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Research Article

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The spray coating art for reconstituted tobacco

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ABSTRACT

Reconstituted tobacco is typically made by recovered fragments and particles of tobacco, which is customarily coated by impregnating in a bath of a liquor of tobacco extract to rich the reconstituted tobacco base sheets in flavor. An innovative non-contact coating process, spray coating, was proposed in this research, which broke through the limitation in wet strength requirement for reconstituted tobacco base sheets in traditional impregnation coating means. The influences of solid content and flow of tobacco extract, and running speed of coating machine on coating amount and final sheets formation were investigated. The results showed that the coating amount of tobacco extract increased with the solid content and flow of tobacco extract in- creasing, the formation of coated paper sheets was significantly improved by increasing the solid content of tobacco extract and coating speed. It was found that basis weight, bulk, and absorbent velocity of reconstituted tobacco base sheets did not produce a significant effect on spray coating performance. This study confirmed the potential of spraying as a choice for reconstituted tobacco coating.

Keywords: Reconstituted tobacco; spray coating; coating amount; formation index

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INTRODUCTION

Commonly, a large amount of crushed tobacco leaf, stem and dust was produced and discarded in regular processing of tobacco products [1-3], reconstituted tobacco by papermaking method was a way of taking full advantage of these tobacco scraps or waste. It involved operations such as digesting the particles and beating them until they form a pulp, this pulp was then formed into a reconstituted base sheet, using equipment which is similar to that used in the paper industry [4-7], the base sheet was finally coated with concentrated aqueous tobacco extract. The coating of tobacco extract was essential for reconstituted tobacco base sheet to cover the wooden smell and obtain a good flavor [8].

The most common coating methods presently was impregnation coating, the wet strength of reconstituted tobacco coated by impregnating process was of important commercial significance for coating machine running without tobacco sheet broken. However, the wet strength of reconstituted tobacco sheet was generally too weak, since there were considerable of tobacco fines and scraps, which was much shorter in length than the right fibers that capable of interweaving and forming a web. Based on it, innocuous strength aid was commonly used in the manufacture of cigarettes and similar smoking articles for sake of food safety [9-11]. Now therefore, a coating method covering enough tobacco extract on reconstituted tobacco regardless of the base sheet strength was demanded. While spray coating was a non-contact coating method without the request for wet strength of base sheet, and consequently would be a good choice for production of reconstituted tobacco.

In short, the main objective of this research is to evaluate the potential of spray coating as a choice of coating method for reconstituted tobacco. The effectiveness of spray coating was examined in terms of solid content of tobacco extract, tobacco extract flow, coating speed, and basis weight, bulk and absorbent velocity of tobacco sheet. Results were analyzed in terms of coating amount and formation index of the final tobacco sheet products.

EXPERIMENTAL SECTION

Materials

The raw pulp fibers and chemicals including tobacco stem and tobacco waste, unbleached softwood pulp, and eucalyptus pulp, PCC(precipitated calcium carbonate) in food grade, chitosan were provided by Xin Ye reconstituted tobacco Co. Ltd., (Wuhan, China).

Preparation of reconstituted tobacco base sheets

The stock for reconstituted tobacco base sheet was a mixture of tobacco stem and tobacco waste pulp, unbleached softwood pulp, and eucalyptus pulp, which were respectively refined initially with KRK high consistency refiner(Japan), and then successively beaten to refining degree of 40 ºSR, 50ºSR and 30ºSR with PFI refiner(PTI corporation, Norway) before mixing. PCC in food grade was added into reconstituted tobacco sheets as filler, and 0.06% of chitosan was used as retention aids for fibers and filler. And finally the reconstituted tobacco base sheets with basis weight of 35±2g/m² were prepared using Köthen automatic paper sheet former (PTI corporation, Norway) in papermaking method.

Tobacco essence extraction

The tobacco stem and waste were extracted in pure water with liquor ratio of 1:6 at (60±5)ºC for 1h, respectively. And then the extracted liquors were mixed at ratio of 1:1 and condensed in a rotary evaporator at 70ºC to a series of concentration.

