Spunlaced and chemically bonded nonwovens for filtration applications: Performance evaluation and comparison

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The pore size and its distribution for the samples with 25% binder application are illustrated in Figure 5. It was observed that the smaller pores were created during more intense interlocking of fibres with the higher pressure water jets (200 bars) for PP and PET samples with 25% binder application.

The smallest pores were achieved for sample N9-T2 of PP with water jet pressure of 200 bar.

In samples with 25 % binder application, sample N3-T2 (PP) showed the best performance properties in terms of all filtration parameters.

The filtration properties were evaluated on samples with 40% binder application. The results are summarised in Table 3.

Table 3. Filtration properties on spunlaced samples with 40% binder application

<table>
<thead>
<tr>
<th>Filtration properties</th>
<th>N1-T2</th>
<th>N2-T2</th>
<th>N3-T2</th>
<th>N4-T2</th>
<th>N5-T2</th>
<th>N6-T2</th>
<th>N7-T2</th>
<th>N8-T2</th>
<th>N9-T2</th>
<th>N10-T2</th>
<th>N11-T2</th>
<th>N12-T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water jet pressure, bar</td>
<td>60</td>
<td>120</td>
<td>200</td>
<td>60</td>
<td>120</td>
<td>200</td>
<td>60</td>
<td>120</td>
<td>200</td>
<td>60</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Dust arrestance, %</td>
<td>90.9</td>
<td>93.7</td>
<td>99.4</td>
<td>95.8</td>
<td>94.3</td>
<td>66.9</td>
<td>39.4</td>
<td>37.3</td>
<td>33.8</td>
<td>13.5</td>
<td>37.3</td>
<td>33.8</td>
</tr>
<tr>
<td>Dust holding capacity, kPa</td>
<td>62.7</td>
<td>65.3</td>
<td>76.4</td>
<td>48.7</td>
<td>59.4</td>
<td>61.1</td>
<td>37.3</td>
<td>33.8</td>
<td>33.8</td>
<td>13.5</td>
<td>37.3</td>
<td>33.8</td>
</tr>
<tr>
<td>Pressure drop, Pa</td>
<td>25</td>
<td>37.5</td>
<td>25</td>
<td>37.3</td>
<td>25</td>
<td>12.5</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Within the samples with 40% binder, sample N7-T2 (PP) showed the best performance properties for filtration parameters.

CONCLUSIONS

There was an improvement in filtration properties, such as filtration efficiency and dust holding capacity using spunlaced and chemically bonded materials. Spunlacing process binds the fibres in a homogeneous way.

The fibres became tightly packed, making it difficult for particles to pass through the body of the fabric. With the use of finer fibres, the surface area of the filter media shows an increasing number of finer pores. The absence of mechanical damage to the fibres leads to increased filtration performance, as dust can not penetrate the filter media. This helps create cleaner air.

It can be concluded that the optimum parameters for the manufacture of filters from PP fibres, is 200 bar pressure of water jets and 25 % binder application.

The improved surface characteristics from the finer pores of finer fibres will result in the reduction of raw material for manufacturing of lighter filter fabric with higher filtration efficiency. Spunlaced nonwovens are a viable alternative to traditional filters.

INTRODUCTION

Fibre media are defined as a permeable material used to separate particles passing through it. The importance of textile media in air filtration is to control air pollution in improving air quality and hygiene at work.

Filtration is a process of separating solid particles from liquids and gases by passing them through a porous, fibrous or granular substance. Textile filters may be woven, knitted or nonwoven. Nonwovens are the major material structure. The absence of mechanical damage prevents the passing of dust particles through the filter media and leads to the increased resistance of the fabric (Lorentz 2007).

Nonwovens are produced in two stages: web formation and web bonding followed by web finishing. Fibres can be bonded together by different means, namely mechanically, chemically or thermally. Hydroentanglement (also referred to as spining) technique, utilises high speed water jets to entangle fibres of webs. Spunlaced nonwovens offer various performance advantages compared to more traditional technologies used in air filtration. This bonding technology is illustrated by Figures 1 and 2. The turbulence of the water causes rearrangement and entanglement of the fibres with resulting consolidation of the material structure. The absence of mechanical damage prevents the passing of dust particles through the filter media and leads to the increased resistance of the fabric (Lorentz 2007).

Figure 1. Hydroentanglement process

Figure 2. Water jets through a manifold

EXPERIMENTAL

Polypropylene (PP) fibres of 3.6 dtex linear density, 60 mm staple length were selected for PP samples. Polyester (PET) fibres of 3.6 dtex linear density, 60 mm staple length were selected for PET samples, the strength is higher with the 60 bar water jet pressure in MD.

Spunlaced and chemically bonded material. The pore size and its distribution are very important parameters in filtration. The pore size and its distribution for the samples with 25% binder application are illustrated in Figure 5. It was observed that the smaller pores were created during more intense interlocking of fibres with the higher pressure water jets (200 bars) for PP and PET samples with 25% binder application.

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