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Future Trends in Filter Media Development

Trevor Sparks

25/08/2011

filter-ability™



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└ Introduction

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Future Trends in Filter Media Development

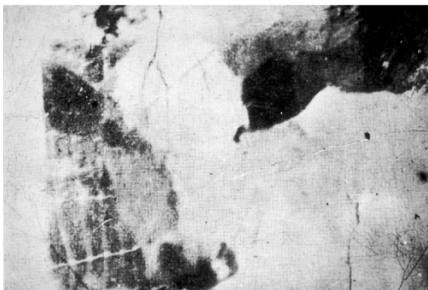
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25/08/2011

filter-ability

Thank you for the opportunity to give this presentation. The aim is to give a perspective on the current state of the filter media market (mostly solid-liquid) and to look for possible future trends.

What do you see in this photograph?



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└ Introduction

└ What do you see in this photograph?

What do you see in this photograph?



It is very tough, but the point is that, once you know, you will not be able to not see it ever again.

Hopefully, there will be at least one or two other things that you will not be able to not see again.

Outline

- Background → What is driving development?
- Developments
- The market, function, size, location.



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└ Introduction

Outline

- Background → What is driving development?
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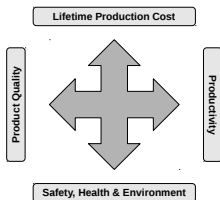
This talk looks at the background to the filter media industry. What drives development, what some of these developments are and also gives an idea of the scale and location of this industry.

We will also look at how the industry functions.

Framing the success of a production process/ company

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└ Background

└ Framing the success of a production process/ company

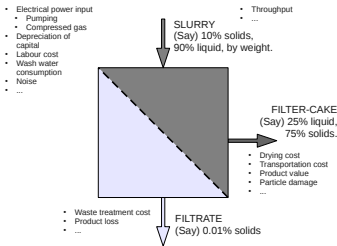
Framing the success of a production process/
company



No matter what you produce, if you are ahead in all of the above four dimensions of success, you are the market leader.

One may come at the expense of the other (you may aim for a higher quality market, but can hardly expect your costs to reduce at the same time).

Filtration outcomes...



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Filtration outcomes...

Filtration outcomes...



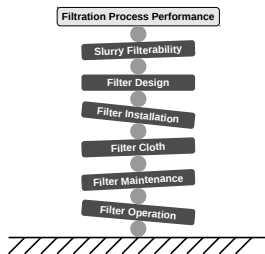
There are a number of outcomes from a filtration process, and these can impact (either directly or indirectly) upon the four dimensions of success. For example, a cake moisture of 20% w/w versus 18% w/w:

- Effect on drying costs
- Effect on dryer throughput
- Effect on transportation – safety, dusting, number of trucks needed ...

This is a very useful exercise – relating the outcome of your filtration process to the overall success of your process and performing a sensitivity analysis.

We know, pretty well, what determines performance

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└ We know, pretty well, what determines performance

We know, pretty well, what determines performance



You can do something about each of these layers, although the time and effort needed may vary. For example:

- Changing an Operational parameter can be done immediately
- Changing a filter Cloth might take a few weeks – contacting vendors, small scale trial then plant trial
- Changing a filter Design might take a week or so (adding a baffle plate) or a couple of years (a new filter)

But each layer can veto this performance

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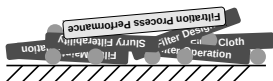
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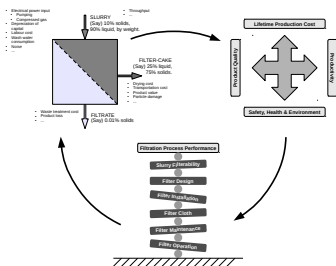
└ But each layer can veto this performance

But each layer can veto this performance



No matter how good every other success-factor, if one is out of whack then the whole thing tumbles over. This is where knowledge of the overall filtration process comes in – understanding all of the success factors, dealing with excursions.

So, in summary . . .



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So, in summary . . .

So, in summary . . .



