Environmental friendly technologies
KEE/ENT

ESF II project of the University of West Bohemia in Pilsen

reg. č. CZ.02.2.69/0.0/0.0/18_056/0013239

Lecture 6

Filters

Ing. Milan Bělík, Ph.D.

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

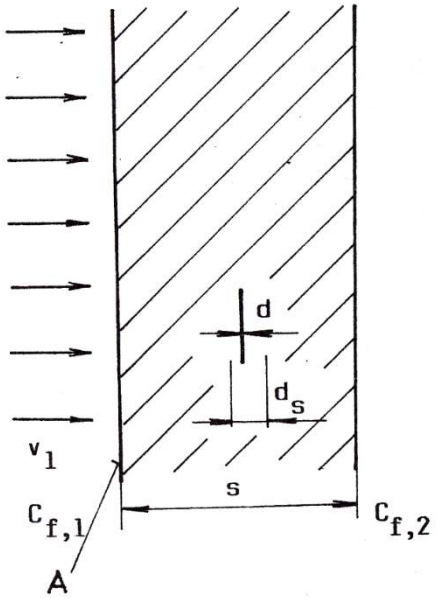
MINISTRY OF EDUCATION, YOUTH AND SPORTS

Filters

Filtration of atmospherical air

Industrial filtration

statics x kinetics of filtration



volume

$$dV_v = (1-\varepsilon)\,ds$$

poresity

Volume filling

$$c = 1-\varepsilon$$

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

Separation on clean layer

$$dV_v = (1-\varepsilon)\,ds$$

$$dl = \frac{4(1-\varepsilon)}{\pi d^2}\,ds$$

$$v_\varepsilon = \frac{v_1}{\varepsilon}$$

$$d\dot{V} = v_\varepsilon d\ dl$$

$$d\dot{N}_f = d\dot{V}\ C_{f,N}$$

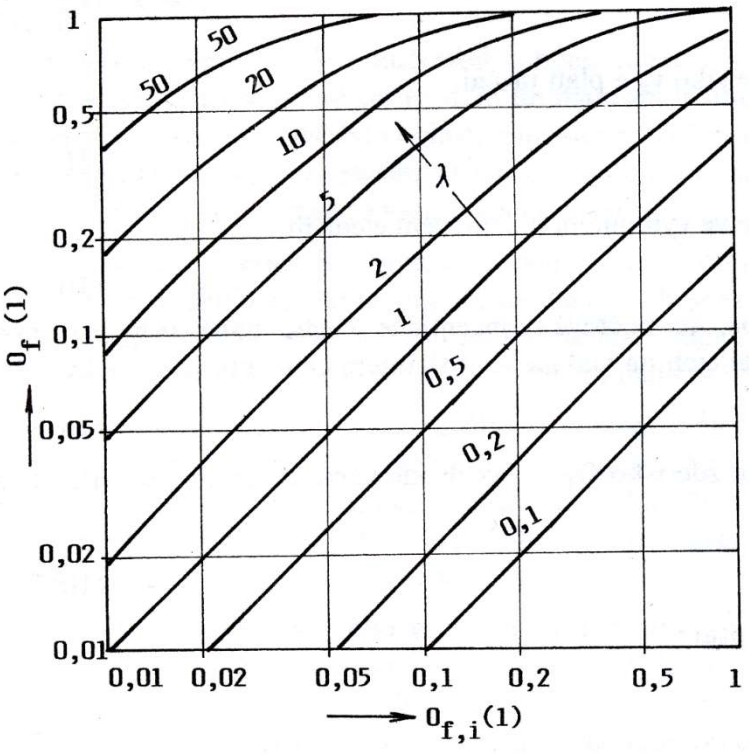
$$d\dot{N}_{f,z} = d\dot{N}_f\ O_{f,i}$$

$$d\dot{N}_{f,z} = \frac{4(1-\varepsilon)v_1}{\pi\varepsilon d}\,C_{f,N}\,O_{f,i}\,ds$$

$$\frac{dC_{f,N}}{C_{f,N}} = -O_{f,i}\,\frac{4(1-\varepsilon)}{\pi\varepsilon d}\,ds$$

$$O_f = 1-\exp\left[-O_{f,i}\,\frac{4(1-\varepsilon)}{\pi\varepsilon d}\,s\right]$$

