IS IMMISION A SERIOUS PROBLEM OR NOT?

Immision is the actual concentration of pollutants in the ambient air.

One of the problems of our civilisation is maintaining the purity of the air that surrounds us, since it has a significant influence on our health. However, the currently used air pollution measurement technique in the presence of wind is invalid. Frequent winds, mostly from the west, bring inside the EU transborder pollutants, which are often underestimated.

During a windy weather, many plants bestow us with air pollutants knowing that the currently used measurement techniques will not detect this.

General information about Immision, wind and rain

Let us consider a space between borders (walls) A,B,C,D, depicted in Fig. 1. Lateral borders are of no interest to us for the time being. In order to simplify the problem, it was assumed that through vertical border „A", clean air flows in with velocity V [m/s] and elementary air capacity Qp [m^3/s]. Pollutants flow in through horizontal border „B", with capacity Qz [g/s]. At border „C", concentration amounts to

k = Qz/Qp [g/m^3].

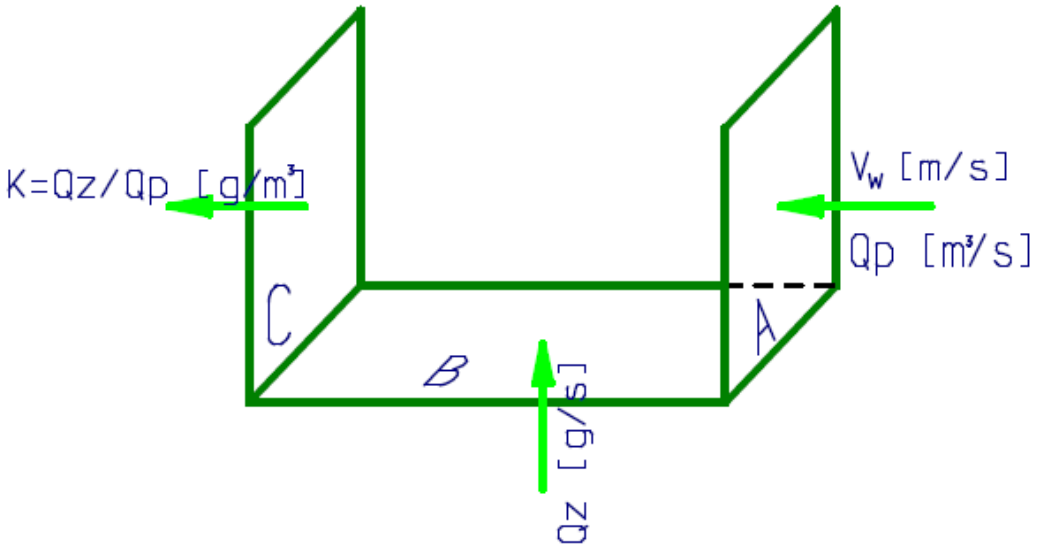

Fig. 1.

Let us note that everything that entered the area through border „B” must leave it through border „C”, regardless of the wind velocity. An increase in the wind velocity results in a decrease of concentration and a simultaneous increase in air flow velocity with the lower concentration. **Fall of pollutants from the air per a given area does not necessarily have to decrease with decreasing concentration when the wind gets stronger and stronger.**

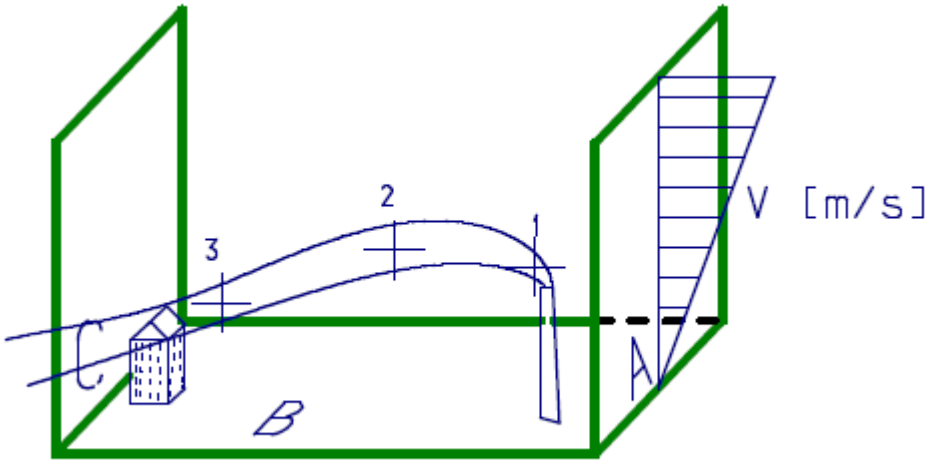

Fig 2.