- The success of a production organisation can be framed in terms of:
 - Productivity
 - Quality
 - SHE
 - Productivity
- Which in turn can be influenced heavily by the outcome of step processes along the way – and, of particular interest here, filtration processes.
- The success of which are pretty-much dependent upon 6 factors.

Drivers



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└ Background

└ Drivers

Drivers



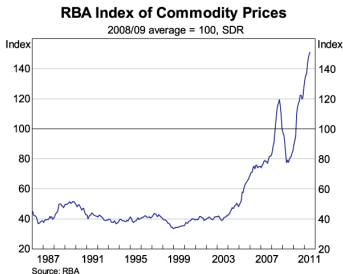
The earliest large-scale filtration was driven by urbanisation in the Industrial Revolution, with the resulting huge increases in population density and the need for clean water and sanitation – the local stream or river was no longer good enough.

Today, urbanisation is taking place on an unprecedented scale.

Further background – Commodities

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└ Further background – Commodities

Further background – Commodities



Three scenarios:

- A Commodities continue their rise – all bets are off.
- B A levelling-off and soft-landing – don't happen very often.
- C Correction (Anyone else remember how grim 1996/96 was?) – in which case competition will become very much tighter.

The price of commodities, and in particular oil, is having a major impact on the manufacturing cost of filter media.

Drivers

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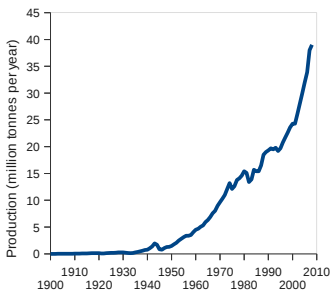
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Drivers



The production of aluminium has trebled in my lifetime, and this is quite typical.

Industrial development – Wheal Martyn museum

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└ Background

└ Industrial development – Wheal Martyn museum

Industrial development – Wheal Martyn museum



This image, from around 100 years ago, shows clearly how much, and, at the same time, how little things have moved-on.

While there have been significant improvements in personal protective equipment (PPE), this filter has the same basic construction and operating principle as the vast majority of large-scale pressure filters supplied today.

There have, however, been many developments in materials technology (the plates in this image are probably made from wood), design & manufacturing methods, automation/ control and, crucially, cloth technology.

Challenges and response

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Push

- Globalisation
 - More competition – Cost, Quality, SHE, Productivity
 - More customers
- We have eaten many of the low-hanging fruit
 - Finer particles – e.g. concentrate grinding
 - Higher temperatures
 - New solvents
- Environmental regulations – especially air quality/ water quality ...

Filter media response

- Manufacturing technology
 - Materials
 - Finishing methods
 - Business methods
- Technical developments
 - Active depth media (de-colourising)
 - High temperature ceramic filter media (gas)
 - Membranes
 - Multi-layer/ coated media
 - Very fine nano-scale spun materials



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- └ Challenges
- └ Challenges and response

Challenges and response

Push <ul style="list-style-type: none">● Globalisation<ul style="list-style-type: none">● More competition – Cost, Quality, SHE, Productivity● More customers● We have eaten many of the low-hanging fruit<ul style="list-style-type: none">● Finer particles – e.g. concentrate grinding● Higher temperatures● New solvents● Environmental regulations – especially air quality/ water quality ...	Filter media response <ul style="list-style-type: none">● Manufacturing technology<ul style="list-style-type: none">● Materials● Finishing methods● Business methods● Technical developments<ul style="list-style-type: none">● Active depth media (de-colourising)● High temperature ceramic filter media (gas)● Membranes● Multi-layer/ coated media● Very fine nano-scale spun materials
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The ever-increasing demands placed upon the process industries (Mining, Metallurgy, Chemical, Food and Pharma) from population growth, population density and tighter environmental standards make life more challenging.

You nearest business competitor may now be several thousand kilometres away.

A lot of the world's easily extracted minerals have already been exploited, new discoveries are more remote and hold onto their minerals more tightly.

The perfect filter media?

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Now. Some fool has invented an indestructible cloth. Where is he? How much does he want?

Sir John Kierlaw [a cloth factory owner]
in the film *The Man in the White Suit*(1951).

- Infinite life-time
- Absolute particle retention
- Low pressure drop (energy consumption)



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Filter media

The perfect filter media?

The perfect filter media?

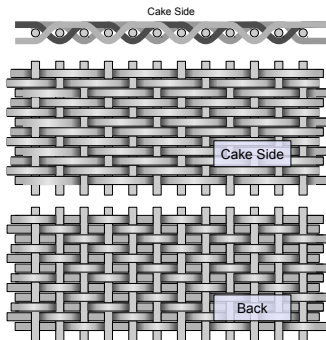
Now. Some fool has invented an indestructible cloth. Where is he? How much does he want?

Sir John Kierlaw [a cloth factory owner]
in the film *The Man in the White Suit*(1951).

- Infinite life-time
- Absolute particle retention
- Low pressure drop (energy consumption)

From the end-user perspective, the perfect filter medium would simply be installed and then left for ever.

Twill weave



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└ Filter media

└ Twill weave

Twill weave



The basic, functional twill weave (and other satin weaves) are common-place in liquid filtration, but their functionality can be enhanced with post-weaving treatment, for example stretching, heat-setting, calendaring ...

Multi-layer woven cloths

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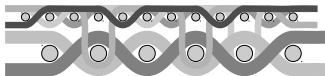
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└ Filter media

└ Multi-layer woven cloths

Multi-layer woven cloths



... where an application may require both strength and a fine filtration surface – cloth manufacturers have been able to engineer double, or even more, layer weaves.

This type of weave gives a functional layer supported by a mechanical layer – for example to act as a conveyor.

Plasma surface treatment

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Europlasma NV



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└ Filter media

└ Plasma surface treatment

Plasma surface treatment

Europlasma NV



Plasma, the fourth state of matter (solid → liquid → gas → plasma) can be used to modify the surface of filtration yarns.

In this roll-to-roll machine, the fabric can have its filtration properties modified (it can be made hydrophilic or phobic).

Given that filtration performance can depend heavily on particle-yarn interaction, this can make a huge difference to the filtration performance of the fabric.

Plasma surface treatment

Europlasma NV



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└ Filter media

└ Plasma surface treatment

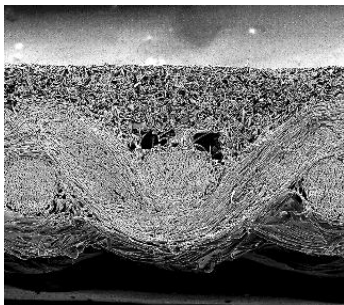
Plasma surface treatment
Europlasma NV



An illustration, from Europlasma BV of how the properties of a non-woven fabric can be modified

Coated filter medium

Courtesy ClearEdge



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└ Filter media

└ Coated filter medium

Coated filter medium
Courtesy ClearEdge



Surface coating can enhance particle retention and increase resistance to wearing.

Activated carbon woven media

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Chemviron – Zorflex [®]



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└ Filter media

└ Activated carbon woven media

Activated carbon woven media

Chemviron – Zorflex [®]



Capillary-action media

Outotec



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└ Filter media

└ Capillary-action media

Capillary action media

Slide



An honourable mention should go to capillary action filters, of the type shown in the illustration above. This unique medium (initially developed out of the Finnish paper industry) is hydrophobic and composed of micro-pores (1-3 microns). This medium allows water to flow freely, but prevents the flow of air.

This *can* lead to a reduction in vacuum pump size of >95%, although most of its application is in the mining industry, de-watering relatively coarse mineral concentrates.

Woven metallic media

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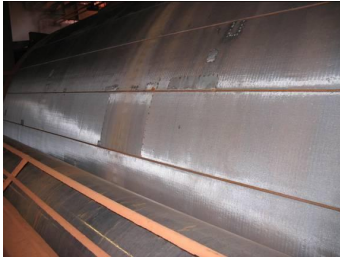
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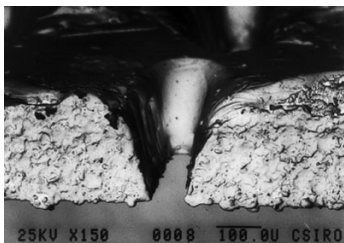
└ Woven metallic media

Woven metallic media



Laser perforated media

<http://www.actionlaser.com.au/>



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└ Filter media

└ Laser perforated media

Laser perforated media

<http://www.actionlaser.com.au/>



Metallic media, woven wire or perforated plate can be used in “static” filter cloth applications (pan filters, drum filters). Their use is becoming more widespread.

It may be that fine perforated sheets can be used as a belt-filter medium. While it is usually more expensive per unit area, in some applications, the lifetime could be much longer.

Paying 10 times more for a medium that lasts only 8 or 9 times as long may still be an extremely attractive alternative, eliminating much of the down-time and uncertainty.

Metallic media may also offer more choices when it comes to chemically cleaning.

Pin hole

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└ Pin hole

Pin hole



This pin-hole was too small to see on a dirty filter cloth, but turned a pilot-scale test filtrate from totally clear to so cloudy that it looked like slurry.

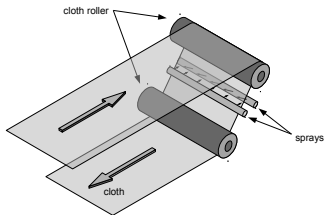
In this particular application, kaolin, it is common practise to turn-off the filtration step if there is a drop in feed solids.

An hour of lost production to recover a thickener is preferable to an 8 hour cloth swap.

Cloth cleaning systems

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└ Cloth cleaning systems

Cloth cleaning systems



Some filter types lend themselves to cloth cleaning. Continuous belt-filters, in particular, offer-up both sides of the filter cloth for cleaning. The cloth can be spray-washed on both sides of the cloth (and the wash liquid returned to the cake to close the solids loop). In extreme cases, the cloth can be passed through a series of baths for chemical and/or ultra-sonic cleaning.

It is not just the best filter medium – but the combination with the filter design (along with the other 4 success factors in the tower of filtration performance).

Cloth cleaning

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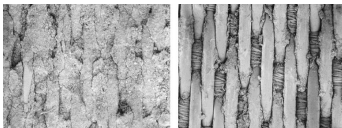
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Cloth cleaning

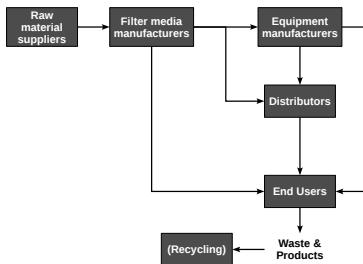


Media Supply Chain

(W Chen, Dow Chemical, R Wakeman)

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Media Supply Chain

(W Chen, Dow Chemical, R Wakeman)



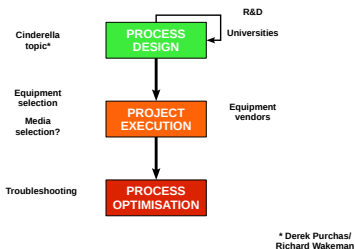
The relationship between end-users and filter media suppliers can be complicated and have equipment manufacturers and distributors in the chain.

A newcomer to this industry are players who actively recycle (or treat) used or contaminated filter media.

The life-stages of a production process

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The life-stages of a production process

The life-stages of a production process



It may take five to ten years for a product to begin production after the discovery of a resource, or the patenting of an active pharmaceutical ingredient.

Most of the processes in R&D do not become production processes.

The purchase of large-scale solid-liquid filtration equipment in pharma, mining & chemical processing is around €2 billion per year.

During this time, a large number of decisions need to be taken. If one of these decisions affects the production cost, quality etc. by fifty cents a tonne, then over 20 years

The days when large process industry players had specialised filtration and separation knowledge are disappearing.

Future developments

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Conclusions

- Fixable media – locally modified.
- Adaptable filter media – turn a dial to change filtration characteristics.
- Media with a *cleaning mode*
- Recycling industry.



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Future developments

Conclusions

- Fixable media – locally modified.
- Adaptable filter media – turn a dial to change filtration characteristics.
- Media with a *cleaning mode*
- Recycling industry.

Possible ideas for future development.

Conclusions

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Conclusions

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