Filters for the separation of bulk freight in the On- or Off-line service

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The new environmental-awareness, the importance of controlling costs and increasing levels of automation have resulted in an increase in the use of filters. For example, filters are now used instead of cyclones. They are also being used where previously considered unnecessary in applications such as grain or building materials silos. As a consequence, increased demands are being placed on filter manufacturers and a filter must be carefully chosen.

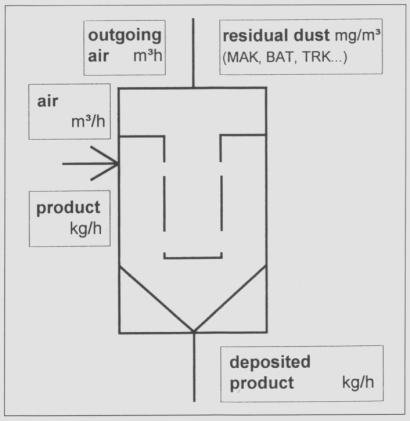

Figure 1 Filter function

In the past, it was commonplace for filter manufacturers to claim emission levels of over 75 mg/m³. Today however claims of <1mg/m³ are more likely. Advances in filters and electronic controls mean that even with very fine dusts, emission levels of <20 mg/m³ are possible.

Schedule1 shows fundamental differences between filters for Off-line service (mechanical cleaning) and filters for On-line service (with compressed air-cleaning).

Schedule 2 will help to decide if a central filter or single filter should be used.
The resultant filter function is shown in **figure 1.**

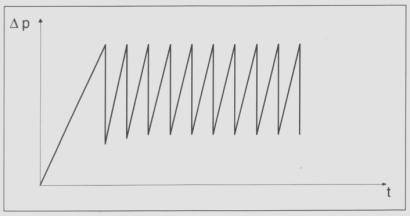

Figure 2 Air pressure controlled On-line cleaning

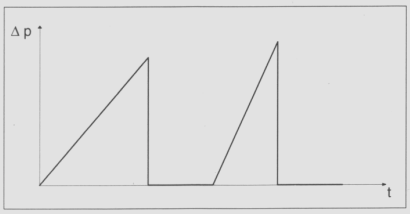

Figure 3 Time controlled Off-line cleaning

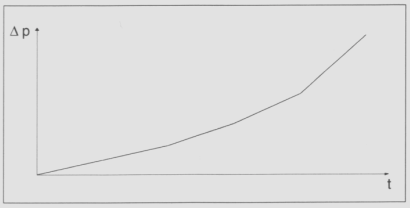

Figure 4 Pressure line without cleaning

Mechanical Filter	Reverse Jet Filter
Filter area depends on the duration of the operating cycle, the air to cloth ratio and the air volume	Filter area depends on the air to cloth ratio and the air volume (continuous operation)
Operation interrupted during cleaning	No interruption of operation during cleaning.
Mechanical cleaning not so thorough.	Maintenance of optimum level of filter cake possible.
Shaker mechanism with fan assistance necessary	Differential pressure control enables: * Minimal air consumption * Increased idle time Electronic control enables remote monitoring and fault diagnosis.
Larger filters	Smaller filters
Higher maintenance and service costs. (weekly checks)	Lower service and maintenance costs (annual checks)
Greater wear due to shaking action	Less wear
Requires more consideration of end surge	End surge more easily coped - with.

Schedule 1 Cleaning systems

Figure 5 Rest dust with On-line cleaning

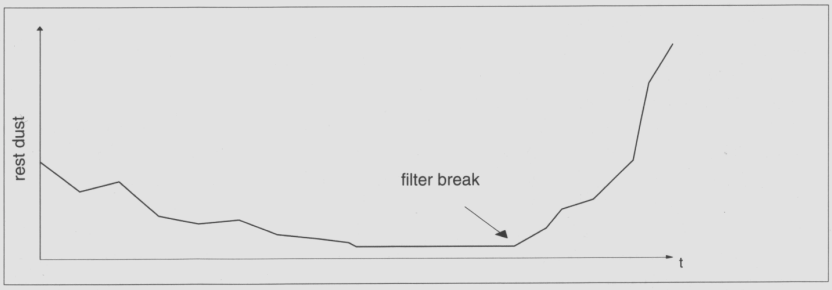

Figure 6 Rest dust in the Off-line service without cleaning

Central	Single
Investments	
devices of taking the products	-
pipe flap	-
adapter	-
filter unit	filter unit
slide flap	-
fan	fan
Process	
total air volume	single air volume (no loss)
low dust load	higher dust load
filter aid layer built up slowly	optimum air volume with filter aid layer
leakage	-
deposit in pipelines	-
source of glowing in adapters and pipelines	-
wear and tear of the pipelines	-
adjusting of the single places with pipe flap	-
one filter material for all bulk materials	filter material adjusted to the different bulk materials
disposal required	no disposal required; the product flows back into the production process
bulk materials are mixed because all are lead together	-
design pressure approx. 300 mmWS	design pressure approx. 150 mmWS
to take one filter out of order you have to use automatic control engineering	to take the single filter place out of order you only have to turn the switch on/off
all dedusting sources are affected in the case of an incident (induction sides, workplaces)	only the single place is affected in the case of an incident
Maintenance & Service	
the whole expenditure at one time	expenditure according to the use of the filter
all single places are affected at the same time	single filter places are more distributed; less loss
rest dust	rest dust
big quantities of air	small quantities of air
duty of supervision; frequent records needed	partly suvervision on your own possible; proof limit: occasional measuring
endurance after the weakest part	endurance adjusted to the used bulk material