$$\lambda = \frac{4(1-\varepsilon)s}{\pi\varepsilon d}$$



Pressure loses of clean layer

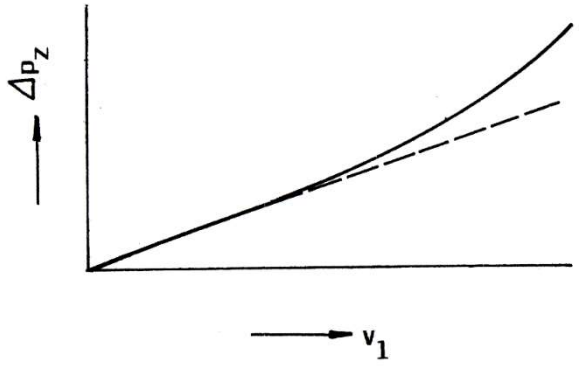
$$\Delta p_z = \frac{l\, F_\tau}{A}$$

$$F_\tau = \xi_d\, d\, \frac{v_\varepsilon^2}{2}\, \rho$$

$$\xi_d = \frac{\alpha}{\mathrm{Re}_d}$$

$$\mathrm{Re}_d = \frac{v_\varepsilon\, d\, \rho}{\eta}$$

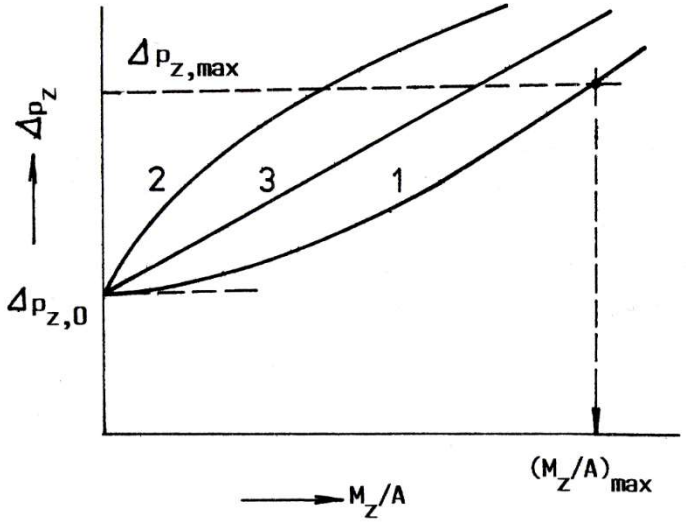
$$\Delta p_z = \frac{2(1-\varepsilon)\,\alpha}{\pi\,\varepsilon}\, \frac{v_1\, s\, \eta}{d^2}$$

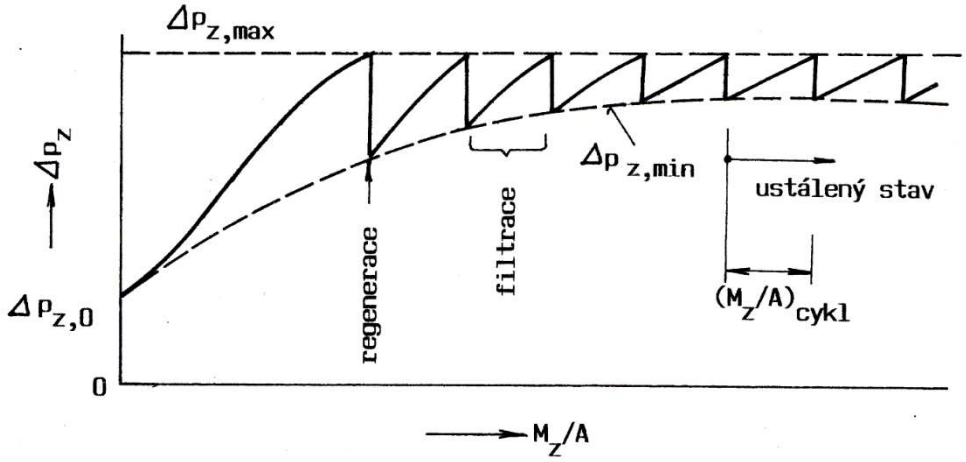


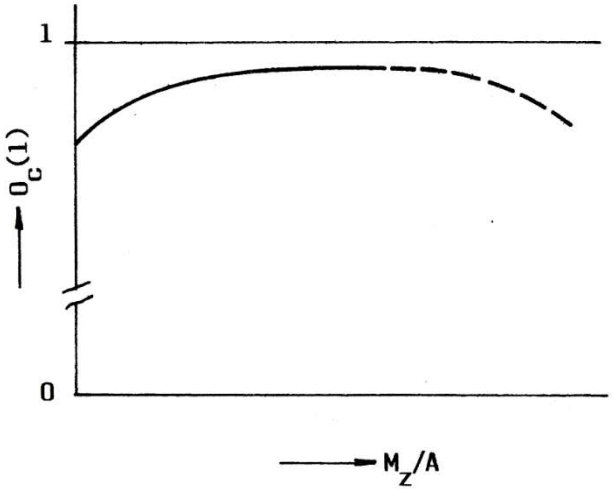
EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

