Cartridge Filter Testing and Development

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Introduction

Polypropylene filters are manufactured using melt-blown technology. The polymer is melted and forced through an extruder onto a rotating collector which forms the cylindrical filter. Several variables are present in making these filters, such as polymer temperature, extruder speed, air pressure, etc. Due to the high number of variables, designing the optimum filter can be a challenge.

Objectives

- Determine the optimal conditions for manufacturing the melt blown filters.
- Test filters for rigidity, flow rate, and differential pressure.

Methods

The filters that were designed for testing were created using the melt-blowing machines at the sponsor’s manufacturing site. A filter test stand that was built by the previous year’s senior design team was used to test the flow rates and the differential pressures of the filters.

The rigidities of the filters were obtained by using the simple compression test in the Solid Mechanics Lab.

Results and Conclusion

The three parameters chosen for testing were air pressure, polymer temperature, and extruder speed. Air pressure and the extruder speed had the greatest impact on the rigidity of the filters, while polymer temperature and pressure had the greatest impact on the differential pressure across the filters. Changes in flow rate between filters was negligible. Filter #8 had the highest rigidity and was created using high temperature (440 °F), low pressure (25 psi), and high extruder speed (22 Hz).

Next Steps

Improvements can be made to the test stand by adding a particle counting apparatus, contamination streams, flow controls, and drain valves around the cartridge.

Along with the improvements to the test stand, more filters can be created using Filter #8’s parameters and subjected to more testing, such as particle counting, particle size distribution, and filter fiber diameter, in order to further understand how the rest of the production variables can affect the filters’ characteristics.