If we place an emitter near border A, i.e. a chimney periodically emitting smoke (Fig. 2) and a housing estate near border C and the wind transfers the pollution from the emitter to the housing estate, then if the emitter is deactivated, the wind will remove the pollution from over the estate faster, but if the emitter starts working again, the wind will bring the pollution faster. **The wind does not purify the atmospheric air, it can only make the movement of polluted air more dynamic with changing pollution generation conditions.**

For a single emitter during the wind, a better pollution dissipation may occur as a result of a flow disturbance caused by obstacles. In case of large pollution-emitting areas, such disturbance does not have any effect.

Observing a stream of hot gas with pollutants rising from the emitter, we can say that **solid particles heavier than air will always fall in relation to the air due to gravity.**

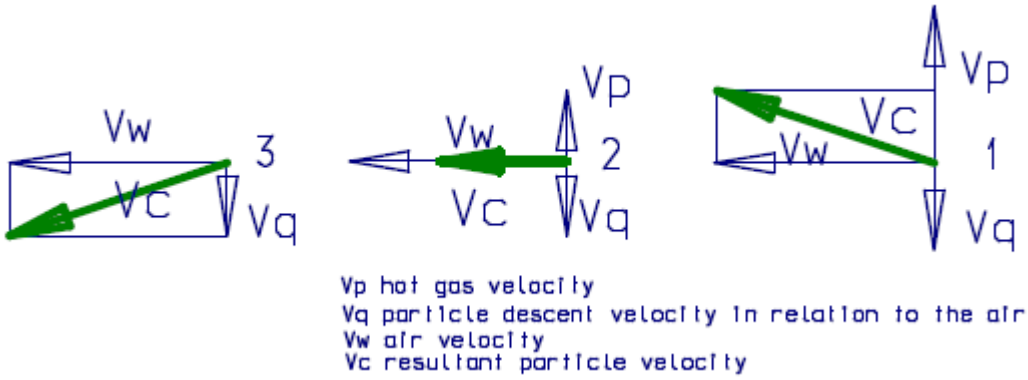

Fig. 3

The fact that they rise above the emitter is a result of the increased velocity of hot gas directed upwards rather than from the particle descend velocity. The 3 points marked in the stream coming out of the emitter have velocity distributions depicted in Fig. 3, according to which it is possible to determine the particle movement direction. In the model depicted in Fig. 4, we should consider the upper, horizontal border D, through which the rain may fall. The rain has the form of an atmospheric front moving from border A to C. Depending on the wind velocity profile, the rain front in the near-ground layer of the atmosphere may move faster or slower than the wind blowing in that layer.

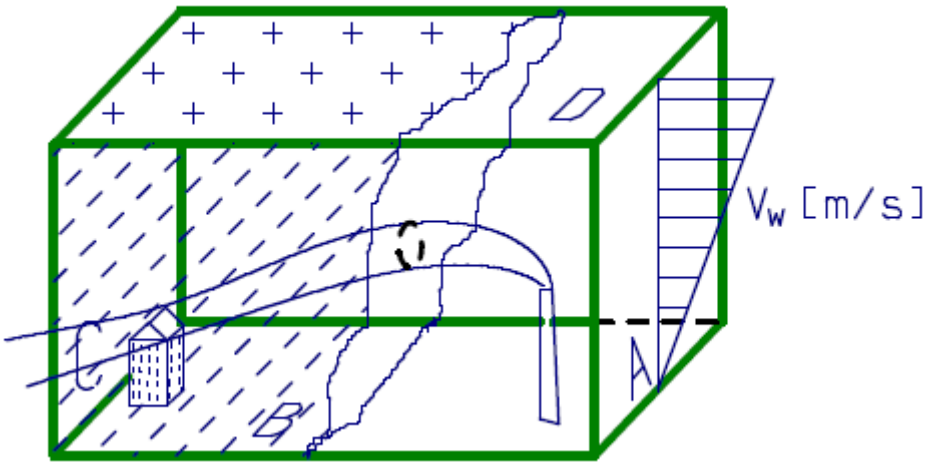

Fig 4.

When the rain front recedes faster than the air is blown in, then the air in this area is purified by the falling water drops.

It occurs with fast, cold and stormy atmospheric fronts.

When the rain front recedes slower than the wind is blowing, then the pollution concentration increases. It may occur with slowly-moving warm atmospheric fronts.

Therefore, we can conclude that rains do not always purify the air.

Examination of the Immision during the wind

Coming back to the stream coming out of the emitter (Fig. 2) in the point 3, let us analyse how air pollution can be measured.

