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

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

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

Questions and answers I.

Atmosphere
Separation of solid particles
Mechanical separators

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1. **What is the correct definition of atmospere?**

2. **What are the components of atmosphere and what is the function of atmosphere?**

3. **What are the components of atmosphere and what layers you know?**

4. **What is the troposhere and what features it has?**

5. **What are the solid harmful esences and what is their origin?**

6. **How does the amout of ash depend on technology of fossil fuels burning?**

7. **What are the emission limits for burning of particular fuels?**

8. **How you can choose the separator, what categories you know and what physical principles they use?**

9. **What mechanical separators you know, what principle they use and what features they have?**

10. **Explain the principle of settling chambre.**

1.
The basic definition says: Atmosphere = gaseous compound of Earth. This definition is not correct, because the atmosphere contains also liquid and solid parts.

2.
Components of atmosphere and gaseous (oxygen, nitrogen, vapours,...), liquid (rain drops), solid (ice, dust particles,…).

- Functions of atmosphere:
- meteorits burn or are being destroyed
- Contains oxygen breathing
- Reflects part of the solar radiation to the space Earth does not overheat
- Reflects heat back to the surface temperatures do not drop too much

3.
Defenition according to temperature

- troposphere → up to 11 km
- stratosphere → up to 55 km
- mezosphere → up to 85 km
- termosphere → up to 800 km
- exosphere → up to 70 000 km

4.
Troposphere is athosperical layer up to 11 km above surface.

- Almost all observable phenomenons (wind, rain, clouds)
- Temperaure decreases with altitude (o 0,6 °C na 100 m)
-]temperature at the edge: -60 °C
- Contains almost all mass of the componets:
    - 78 % nitrogen
    - 21 % oxygen
    - 1 % others,..

5.

The combustion of fuels and other industrial activities generates dust emissions, for which the name of solid pollutant (TZL) is often used. They are formed on a general level during processes such as crushing, grinding, blasting rocks, etc. Their separation from waste gases is necessary with a view to protecting the environment and human health.

When burning solid fuels, especially coal, the ashes contained in the coal are transformed into ash, which is carried out of the boiler with flue gases and is captured in separators, as well as is extracted from the bottom of the boiler. In the first case we are talking about ash, in the second - about

cinquefoil. When burning liquid fuels, TZL forms amorphous carbon (soot). Gaseous fuels, such as natural gas, do not form TZL under the correct combustion regime, unless these have already been contained in the gas itself from the production operations in which these gases are produced (e.g. in blast furnace or coke oven gas or in natural gas as a result of corrosion of pipelines).

6.

When burning coal, the proportion of ashes passing into the flue gases as fly ash depends primarily on the combustion technology, e.g.:

- powder boilers 80 – 90 %
- grate boilers 40 %
- cyclone 30 %
- circulating fluidized bed > 90 %

In powdered boilers, fly ash concentrations in the flue gas in front of the separators reach values of about 40 $^{g.m-3}$.

7.
Eemission limit values for the combustion of coal and liquid fuels

Fuel type	**Power limit [MW]**	***Emission limit*** **[mg.m $^{n-3}$]**
For existing resources		
Coal (6 % by$_2$)	> 0,2 – 5 MW TV[1)]	250
	> 5 – 50 MW TV	150
	> 50 MW TV	100
Liquid fuels (3% O_2)	> 0,2 – 50 TV	100
	> 50 TV	50
For new sources and existing sources after 2008		
Coal (6 % by$_2$)	> 0,2 – 5 MW TV	250
	> 5 – 50 MW TV	150
	> 50 MW TP[2)]	30
Liquid fuels (3% O_2)	> 0,2 – 50 TV	100
	> 50 TP	30

[1)] heat output

[2)] thermal input

8.

The choice of separator depends on:

- particle size;
- their distribution and shape;
- certain physical properties (e.g. resistivity);
- the value of the emission limit;

According to the 1st phase of separation, the separators are divided:

- mechanical;
- filters;
- electrostatic;

Each of these groups is characterized by one or two of the following separation principles:

- mechanical separators – mainly inertia, to a lesser extent gravity;
- filters – diffusion or inertia;
- electro-separators – electrostatic forces and gravity.

According to the 2nd phase of separation, the separators in each of the above groups are divided into:

- dry;
- Wet.

9.

Mechanical separtors are based on inertia and gravity. They are divided into dry and wet.

Dry separators include:

- settling chambers;
- blinds;
- vortex.

