Design & Development of Soundable CYO

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Abstract. In order to increase the interest of cigarette smoking, enrich consumers' consumption experience, realize the satisfaction of hearing in the process of cigarette combustion, and meet the needs of some consumers who have little warning effect on hearing sound, a sound-producing CYO component was designed and produced, which uses the sound-producing device to be installed between the upper cover and the lower cover of the connector, so that the sound-producing mode of the connector adopts pure mechanical structure to achieve. The physical parameters of the splicer are calculated by ANSYS software, and the connecting effect is simulated. The CYO cigarettes connected by the connector are verified. The results show that the connector achieves the sticky effect and the tightness similar to the conventional cigarettes. There is no significant difference between smoking evaluation and smoke detection with conventional cigarettes, thus the ideal design effect is achieved.

1. Introduction
FM (Factory Making) mechanism cigarette is the most common mode of cigarette production. RYO (Roll-Your-Own): refers to the purchase of cigarette paper, tobacco, filter rods and other materials for their own cigarettes. CYO (Connect Your Own) combines the advantages of FM and RYO cigarettes, uses combination design, so that consumers have more rights to choose independently. After purchasing cigarette sticks and filter rods that meet their preferences, CYO (Connect Your Own) participates in the process of splicing, participates in the process of cigarette processing, completes the last link of cigarette processing, and makes "R&D" a part of consumer behavior, highlighting and displaying. Characterization of individual fees.

Nowadays, there is no soundable cigarette on the market, and there is still a lack of product development for products that can stimulate consumers' five senses. In this paper, a sound-producing CYO cigarette is designed. The splicer uses the principle of physical acoustic vibration to produce sound in a pure mechanical structure, which increases the interactive experience of consumers' smoking and meets the different consumption habits of consumers. The physical parameters of the splicer were calculated by ANSYS software, and the splicing effect was simulated. The CYO cigarettes spliced by the splicer were validated. There was no significant difference in smoking evaluation and smoke detection between the two kinds of cigarettes, and the ideal design effect was achieved.
2. Simulation & calculation

Through simulation calculation, the model of smoke flow rule in connector was established, the influence rule model of splicer on smoking resistance of separated cigarette and the influence rule model of connector on temperature of CYO cigarette were established.

2.1. The ISO standard suction mode conditions of GB/T 19609-2004 were used for simulation. The suction time was 2 s for each suction, one suction per 60 s, and the suction capacity was 35 ml.

2.2. Under ISO standard smoking mode, the simulated number of times of smoking was 7 times, and the temperature at the interface between the end of the cigarette and the filter rod was determined. Temperature data can be obtained from experiments.

2.3. The project requires simulating the smoke resistance and temperature of flue gas passing through splicers and filter rods. The peak and average values of smoke resistance and temperature were determined for simulating the smoking process in each inhalation. The cross section is selected at the outlet of the splicer (Z = 30 mm), the middle of the filter rod (Z = 15 mm), the back of the filter rod (Z = 7 mm) and the end of the filter rod (Z = 0 mm). There are 7 groups of data for each cross section (7 simulations by aspiration).

2.4. For the simulated boundary conditions, the parameters of filter rod, such as heat transfer coefficient of cellulose acetate fiber, porosity of filter rod, inertia resistance coefficient of filter rod and viscous resistance coefficient of filter rod, can adopt standard value or empirical value.

3. EXPERIMENTAL RESULTS AND DISCUSSIONS

3.1. Design of connector

The soundable connector is installed between the upper cover and the lower cover of the splicer, so that the connector's voice mode is realized by pure mechanical structure.

When inhaling, the smoke enters through the intake port of the convex paraboloid of the soundable connector and reaches the sound hole of the concave paraboloid of the generator through the resonant cavity of the generator. At this time, the concave paraboloid generates vibration and concurrent sound, which causes the resonant resonance of the generator cavity. After resonance, the sound is transmitted from the sound hole to the outside. The structure diagram is shown in Fig. 1.

Fig.1 Structural sketch of soundable CYO cigarette

3.2. Geometric model and mesh generation of splicer and filter rod

The material of the filter rod is cellulose acetate fiber. The size of the tow is 3.0Y32000, the circumference is 24.5mm, the length of the filter rod is 30mm, and the wall thickness of the filter rod is 0.08mm. The connector and filter rods were modeled by UG software. The geometric model of splicer flue duct was obtained by DesignModeler of ANSYS, as shown in Fig. 2.
The geometric model of splicer and filter rod is meshed by ANSYS ICEM software, and tetrahedral mesh is used to refine the boundary layer. The grids of splicers and filter rods are shown in Fig. 3. Z = 0 mm is the filter rod sucking end, Z = 30 mm is the splicer outlet end, Z = 32 mm is the splicer input end. Smoke flows from the cigarette end to the smoking end, and nicotine is intercepted inside the filter rod.

3.3. Determining the Boundary Conditions for Computation
(1) The splicer adopts speed entrance, and the speed changes with time. Under ISO suction mode, \( v = 0.61 \sin(\pi t/2) \) is loaded with UDF custom function. The time of each puff is 2 s, and the capacity of each puff is 35 ml. A total of 7 puffs are smoked to determine the temperature at the boundary between the smoking branch and the filter rod, and the temperature of seven puffs is used as the connector. The boundary conditions of the mouth temperature.

(2) Set the inlet temperature: 375K.
(3) Entrance velocity: UDF equation was introduced by standard suction.
(4) Export pressure: UDF equation was introduced by standard suction.

3.4. Standard Suction UDF Program
Write UDF program for outlet pressure and inlet velocity of splicer and import it to Fluent for calculation.
3.5. Simulation results of connector

Fig. 4 Draw resistance variation through connector along Y and X axis
In conclusion, the distribution of temperature field and pressure drop field is centered on the axis of the geometric figure on the side of the component, which expands from inside to outside in turn. The temperature decreases gradually from inside to outside, the suction resistance increases from top to bottom, and the temperature at the edge of the speaker is slightly lower. The calculation can be used as an important basis for selecting suitable temperature for manufacturing component materials.

As shown in Fig. 7, the stitching point achieves the sticky effect and sealing property similar to that of conventional cigarettes. Voicers are easier to make sounds. Smokers are more interesting when smoking, which also plays a warning role. There is no significant difference between smoking evaluation and smoke detection with conventional cigarettes, and the ideal design effect is achieved.
4. Conclusions
1. A sound-producing separate component was designed. Utilizing the principle of physical sound wave vibration, pure mechanical structure can produce sound, increasing the interactive experience of consumers' smoking, and satisfying the different consumption habits of consumers.

2. The distribution of temperature field and pressure drop field is centered on the axis of the geometric figure on the side of the component, which expands from inside to outside in turn. The temperature decreases gradually from inside to outside, the suction resistance increases from top to bottom, and the temperature at the edge of the speaker is slightly lower.

3. Stickiness effect and airtightness of conventional cigarettes can be achieved at stitching points. Connector is easier to make sound during the smoking process. Smoking becomes a more interesting experience, which also plays a warning role. There is no significant difference between smoking evaluation and smoke detection with conventional cigarettes, and the ideal design effect is achieved.

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