A Novel Nozzle Design for Producing Hydroentangled Nonwovens with Minimum Jet-Marks

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The presence of jet-marks in hydroentangled nonwovens is usually undesirable. Jet-streaks degrade aesthetic features and physical properties of the resulting fabrics. Reducing the jet-streaks will lead to increased use of this class of fabrics in many applications.

It is known that the jet-streaks change every time the web is impacted by a waterjet curtain. Consequently, the jet-marks that permanently stay on the fabric are those which are caused by the last manifold. This is especially true when the last manifold operates at the highest pressure. Our new nozzle-strip is designed to be placed in the last manifold.

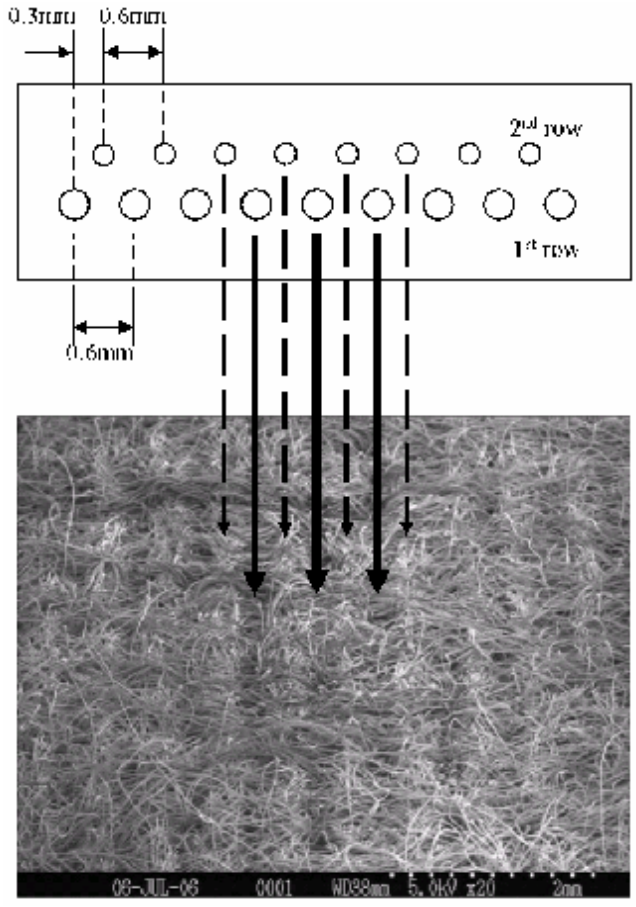

Fig. 1: Schematic of a double-row nozzle-strip with the arrows representing the waterjets of the 1st and 2nd rows

The 1st row of waterjets washes away the previously formed jet-marks, and creates a final set of peaks and valleys. A second row of nozzles, being smaller in diameter, is considered in our new design to impact the peak of the ridges formed by the first row (see Fig. 1) and alleviate the ridges without creating any new noticeable streaks.

The optimal ratio between the diameter of the jets in the 1st and 2nd row depends on the hydroentangling pressure, as well as the web characteristics. In this study, different nozzle diameters ranging from 100µm to 130µm for the 2nd row were examined in combination with a fixed diameter of 130µm for the nozzles in the 1st row. For the type of fiber-web used and the operating pressures considered, a combination of nozzles with 130µm diameter in the 1st row, and nozzles with 110µm diameter in the 2nd row, was found to provide the optimum setting for eliminating / minimizing the jet-marks. This conclusion is drawn based on the information we obtained by analyzing the surface texture of the fabrics. The co-occurrence analysis (see Fig. 2) reveals the presence of dominant peaks occurring at a period of about 600µm for the jet-streaks in the Control fabric (entangled with a single row nozzle-strip with nozzles of 130µm diameter). The results obtained from the sample fabrics show damped oscillation indicating that the jet-streaks are reduced. It can be seen that the sample-110 has the best performance for the pressures considered in this experiments.

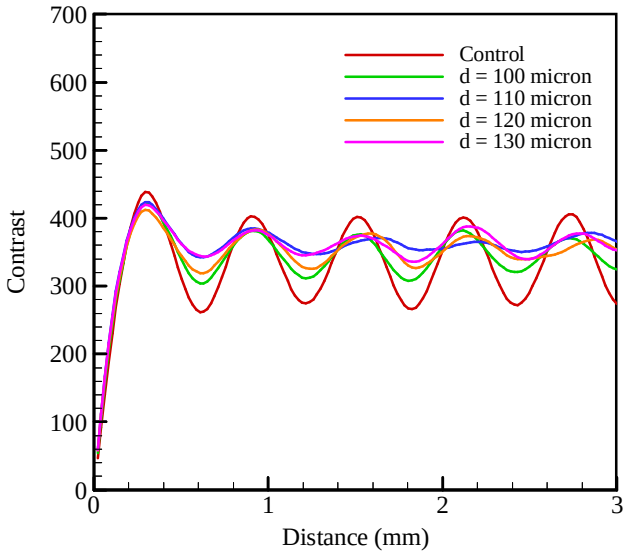

Fig. 2: Co-occurrence curves indicate that the sample-110 is the best choice for the 2nd row in current configuration.

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