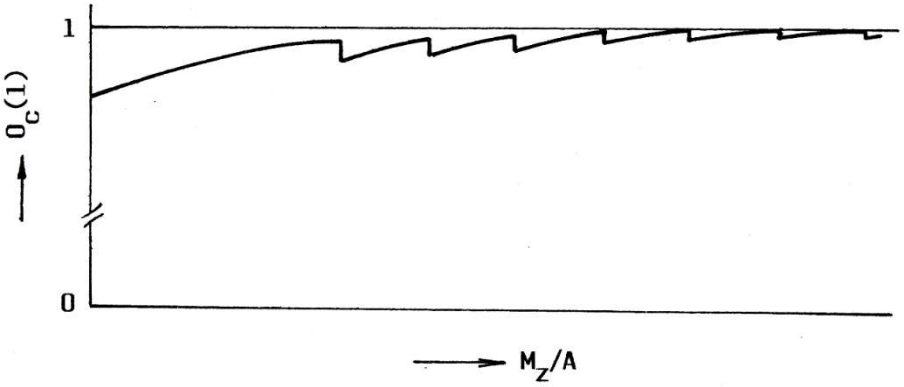
MINISTRY OF EDUCATION,
YOUTH AND SPORTS

Kinetics of filtration

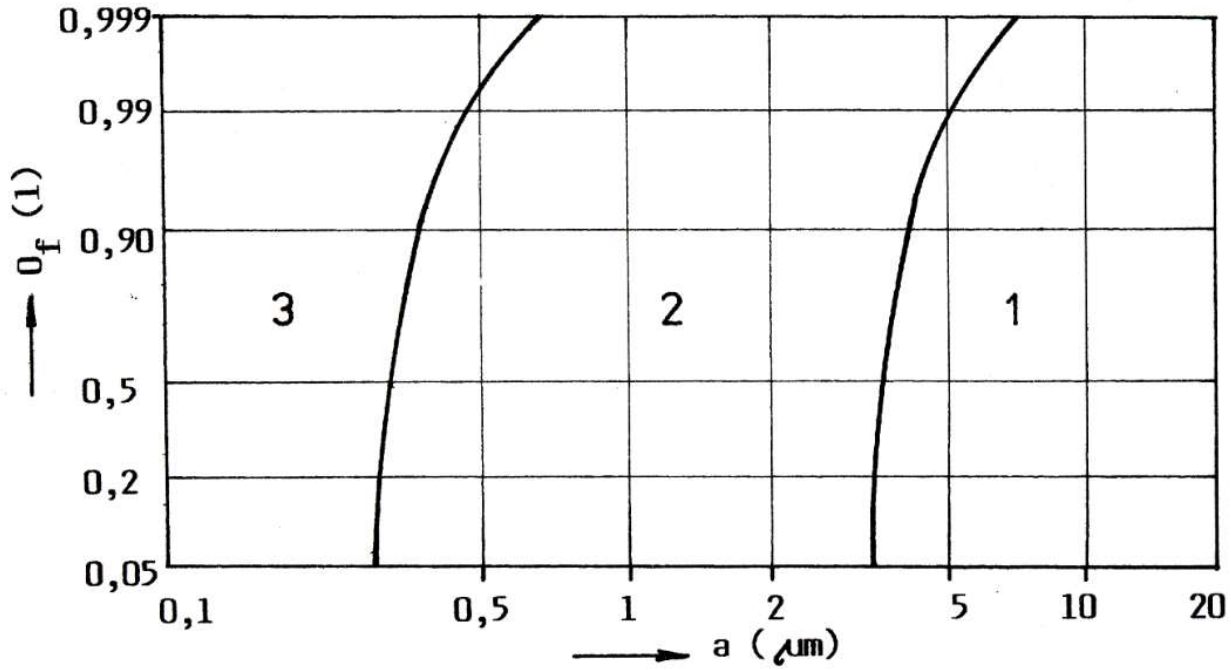








Materials for filters



Materials for filters

teplota (°C)	materiál	teplota (°C)	materiál
40 ÷ 50	PVC - polyvinylchlorid	~ 150	PES - polyester
75 ÷ 85	bavlna	200 ÷ 250	PTFE - polytetrafluorethylen
80 ÷ 90	vlna		(Teflon)
75 ÷ 85	PAD - polyamid	~ 230	aramid (Nomex)
~ 90	POP - polypropylen	250 ÷ 300	skleněná vlákna
~ 135	PAN - polyakrílonitril	> 300	kovová vlákna

odolnost proti	PES	POP	PAN
kyselinám	4 - 5	5	2 - 3
zásadám	2 - 3	5	2
hydrolýze	3	4	5
abrazi	5	5	4

