Study on Resistance Characteristic of Groove Filter Rod

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Abstract. In order to study the influence of groove on the resistance of filter rod, 6 different sizes (10+20, 15+15, 20+10), two different groove profiles (inner and outer grooves) were tested and analyzed. Results show that: (1) groove distribution of filter rod draw resistance has obvious effect, under the same conditions, inner grooved filter rod draw resistance greater than outer grooved filter rod draw resistance. The groove length is longer, the distribution of the trench suction on the impact resistance is greater: 20-10 inner and outer groove suction resistance difference >15+15 inner and outer groove suction resistance difference >10+20 inner and outer groove suction resistance difference. Groove length and draw resistance to reduce the proportion of a quadratic function relation. Grooved filter rod with increasing the length of the groove, the difference of suction rod resistance and light resistance increased.

Introduction

Cellulose acetate groove filter rods is made of cellulose diacetate tow, cellulose paper and filter shaped paper [1], is a development application earlier, and one of the obvious effects of reducing tar of special filter rods. Cellulose acetate groove filter rod has better performance of filter cigarette smoke, can significantly lower the quality and quantity of aerosol particles [2], compared with the ordinary cellulose acetate filter rod, the same condition the tar release quantity can reduce 2 to 3 mg/one cigarette, smoke nicotine content also has a certain extent reduce [3-5]. With groove filter rod loading paper porosity or the pressure drop increased, conventional cigarette smoke components, harmfulness evaluation index are falling, in different pressure drop cellulose acetate groove filter rod with ordinary cellulose acetate filter rod of ammonia, phenolic s and tobacco specific nitrosamines intercepting effect of the differences, the coating of the modified cellulose paper groove filter rods made of selective choice of phenol to release a quantity to role in reducing cigarette smoke [6]. With different grooves of groove filter rod length and position distribution and the relationship between cigarette smoke was studied, the results showed that single segment groove conic relation with the length of flue gas index, and the groove length of 20 mm, the highest filtering effect [7]. Zhan-ping Yang [8] using equivalent filter model, the export of filter rod filter characteristics, gas flow and filtration behavior of mathematics basic equations, established a tow, filter rod parameters such as connection, and is applied to analyze the suction resistance variation rule, and about groove filter rod resistance characteristic and reported for the first research on the laws of the impact. So the resistance characteristics of cellulose acetate groove filter stick to cigarette filter rod type selection in product design and production process control of groove filter rod plays an important role.

Materials and Methods

Materials and Equipment
Cellulose acetate tow 3.0 Y28000 (Nantong Acetate Fiber Co., Ltd.), cellulose paper (width is 22.5 mm, quantitative 60 g/m², Korea GuoYi paper co., Ltd), filter forming paper (width is 26.5 mm,
quantitative 32 g/m², ZheJiang MinFeng paper co., Ltd.), the comprehensive test bed (Britain, Cerulean company), grooved roller (customization, JiaXing special equipment machinery factory)

**Test Method**

10+20 grooved roller installed on the machine of KDF2 to test and adjust the volume of circumference, opening ratio and into the tow, make sure the conditions that the light rod circumference of 24.08 mm, the resistance is 290 mmH₂O, other parameters constant, adjust the roller spacing, to ensure that the groove depth of 0.3 mm, at the same time by adjusting the cutting position, trial production groove filter of 10 + 20 inner groove filter rod and 10 + 20 outer groove filter rod, after waiting for test stability respectively sampled 200 test physical indicators.

According to the above test method, with 15+15 grooved roller, the resistance test when light resistance is 310 mmH₂O of 15+15 inner groove filter rod and 15 + 15 outer groove filter rod, and sampling 200 respectively for subsequent testing physical index; change 20 + 10 grooved roller, resistance test when light resistance is 405 mmH₂O groove filter stick with 20+10inner groove filter rod and 20+10 outer groove filter rods. Detect physical index and sampling, 200 respectively.

**The Results and Discussion**

**Groove Distribution on the Influence of the Suction Resistance**

**Influence of Groove Distribution on Suction Resistance of 20+10 Grooved Filter Rods.**

As shown in figure 1, figure 2, the inner groove filter and outer groove filter of 10+20 groove filter have equal length with the groove length, but because the groove is different, in the conditions of the same suction resistance of light filter(toe fill the same amount) and same groove depth, the suction resistance is different. As shown in figure 3, the suction resistance is 253.3 mmH₂O of inner groove filter rod, and 247.28 mmH₂O of ouer groove filter rod, in the same conditions ,inner groove filter rods absorb 6.02 mmH₂O resistance is bigger than outer groove filter rods.

**Influence of Groove Distribution on Suction Resistance of 15+15 Grooved Filter Rods.**

As shown in figure 4, figure 5, 15+15 inner groove filter and 15+15 outer groove filter have equal length with the groove length, but because the groove is different, in the same conditions of the same suction resistance of light filter(toe fill the same amount) and same groove depth, the suction resistance is different. As shown in figure 6, the suction resistance is 253.3 mmH₂O of inner groove filter rod, and 247.28 mmH₂O of outer groove filter rod, in the same conditions, inner groove filter rods absorb 6.02 mmH₂O resistance is bigger than outer groove filter rods.
Figure 6. Different grooves distributed on 15 + 15 groove filter stick the suction resistance.

