S3.4.3 MAXIMUM PENETRATING PARTICLE - LOOKING FOR THE NEEDLE IN A HAY STACK

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Bubble Point testing has traditionally been used to search for the largest opening in a filter medium. However, the conversion of the appearance of the first bubble into a pore size has given variable results. In addition, the analysis of a relatively small sample compared to the hundreds of square feet on a filter roll is subject to large measurement uncertainties because the sample taken is unlikely to be representative. This is especially true for non-woven media. Finding the largest pore size, which is responsible for the Maximum Penetrating Particle (MPP), is therefore like looking for the proverbial Needle in a Haystack.

The next uncertainty relates to matching the pore shape with the particle shape. An irregular particle has to be perfectly aligned to an irregular pore in order for it to pass. To overcome orientation difficulties, recent mathematical modelling programs have developed the concept of Geometric Pore Size, which is the largest sphere that will just pass an aperture.

Whitehouse Scientific have been using glass microspheres for many years for Challenge Testing filter media, both in the dry state and as aqueous suspensions. The derived Cut Point has been set as the 97th percentile of the calibrating microspheres passing the filter, and is defined as the pore size that will remove 97% of the challenging microspheres. The Cut Point is the size that will clarify an aqueous suspension or dust cloud. There is obviously a further 3% which may or may not contain the largest penetrating particle.

Glass beads are produced by a melt process, which invariably contains some non-spherical particles. These must be removed either physically prior to the test or electronically after the test, otherwise erroneous results will ensue. It was found that failure to use spherical particles in the analysis of wire woven meshes produced measurement uncertainties for the MPP in excess of 20% making filter comparisons impossible.

Using the shape analysis feature on the Whitehouse PoreSizer enabled non-spherical particles to be electronically removed, which resulted in significantly reduced uncertainties; in the case of the Cut Point (d97%), to less than 2%. For open square meshes, where pores can be directly measured, the d97 repeatability was less than 1% for apertures as low as 15 microns.

A further enhancement to the Challenge Test method was to place wire meshes as close as possible in size to the MPP size under the filter in order to concentrate the maximum sized particles. The probability of finding the 'Needle in a Haystack' was then considerably improved.

Whether the MPP measurement is sufficient to discriminate between different meshes remains a matter of conjecture.