High-resolution imaging of depth filter structures using X-ray computed tomography

Thomas Johnson[1], Francesco Iacoviello[1], John Welsh[2], Paul Shearing[1], and Daniel Bracewell[1]

[1]University College London
[2]Pall Europe Ltd

January 12, 2021

Abstract

A multiple length scale approach to the imaging and measurement of depth filters using X-ray computed tomography is described. Three different filter grades of varying nominal retention ratings were visualized in 3D and compared quantitatively based on porosity, pore size and tortuosity. Positional based analysis within the filters revealed greater voidage and larger average pore sizes in the upstream quartile before reducing progressively through the filter from the center to the downstream quartile, with these results visually supported by voidage distance maps in each case. Flow simulation to display tortuous paths that flow may take through internal voidage were examined. Digital reconstructions were capable of identifying individual constituents of voidage, cellulose and perlite inside each depth filter grade, with elemental analysis on upstream and downstream surfaces confirming perlite presence. Achieving an appropriate pixel size was of particular importance when optimizing imaging conditions for all grades examined. A 3 µm pixel size was capable of representing internal macropores of each filter structure, however for the finest grade an improvement to a 1 µm pixel size was required in order to resolve micropores and small perlite shards. Enhancing pixel size resulted in average porosity measurements of 70% to 80% for all grades.

Hosted file

`TFJ Depth filter manuscript for submission 2021-01-07.pdf` available at https://authorea.com/users/389040/articles/503703-high-resolution-imaging-of-depth-filter-structures-using-x-ray-computed-tomography