Spray coating of reconstituted tobacco base sheets

The moving of prepared reconstituted tobacco base sheets was controlled by RK-303 coater(RK Co. Ltd., England) through fixing it on a home-made disc, and the spray gun(Wei You Te Co. Ltd., Fenghua, China) was also fixed on the coater, thus the reconstituted tobacco base sheets were coated as they go through. The coated reconstituted tobacco sheets were put into drying oven for 2 min, and then the prepared reconstituted tobacco sheets were conditioned at a constant temperature and moisture for more than 24 hours, and then weighed. The filter papers with formation index about 137 were used and coated in order to eliminate the interference of formation of base sheets in measuring the effect of solid content of tobacco extract, tobacco extract flow, and coating speed on coating weight and formation index of paper base sheets; The handmade reconstituted tobacco sheets using the tobacco stock mixture were used and coated in measuring the effect of basis weight, bulk and absorbent velocity of the reconstituted tobacco base sheets on coating amount.

Measurement of paper and reconstituted tobacco sheets

The basis weight of filter papers and reconstituted tobacco sheets before and after coating was measured according to GB/T451.2—1989, the bulk of reconstituted tobacco sheets was tested by paper sheet thickness tester(paper sheet testing machine factory, Changchun, China), and absorbent velocity of reconstituted tobacco sheets was measured by ZZ-100 Klrlm paper sheet surface adsorption weight tester(Sanquanzhongshi testing machine Co. Ltd., Jinan, China) according to the standard method GB/T461.3—1989. The formation index was tested by paper sheet formation tester(Techpap Co. Ltd., France).

RESULTS AND DISCUSSION

Effect of solid content of tobacco extract on coating amount and paper sheet formation

The uniformity of paper thickness is the real distribution of the paper quality in the specified area. Fig.1 showed the coating weight and formation index of paper sheets as a function of solid content of the tobacco extract. The filter papers of formation index 137 were used as the base sheets due to their consistent formation. The smaller the formation index, the better the paper formation was. It could be seen that all of coated filter papers obtained better formations than the uncoated ones. The formation index of spraying coated filter papers decreased continuously with the solid content of tobacco extract increasing from 10% to 50%, and then increased as the solid content of tobacco extract increased to 60%, the best information index of 79 was achieved at the solid content of tobacco extract of

50%. Furthermore, the coating weight on filter paper sheets increased constantly as the solid content of tobacco extract increased. It can be concluded that the spray coating gave a positive effect on the formation of paper sheets and coating weight of tobacco extract, and subsequently a better flavor of reconstituted tobacco was expected. Since some insolubles of tobacco extract was precipitated and blocked the bumper as the solid content of tobacco extract exceeded 51.5%, therefore, 41.2% was adopted for subsequent experiments.

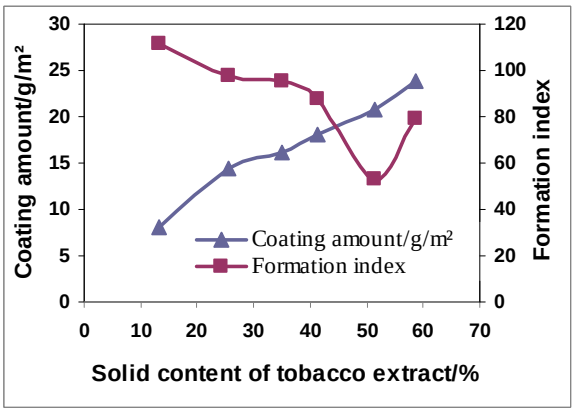

Fig. 1. Coating amount and paper sheet formation index as a function of solid content of tobacco extract(*coating machine speed was 20 m/min, spraying flow was 3.45 ml/s)

