Synthetic media
Investigating the electrostatic effect

Leadership in Filtration

MANN+HUMMEL

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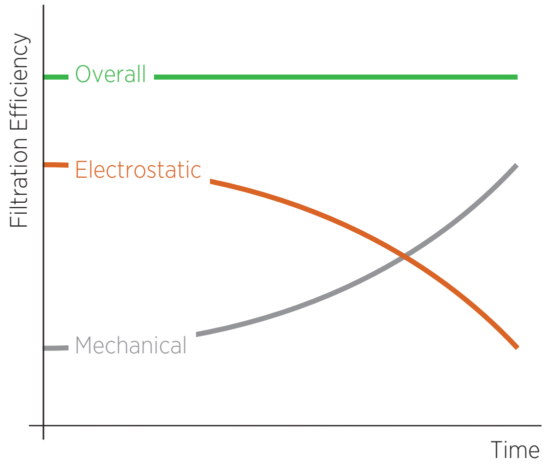
As the largest component of an air filter, media design contributes greatly to overall performance. Glass fiber has traditionally been the most common media material, but its synthetic alternative boasts many advantages including a cleaner production process and greater potential for future development, to name but two. Here, we examine one of the main features of synthetic media — electrostatic charge.

ELECTROSTATIC CHARGE

The electrostatic charge of synthetic filters, whether inherent or added during production, holds two major advantages to the end-user. Firstly, the attraction effect that draws particulate towards the media fibers provides an improved initial filtration efficiency over uncharged media. Subsequently and secondly, this higher efficiency allows a media design that provides significantly reduced pressure drop characteristics.



Filters manufactured from synthetic fibers utilise mechanical filtration in the same way as other media materials, but with one very beneficial addition - an electrostatic charge. This provides an additional filtration mechanism that is over and above the other techniques. It is this combination of electrostatic and mechanical filtration principles that results in a high efficiency combined with a low pressure drop.

In the initial stages of its service life, a synthetic filter predominately attracts dust particulate by an electrostatic charge that is supplemented by a lower level of mechanical separation. As the filter's fibers become coated in dust particles, the electrostatic charge, although still present in the fiber, is shielded by the captured dust particles and becomes less effective. This reduction, however, is counteracted by the increase in mechanical filtration efficiency that the growing dust cake provides. So whilst electrostatic filtration falls, mechanical separation increases and nullifies the loss.

MECHANICAL FILTRATION

Straining – the particle is larger than the space between two fibers, and so cannot follow the airstream through and is captured.

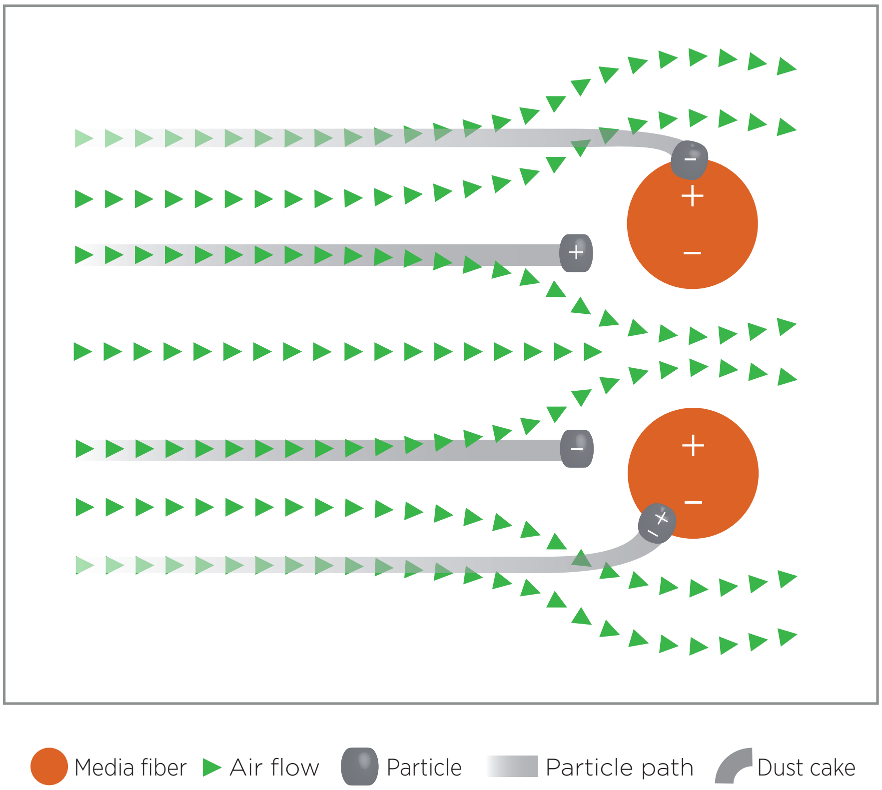
Inertia – inertia of the particulate causes it to separate from the airstream and collide with the fiber to which it becomes attached.