Filters for atmospherical air

Inset

- -flat
- -fillers
- -pockets
- -layers
- -structural
- -dielectrical

Belt

- -runners
- -rollable

EUROVENT 4/5	CEN	Střední odlučivost na syntetický prach O_p (%)	Střední odlučivost na atmosférický prach O_a (%)
EU 1	G 1	$O_p < 65$	(0 ÷ 10)
EU 2	G 2	$65 \le O_p < 80$	(10 ÷ 20)
EU 3	G 3	$80 \le O_p < 90$	(20 ÷ 35)
EU 4	G 4	$90 \le O_p$	(35 ÷ 40)
EU 5	F 5	(92 ÷ 95)	$40 \le O_a < 60$
EU 6	F 6	(95 ÷ 98)	$60 \le O_a < 80$
EU 7	F 7	(98 ÷ 99,3)	$80 \le O_a < 90$
EU 8	F 8	(99,3 ÷ 99,5)	$90 \le O_a < 95$
EU 9	F 9	(> 99,5)	$95 \le O_a$

EUROVENT 4/4	Počáteční celková odlučivost O_c (%)
EU 10	$95 \le O_c < 99,9$
EU 11	$99,9 \le O_c < 99,97$
EU 12	$99,97 \le O_c < 99.99$
EU 13	$99,99 \le O_c < 99,999$
EU 14	$99,999 \le O_c$