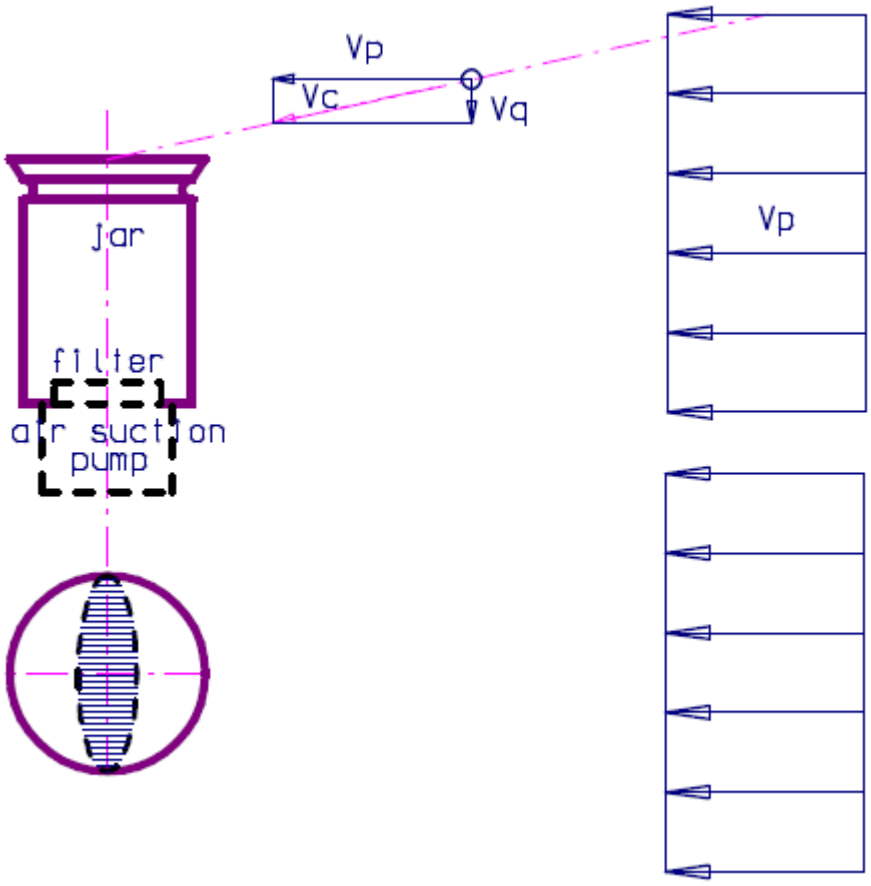

Fig. 5.

The simplest measuring device would be… a jar depicted in fig. 5, into which particles carried by the wind would fall. The jar perfectly measures the particles when there is no wind at all. When the wind blows, this solution has one serious disadvantage: the faster the wind blows, the flatter the trajectory of particles and the round opening in the jar, from the particle trajectory, becomes an ever-thinning ellipse whose longer axis is equal to the jar intake diameter.

The number of intercepted particles will be proportional to the ellipse cross-section and to some extent, inversely proportional to the wind velocity. Equipping the jar with, for instance, a filter at the bottom and an additional air suction pump will not do any good, as the main role is played by the decreased cross-section of the intake and air flow direction.

Observing the air monitoring stations placed in different locations in the EU , we notice the distinctive shapes of air intakes, protruding above station roofs. What do we see? We see instruments resembling jars, but equipped with covers… Even the most sophisticated cover will not make a jar a good pollution-measuring device when the wind is blowing. The situation is even worse: when the wind is not blowing, the cover causes particle interception errors, higher than in the case of jars not equipped with covers.

What is inside these splendid devices and what sophisticated equipment they contain is not important, since the error is at the air intake, i.e. input to the air monitoring system.

What does the correct Immision measurement during the wind consists in?

In order for the Immision measurement to be correct, we must:

1. Know the velocity and direction of wind
2. Set the air intake exactly against the wind.
3. Suck in the air with pollutants through the intake with velocity that is the same as the velocity of air outside the intake. This is called isokinetic suction.

This method of air suction is extremely important for the correct dust content measurement, because when the velocity at the intake is low, bigger particles fall into it more easily and smaller ones may pass the intake along with the air that was not sucked in correctly.

When the sucking velocity is high, then an excess of small particles enters the intake. These particles are sucked into the measuring device from the flow cross-section that

is larger than the intake cross-section, as a result of which, the measured concentration is higher than the actual one.

On the basis of the above guidelines, it is possible to build a device which will reliably measure Immision regardless of wind strength and the measurement will be free of “jar” errors, which, with 1 m/s wind, may amount to 50%. **This error results in a lower air pollutant concentration value and makes us feel good.**

The monitoring stations conduct air pollution measurements according to the European standard EN12341, which prefers “the jar technique”.
The following questions beg to be asked:
Do we have to use a poor standard without any limitations in the EU ?
Can’t we develop a new standard that would permit accurate and error-free Immision measurement?

PS. The problem of faulty measurement applies not only to airborne dust, but also to the content of chemical compounds in the atmosphere that are contained in the dust.