Diffusion – occurs with very small particles which follow irregular patterns. This irregular pattern increases the chance of capture through contact with the fibers.

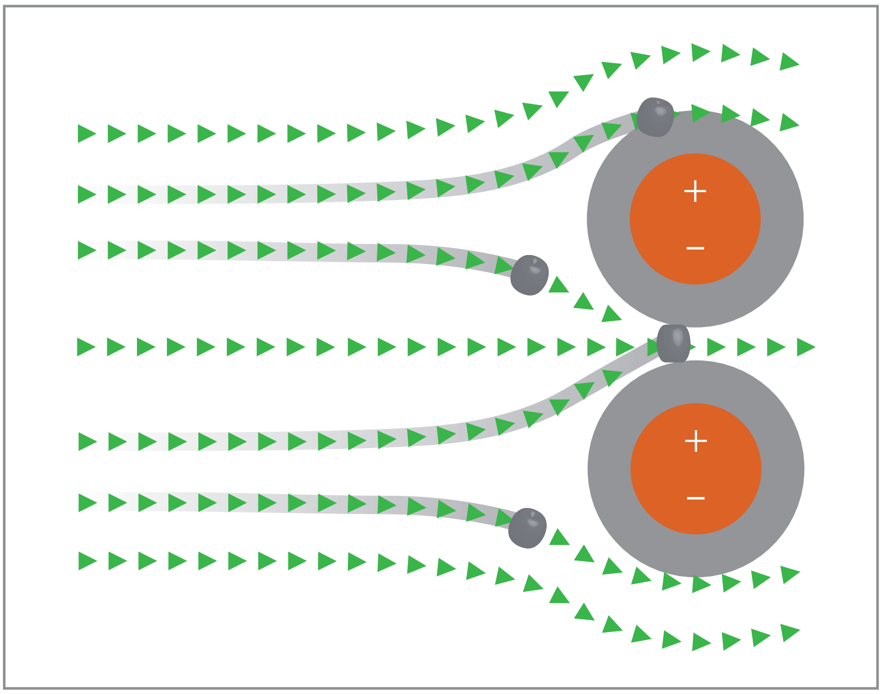
Stages of filter life

Different mechanisms at different times

In the initial stages of service, filtration is primarily by means of electrostatic charge, with particulate attracted away from the air flow towards the media fiber.



As the dust builds around the media fiber the electrostatic charge is masked, but, as mechanical filtration (in this case straining) is increased, there is no significant loss in overall efficiency.



Choosing an air filter
Configuring your system

PRE-FILTRATION & EFFICIENCY RECOVERY

With advanced filters, such as Revo II, the use of a pre-filter will actually slow down the build-up of dust on the media and inhibit the recovery in filtration efficiency. It is because of this that Revo II has a layered media with its own integral pre-filter, so a separate stage is neither needed nor recommended. Whilst the exact rate of return to the initial efficiency level is dependent upon environmental factors, the filter will continue to meet the required parameters of EN 779 at all times, but simply do so with improved pressure drop characteristics.

EN 779:2012 provides the following insight into the performance of electrostatically-charged filters:

> "Many types of air filter rely on the effects of passive static electric charges on the fibers to achieve high efficiencies, particularly in the initial stages of their working life. Environmental factors encountered in service may affect the action of these electric charges so that the initial efficiency may drop substantially after an initial period of service. In many cases this is offset or countered by an increase in efficiency ("mechanical efficiency") as dust deposits build up to form a dust cake. In the later stages of operating life the efficiency may increase to equal or exceed the initial efficiency".

'DISCHARGED' TEST EFFICIENCY

The latest EN 779 standard prescribes a minimum efficiency for grade F7, F8 and F9 once the electrostatic charge has been "discharged".

To neutralise the electrostatic charge, filters are immersed in isopropanol and left to dry before testing. This need to immerse in an aggressive alcohol-based solution underlines the resilience of the electrostatic charge – it does not dissipate after a week, a month or even after a year.

The electrostatic effect was discovered by a Japanese researcher in 1920 and there is samples of synthetic media manufactured at this time that has still retained its charge today.

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