Among the wet separators:

- vortex wet;
- level;
- foam;
- Current.

Dry separators are characterized by:

- simple construction;
- low acquisition costs;
- low power consumption;
- low separability of submicronic particles.

Their use is most often limited to separation at high temperatures and as the first stage of separation (pre-separation).

Wet separators in comparison with dry ones have the following advantages:

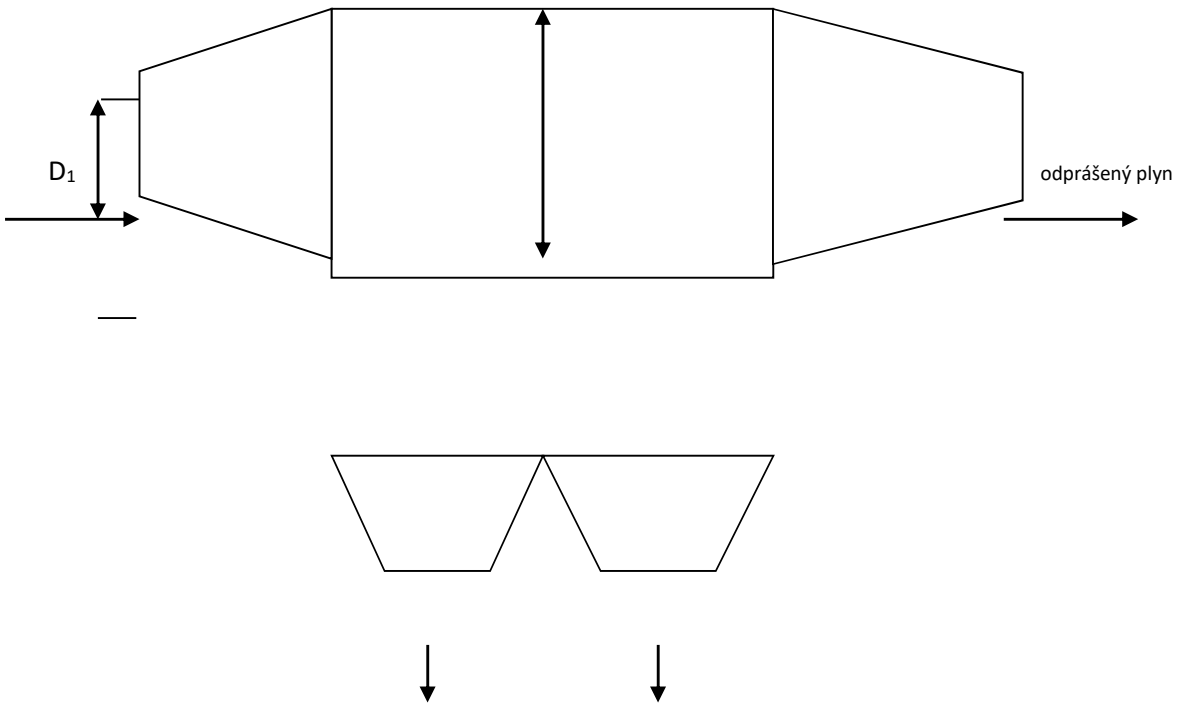
- higher separability due to the binding of dust to liquid on wetted walls;
- are suitable for abrasive and sticky dusts;
- the possibility of simultaneous separation of gaseous pollutants.

The disadvantages of wet separators are:

- high water consumption;
- the need to operate sludge management, more demanding maintenance and operation;
- higher corrosion rate.

10.

This is the gravitational principle of dust separation. Dust deposition occurs by reducing the gas velocity to the value of the particle stall velocity due to the extension of the diameter of the inlet pipe D_1 to the diameter D_2 in the settling chamber. The velocity of the gas in the chamber should be < 1 $^{m.s-1}$ (Fig. 1). Settling chambers were used for large particles (>10^2 μm) or as pre-separators. The flow through the chamber is horizontal, at the bottom of the chamber there are hoppers with caps. Dust deposited in the dumps is removed.



Kritická velikost odlučovaných částic a se vypočte podle vztahu:

$$a = \sqrt{\frac{18\eta h v}{l \varphi g}}$$

kde symboly znamenají:

α – velikost částic, h – výška komory; l – délka komory, η – dynamická viskosita; ϕ – měrná hmotnost prostředí; v – lineární rychlost plynu v komoře; g – tíhové zrychlení.