Effect of tobacco extract flow on coating amount and paper sheet formation

As can be seen from Figure 2, as tobacco extract flow rate increased from 1.25 ml/s to 6.91 ml/s, the coating weight sharply increased from 8.64 g/m² up to 27.05 g/m², the gross growth reached 213%. However, given the limitation of spray gun, the tobacco extract flow could not be raised any further, or a much higher coating amount was to be expected. It seemed that a higher tobacco extract flow rate would not bring a positive effect on paper sheet formation, since no significant decline in formation index was detected after tobacco extract flow exceeded 2.25 ml/s, the formation index stayed around 80. The possible reason was that the particles of spraying tobacco extract coagulated and consequently resulted in worse particle size distributions with the flow rate increasing.

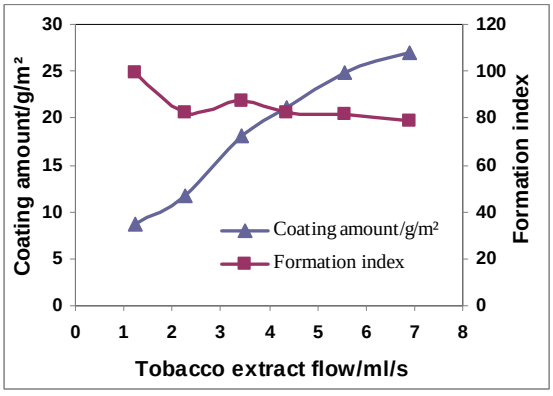

Fig. 2. Coating amount and sheet formation as a function of tobacco extract flow (*coating speed was 20m/min, solid content of tobacco extract was 41.2%)

Effect of coating speed on coating amount and paper sheet formation

As can be seen from Fig 3, the coating amount declined greatly as the coating machine speed increased, it reduced by 14.46 g/m² as the coating machine speed rose from 10m/min to 40m/min. However, the acceleration of coating machine did not cause a poor paper sheet formation, conversely a much better formation of paper sheets was gained, the formation index decreased from 91.5 to 51.6. From the point of mass production, higher machine running speed was expected for higher production efficiency. However, from the experiment results in this laboratory scale, the coating speed acceleration gave an adverse effect on coating amount of tobacco extract.

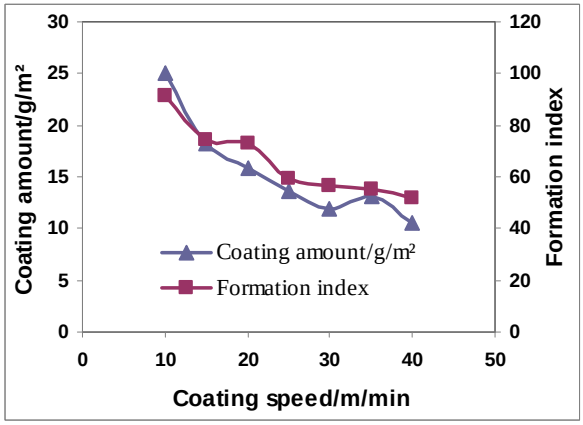

Fig. 3. Coating amount and paper sheet formation as a function of coating speed (*solid content of the tobacco extract was 41.2%, tobacco extract flow was 3.45ml/s)

Effect of basis weight of reconstituted tobacco base sheets on coating amount

From this part of experiment, the tobacco extract was coated on the handmade reconstituted base sheets instead of filter paper in order to discuss the effect of basis weight, bulk and absorbent velocity on the coating amounts. As can be seen from Figure 4, no significant difference in coating weight was observed with the basis weight of reconstituted tobacco base sheets decreasing from 67.84g/m² to 29.68 g/m², which indicated that there was no definite relationship between the basis weight of reconstituted tobacco base sheet and the spreading of tobacco extract on its surface.

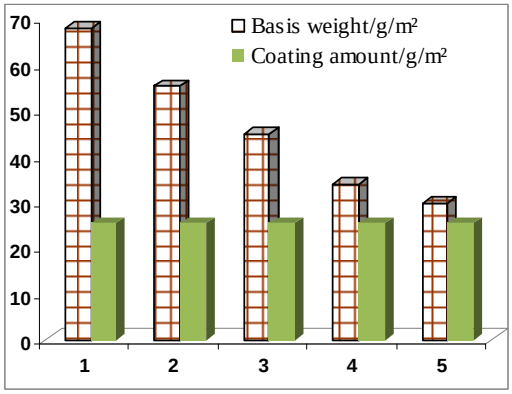

Fig. 4. Coating amount as a function of basis weight of reconstituted tobacco sheets(*solid content of the tobacco extract was 41.2%, temperature was 22 °C, coating machine speed was 10m/min, tobacco extract flow was 4.35 ml/s)

Effect of bulk of reconstituted tobacco base sheets on coating amount

A series of reconstituted tobacco sheets with various bulks were prepared through the process control including the pulping of tobacco and wood fibers and the pressing of the prepared base sheet, at the same time, the basis weights of all of the tobacco base sheets were kept on about 34 g/m². As can be seen from table 1, similar to the effect of basis weight, the bulk of tobacco base sheets did not exert a distinct influence on the coating amount. As the bulk increased from 1.83 cm³/g to 3.15 cm³/g, the coating amount of extract on reconstituted tobacco base sheets increased slightly.

Effect of absorbent velocity of reconstituted tobacco base sheets on coating amount

It can be seen in fig.5, no significant change in coating amount was detected, although the absorbent velocity increased sharply from 9.5 to 33.1 mm/10min. Generally speaking, the reconstituted tobacco sheet with higher

absorbent velocity should has higher adsorption capability, therefore theoretically the coating amount was supposed to be much higher, which was not observed in the result of this part.

Table 1. Effect of bulk of tobacco base sheets on coating amount

Bulk /cm³/g	Basis weight before coating /g/m²	Basis weight after coating g/m²	Coating amount g/m²
1.83	34.68	52.15	17.47
2.14	33.41	51.20	17.79
2.31	34.55	51.65	17.10
2.53	34.82	52.10	17.28
3.15	34.39	52.80	18.41

*(*solid content of tobacco extract was 41.2%, coating temperature was 22ºC, coating speed was 10m/min, tobacco extract flow was 2.35 ml/s)*

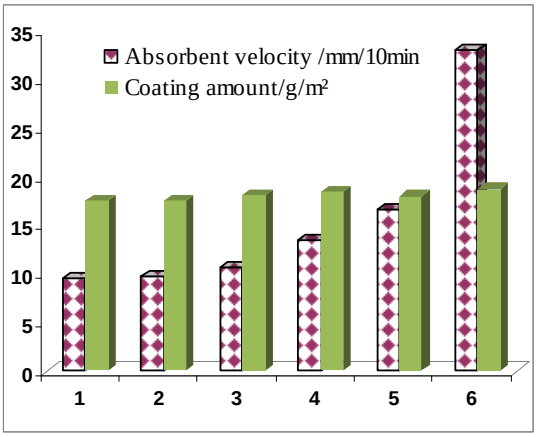

Fig. 5. Coating amount as a function of absorbent velocity of reconstituted tobacco sheets (*solid content of the tobacco extract was 41.2%, temperature was 22 ° C, coating machine speed was 10m/min, tobacco extract flow was 4.35 ml/s)

CONCLUSION

The spray coating operation was beneficial to paper sheets formation, offering a more homogeneous quality in the specified area; The coating amount of tobacco extract on base sheets was improved by enhancing the solid content of tobacco extract and tobacco extract flow as high as possible; Acceleration of coating speed gave a negative effect on coating amount. The coating amount of tobacco extract was not significantly influenced by the basis weight, bulk, and absorbent velocity of reconstituted tobacco base sheets in spraying coating process. This study provided a promising strategy for reconstituted tobacco coating production to reject strengthen agent.

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