As shown in figure 4, figure 5, the inner groove filter and outer groove filter of 15+15 groove filter have equal length with the groove length, but because the groove is different, in the conditions of the same suction resistance of light filter (toe fill the same amount) and same groove depth, the suction resistance is different. As shown in figure 6, the suction resistance is 261.30 mmH2O of inner groove filter rod, and 253.11 mmH2O of outer groove filter rod, in the same conditions, inner groove filter rods absorb 8.19 mmH2O resistance is bigger than outer groove filter rods.

**Influence of Groove Distribution on Suction Resistance of 20+10 Grooved Filter Rods.**

As shown in figure 7, figure 8 and figure 9, the inner groove filter and outer groove filter of 20+10 groove filter have equal length with the groove length, but because the groove is different, in the conditions of the same suction resistance of light filter (toe fill the same amount) and same groove depth, the suction resistance is different. As shown in figure 9, the suction resistance is 253.40 mmH2O of inner groove filter rod, and 241.60 mmH2O of outer groove filter rod, in the same conditions, inner groove filter rods absorb 11.80 mmH2O resistance is bigger than outer groove filter rods.
Through the analysis of the suction resistance of the above three specifications filter rod, the longer the groove length of filter rod, the greater the effect of grooves distributed on the impact resistance: the effect of resistance difference between inner groove and outer groove filter of 20+10 groove filter rod > 15 + 15 groove filter rod > 10+20 groove filter.

The Influence of the Suction Resistance of Filter Rod

Table 1. Bar groove filter rod and light resistance absorption different specification Groove type light bar.

<table>
<thead>
<tr>
<th>Groove style</th>
<th>Resistance of light bar (mmH2O)</th>
<th>Resistance gap between groove filter and light filter rod (mmH2O)</th>
<th>Percent reduction of filter resistance(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inner groove</td>
<td>Outer groove</td>
<td>Inner groove</td>
</tr>
<tr>
<td>10+20</td>
<td>290</td>
<td>36.7</td>
<td>47.72</td>
</tr>
<tr>
<td>15+15</td>
<td>310</td>
<td>48.7</td>
<td>56.89</td>
</tr>
<tr>
<td>20+10</td>
<td>405</td>
<td>151.6</td>
<td>163.4</td>
</tr>
</tbody>
</table>

The relationship between groove length, groove distribution, suction resistance of groove filter rod and light filter rod was discussed, the result shown in table 1. The groove length of 10+20 specification is 40mm, the suction resistance of the inner grooved filter rod and the outer grooved filter rod compared with light filter rod suction resistance, were reduced 36.7mmH2O and 47.72mmH2O respectively. The groove length of 15+15 specification is 60mm, the suction resistance of the inner grooved filter rod and the outer grooved filter rod compared with light filter rod suction resistance, were reduced 48.7mmH2O and 56.89mmH2O respectively. The groove length of 20+10 specification is 40mm, the suction resistance of the inner grooved filter rod and the outer grooved filter rod compared with light filter rod suction resistance, were reduced 151.6mmH2O and 163.4mmH2O respectively.

It can be seen from the figure 10 and figure 11, the groove filter rod with the increase of groove length, light bar after pressing resistance reduction ratio increases, and grooved rod length and light resistance difference absorption and light bar resistance to reduce the proportion relationship of a quadratic function.

![Figure 10. Resistance gap between inner groove filter and light filter rod.](image)

![Figure 11. Resistance percent reduction between inner groove filter and light filter rod.](image)
Figure 12. Resistance gap between outer groove filter and light filter rod.

Figure 13. Resistance percent reduction between outer groove filter and light filter rod.

It can be seen from the figure 12 and 13, groove filter stick its grooved rod length and light resistance lower proportion of the relationship between relationship of a quadratic function, namely, with the increase of groove groove length of filter rod, the difference of suction rod resistance and light resistance. Combination of the above four figure function expression, you can see that outside groove groove length of filter rod to the influence degree of the suction resistance is greater than the outer groove filter rods. The same groove length, outer groove filter rods absorb great resistance and light resistance difference is greater than the inner grooved filter rods absorb great resistance and light resistance.

Conclusion 3

Through the above analysis, we can get the following conclusions:

1. Groove have significant effect on the distribution of the suction resistance of filter rod, on the same conditions, the suction resistance of outer groove filter rod is greater than the inner groove filter rod.

2. The longer the groove length of filter rod, the greater the effect of grooves distributed on the impact resistance: the effect of resistance difference between inner groove and outer groove filter of 20+10 groove filter rod > 15 + 15 groove filter rod >10+20 groove filter.

3. The relationship of groove length and resistance reduction of light filter rod after pressure groove is a quadratic function, namely the groove filter rod with the increase of groove length, the difference of suction rod resistance and light resistance increased.

4. The suction resistance of groove filter rod is affected by capillary effect, interface effect and grooves on the aspects of effects of fluid viscosity, the next step is to verify the actual data through theoretical deduction, in order to get more scientific basis and guide production.

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References


