S2.4.4 - *Determining Pore Size in Metal Additive Manufactured Filters*

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Porous metal filters can be employed as depth filters in many industries. The non-woven porous metal material can be manufactured by different processes. Some materials are manufactured from base metal and salt and have a narrow range of pore sizes. Sintered metal porous filters are formed from similar size metal spheres which are fused together to form a material with a regular pore size and porosity. Porous metal material formed by powder bed fusion Additive Manufacturing (AM) systems can achieve another level of complexity: that of variable porosity. We have investigated the viability of AM technology to produce depth filters that have different aperture sizes through increasing and decreasing porosity as a porous metal format. Selective Laser Melting AM machine settings were varied to produce a series of porous samples to determine the range of porosity producible for potential Stainless Steel 316L metal filters. Samples with different porosities were produced. However, defining the pore size and overall porosity of the filters is challenging. We are currently investigating different methods as a means to defining the pore size and range of these filters. A further challenge is to determine if the unfused

metal powder is retained within the AM porous filter after cleaning. Multiple laser settings, laser power, overlap, and duration, were used to increase the porosity of SS316L to create porous filters. Test samples produced had different porosities. The pore size was examined using light microscopy which visualized pores on the external surface of the filter and when embedded in resin and cut and polished the pore size within the filter. X-Ray CT was used to determine the pore size and porosity of the whole filter in 3D. Whiles pores and material were visualized in the x, y, and z planes the resolution of the scanning system determined the range of pore sizes detected. The filtration level was determined by two processes. The pore size range was successfully determined using a mercury testing method with a nominal aperture size of 10μm. Particle challenge testing of three filter samples demonstrated clear filtration level differences between AM porous filters made using different AM parameters with two filter types having a filtration level of<10μm and one filter having a filtration level of >10μm. SLM AM successfully manufactured metal porous depth filters.

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Neil Burns a Director of Croft Filters Limited, Warrington, United Kingdom and has more than 34 years' experience developing and delivering high-quality filtration solutions to a range of industries in the UK and worldwide. His engineering experience began with wire mesh fabrication, then mesh suppliers to custom filter manufacturing. Neil's role as Director is very diverse and covers all aspects of financial, product development, growth strategy, staff skills and recruitment and marketing. Neil and fellow Directors recognized the potential of additive manufacturing, for the design and manufacture of complex geometries to create novel filtration media that add value as a filtration solution. He aims to introduce advances in processes employed in filter manufacture as well as creating improved filtration solutions of high quality. Neil gained his MBA from the University of Liverpool in 2012 and MSc by Research at Lancaster University in 2019. Neil is the Past-Chairman of the Filtration Society, UK, and is a Committee Member of ASTM Standards Board (USA) and a

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