Filter Blocking

Hall Pyke

The purpose of filtration is fundamentally the removal of particulate matter. As particulates are removed, they become deposited on or within the filter media. As the filtration proceeds, the filter becomes increasingly loaded with particulates and becomes increasingly blocked. Thus the effective filtration area is progressively decreased.

Flowrate 'F' is directly related to both differential pressure (Δp) and (EFA) effective filtration area. For a constant flowrate, differential pressure and effective filtration area bear an inverse relationship. It follows that in actual filtration, changing one of these parameters alters at least one of the others.

F	Δp	EFA
Constant	Increase	Decrease
Constant	Decrease	Increase
Increase	Constant	Increase
Decrease	Constant	Decrease
Increase	Increase	Constant
Decrease	Decrease	Constant

These relationships are proportionate. Changing one parameter by some percentage or other multiple will necessitate a change in a second parameter by the same percentage or multiple. This follows from the knowledge that flowrate per differential pressure per effective filtration area is a given value.

If the flow is to remain constant, and the differential pressure doubles, then the effective filtration area must be half its initial value because of filter blocking by the removed contaminants. Alternatively, if the differential pressure remains constant, and the effective filtration area doubles then the flowrate will double.

Using these proportions, increases in the differential pressure of an operating filtration system indicate not only that the filter is becoming blocked, but also how much of the filters is unblocked and still available.

Multiple of Initial Δp	% Blocked
1x (initial clean condition)	0%
2x	50%
4x	75%
8x	87.5%

This demonstrates that each time the differential pressure doubles the available filtration area is halved.

% EFA available = 100% divided by the multiple of clean Δp

% EA available = 100% divided by the multiple of clean Δp

When plotted graphically the second equation provides a curve whose slope is increasing at a steadily diminishing rate.

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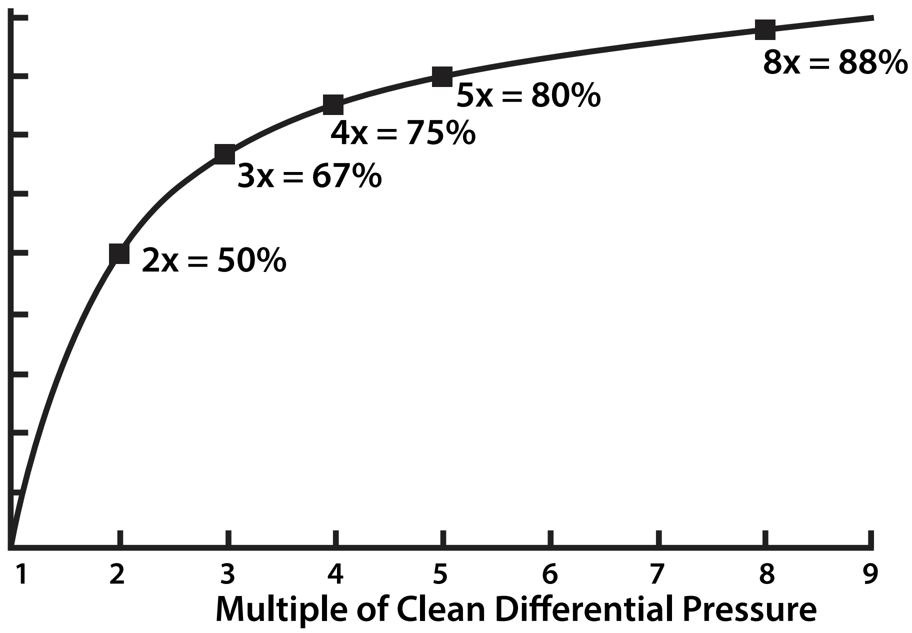
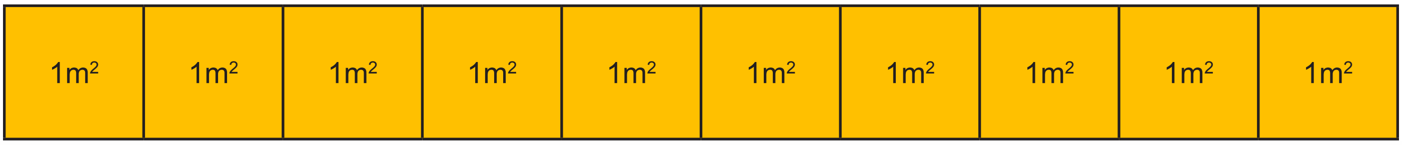
The curve illustrates the law of diminishing returns with optimum usage at 80 % filter blockage. It is for this reason that filters are usually replaced at this point where, at constant pressure, the flow has diminished to 20% of its original rate or where at constant flow the pressure has increased fivefold.

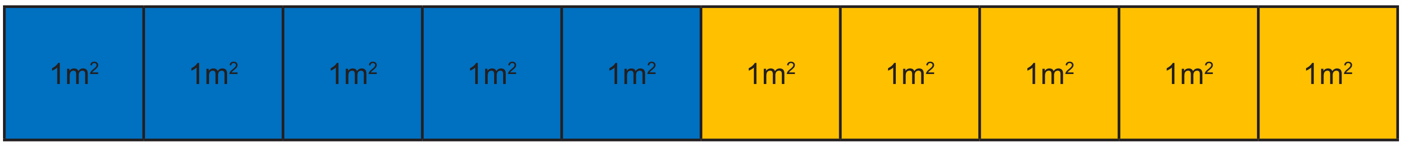
Diminishing Returns



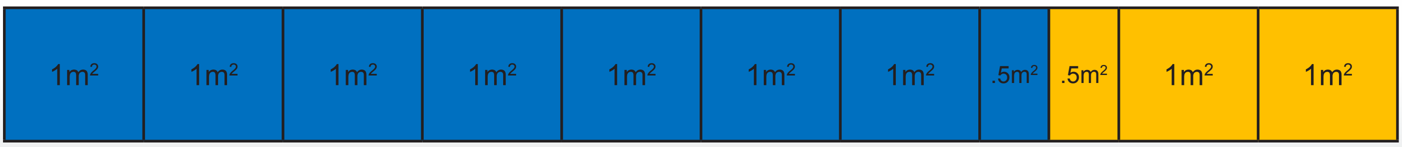
10 m² effective Surface Area filter with Initial 1 psi Δ Clean Pressure Drop



Doubling of the Δp to 2 psi means it is 50% blocked & 50 % of the area remains available



Doubling of the Δp to 4 psi means it is 75% blocked & 25% of the area remains available



Doubling of the Δp to 8 psi means it is 87.5% blocked & 12.5% of the area remains available