding roller of the storage cabinet, the feeding roller in the storage cabinet is been improved. a steel bar is used to connect the top of the rake nail along the distribution state of the rake nail, increase the contact area between the feeding roller and the cut tobacco, and reduce the damage to the physical structure of the cut tobacco while ensuring the uniformity of cut tobacco discharge.

The experimental results show that the modified pick-up roller can effectively avoid the damage of the physical structure of cut tobacco, alleviate the adverse consequences caused by radial rake nails on loose cut tobacco, effectively inhibit the reduction of tobacco whole cut tobacco rate in the storage cabinet, improve the quality of cut tobacco, and facilitate the subsequent processing and production of tobacco.

References

[1] YU Jianjun. Cigarette technology[M]. Beijing:China Agriculture Press. 2003:237-240.

[2] Du Jinsong, Shen Xiaofeng, Li Yuefeng et al.. Effect of cut tobacco structure on physical indexes of cigarette[J].Tobacco Science and Technology., 2008. (8) : 8-13.

[3] Yao Guangming, Qiao Xueyi, Shen Yujun et al. Changes of filling value and whole filament rate of flue-cured tobacco leaves in different cut tobacco drying processes[J]. Henan Agricultural Sciences, 2011.40 (2) : 69-73.

[4] Sun Jia.Study on the influence of the change rate of the whole cut tobacco rate on the quality control of cigarette Jointing[J].Technology and innovation, 2014.20 : 5,7.

[5] D. Layten Davis, Mark T. Nielsen. Tobacco: Production, Chemistry and Technology[M]. Blackwell Science LimitedOxford, UK. 1999:309-311.
[6] Cui Sheng, Wei Xiaoling, Zhong Junning.Analysis on the whole cut rate of tobacco[J].Southern Agricultural Journal, 2012.43 (10) : 1558-1560.
[7] Rezitis AN, Brown AB, Foster WE. Adjustment costs and dynamic factor demands for US cigarette manufacturing[J]. Agricultural Economics, 18 (3):217-231.
[8] Vann MC, Cheek JA, Green B. First report of cigar tobacco production in western North Carolina[J]. Crop Forage & Turfgrass Management. 6(1): e20063.
[9] Ye Jihua, Zhu Weilin, Fei Yue, Song Xingwang.Improved design to improve the stability of material flow in the mixing and flavoring process[J].Light Industry Technology, 2021.37 (11) : 10-11,30.
[10] Ye Hongyin, Wang Tao, Ding Naihong, He Jinhua.Effects of Tracking and Mixture on Stability of Tobacco Index [J].Anhui Agricultural Sciences, 2013, 41 (20) : 8700-8702.
[11] Zheng Yuzhong, Hou Jiawen.Causes and improvement measures for the reduction of the whole cut tobacco rate in the storage cabinet[J].China High-tech Enterprises, 2016. (3) : 35-36.
[12] Song Jie.Upgrading of the discharge mode of the mixing cabinet[J].Shandong Industrial Science and Technology, 2016 : 236.
[13] Hou Jiawen, Ding Rui.Analysis of several schemes to reduce the reduction value of the whole cut tobacco rate out of the storage cabinet[J].Theoretical research, 2013.5 : 76,80.