Schedule 2 Dedusting

In most cases the product is conveyed by air and the filter is responsible for the separation function. The separated product flows into the production-process or into a residual dust control system. The exhaust air is often vented into the production area.The decision as to whether to use an On-line (continuous operation) or an Off-line filter (no cleaning or cleaning during pauses in production) is made at the time of filter selection. An On-line filter has the advantage of requiring less filter area and is therefore generally more compact in construction. In an On-line filter, cleaning is possible by compressed air only. In Off-line filters mechanical cleaning or no cleaning at all are possible. The differential pressure

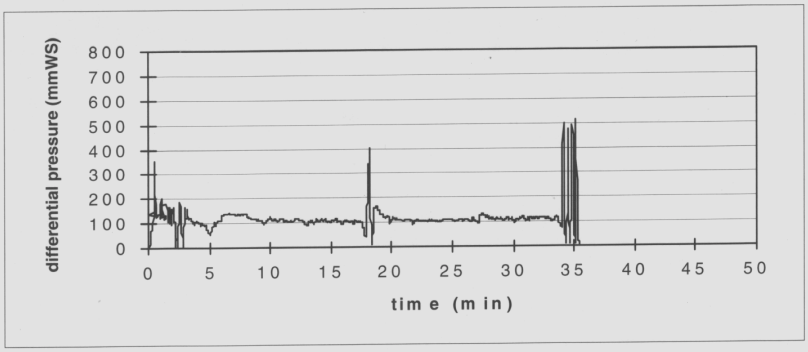

Figure 7 Silo filling with On-line cleaning

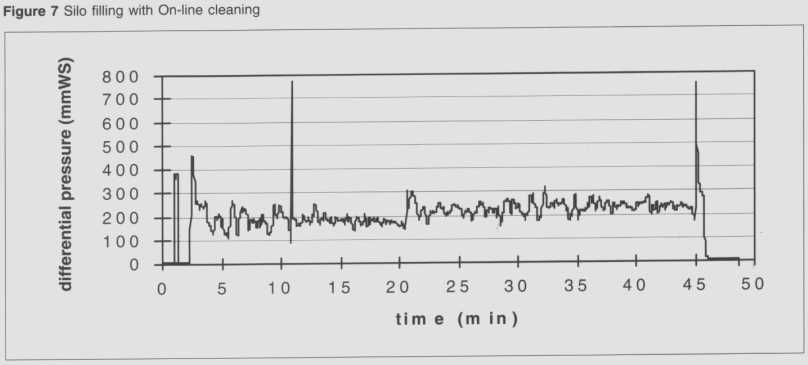

Figure 8 Silo filling with Off-line cleaning

(figure 2) stabilizes during the cleaning process. In an Off-line filter, the differential pressure is unstable. This means, that the differential pressure can rise up to a point at which separation of the air from the product is adversely affected (**figure 3)**

Figure 4 shows the build-up of the beneficial filter cake. In an On-line filter, the filter cake is built-up and maintained at an optimum level. In an Off-line filter, on the other hand, the cake builds up during operation but is then completely removed by the cleaning process. Therefore there is no possibility, of maintaining the optimum level of filter cake in a continuous process.

Figure 5 illustrates the amount of dust in the clean air discharge from the filter (leakage).

During the cleaning period of the On-line filter there is a slight increase in the amount of leakage. This quickly recedes again, however, once cleaning is completed.

In the Off-line filter, the amount of leakage is less predictable. As the filter cake builds up, the leakage reduces. Eventually, though, the filter cake build-up becomes excessive and causes the filter medium to burst **(figure 6)**.

Figure 7 shows the differential pressure across a silo filter during filling by a pressure vessel conveying system. The effect of the vessel end surge can be clearly seen. As this is an On-line filter, however, with cleaning by differential pressure control during operation, the end surge effect is manageable.

When using an Off-line filter for the same duty **(figure 8)** the pressure vessel end surges are more dramatic. In fact, the final end surge, which occurs when the filter cake is at its thickest, can cause the silo relief panel to open or even the filter to burst. Pressure relief valves or, in the case of combustible dusts, suppression systems may also be used but in any case the possibility of an incident is reduced by using the most appropriate filter.

Compared with tube or bag filters convoluted (star) filters have greater active filter areas. It is sometimes mistakenly thought that as the filter cake builds up, the active filter area is reduced to that of a similar tube filter. The active filter area, however, normally consists of a layer of beneficial filter cake less than 1 mm thick The filter cake which builds up on top of this, unless allowed to build up to an excessive level, is generally very porous so does not affect the active filter area. A differential presure control system dislodges the excessive filter cake during cleaning but allows the thin beneficial, layer to be maintained. Todays state-of-the-art filter then, is one which uses a differential pressure control system to control emissions and "star" type filter cartridges to ensure maximum active filter area in a compact construction.

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