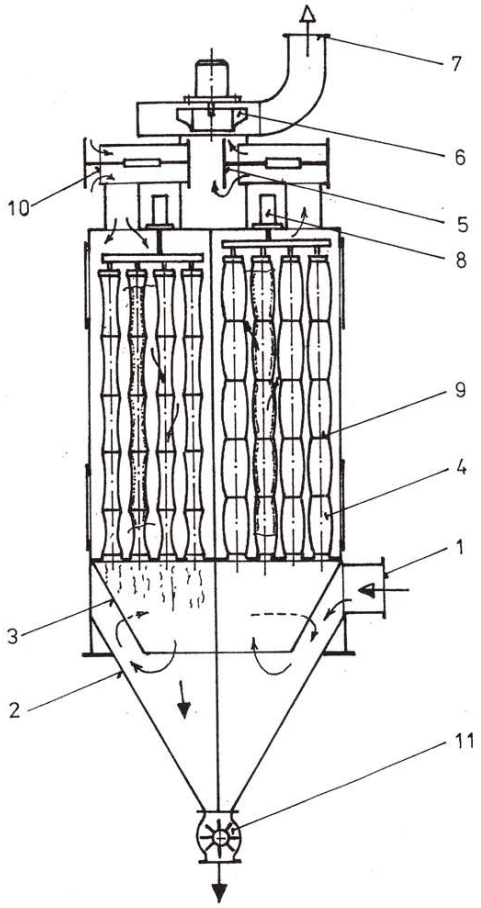
Industrial filtres

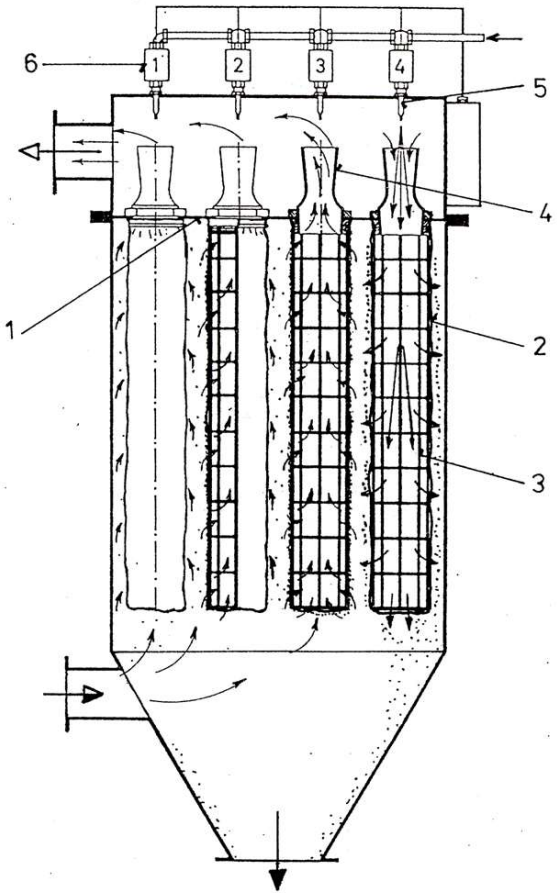
- tubes

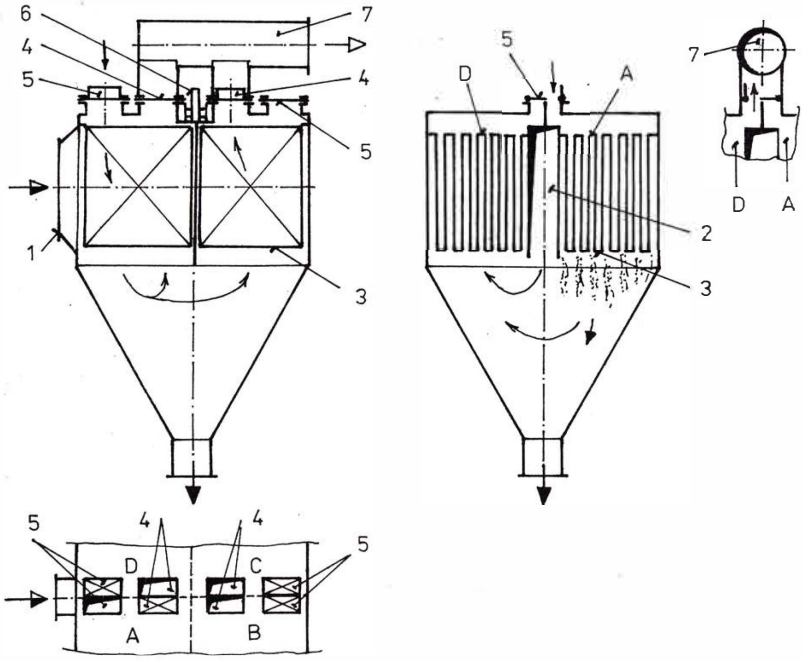
-pockets

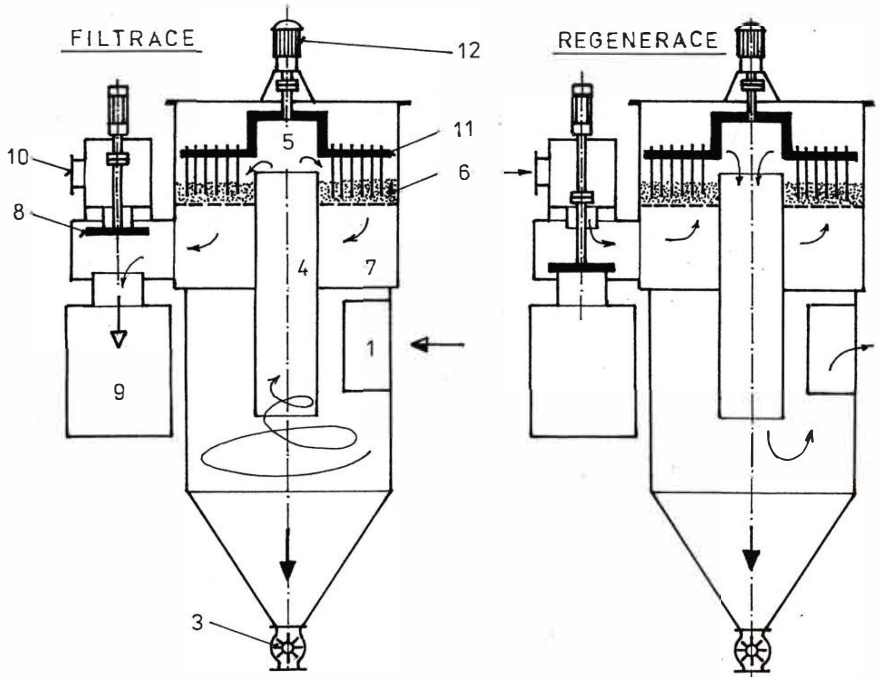
-Backwards regeneration

-Pulse regeneration









EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

Thank you for your attention...

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS