Who among us would not want to breathe clean air without giving up products that make our lives easier? At present, the media mainly report on the negative impact of CO_2 on the environment. It is the duty of the scientist to point out that the truth is somewhat more complex. The public's growing environmental awareness means that, among air pollutants, up to 60% are volatile organic compounds (VOCs), i.e. liquid substances that easily turn to gas. Among them are chemical compounds representing different groups of organic compounds, but the best known are: acetone, hexane, octane, ethyl acetate, terpenes, methanol, ethanol. Their sources of emissions are the various industries in which VOCs are used, e.g. pharmaceuticals, electronics, petrochemicals, chemicals. VOCs are also used in the production of printer inks, paper, plastics, leather or textile dyeing. VOCs are included in paints, varnishes, gypsum compounds, cleaners, plasters, air fresheners, toilet cubes and adhesives. Unfortunately, industrial processes are not the only sources of VOC emissions; combustion vehicles and agriculture must also be mentioned. Significant amounts of VOCs are also released from asphalt. People's everyday lives are also not insignificant. Smoking, cooking and cleaning surfaces are activities that are accompanied by the release of VOCs. Because of this widespread use of VOCs, the human body is exposed to them at home, in the car, at work or on a walk. Dizziness and headaches, irritation of the mucous membranes and respiratory tract, redness of the eyes and skin, nausea are typical symptoms of short-term exposure to most VOCs. Long-term exposure to significant concentrations of these substances results in foetal abnormalities, damage to the nervous and respiratory systems, internal organ dysfunctions and even cancer. Approximately 1 000 volatile organic compounds have been shown to be present in human breath in trace amounts. Some of these appear in all individuals, while some compounds only appear in smokers or lung cancer patients. Due to the harmfulness of VOCs, it is necessary to limit their concentrations in waste gases, outdoor and indoor air.

Engineers have developed several effective ways to remove VOCs from the air. One of these is the adsorption process, which is regarded in the industry as a highly effective way of purifying gases and liquids from organic substances and inorganic compound ions. Adsorption involves the accumulation of molecules of a substance (adsorbate) on the surface of a porous solid (adsorbent), resulting in a change in the concentration of the substance in the volume phase. A particularly widespread adsorbent is activated carbon, which is known not only in the engineering world, as it has found applications in cosmetology, medicine and water and air filters for domestic use. By means of chemical reactions between chemical compounds and the adsorbent, the properties of the adsorbent can be altered, which affects the capture of specific groups of compounds. The aim of this project is to determine the effect of modification of activated carbons on the selectivity of the adsorption of mixtures of volatile organic compounds from the gas phase and to characterise this process in detail. Activated carbon, after modification with malic acid, melamine and potassium hydroxide, will be directed to the adsorber. From below, a stream of air will be directed onto the bed along with the VOC vapours. Bearing in mind that VOCs do not occur individually in waste gases or air, systems will be developed to reflect real-world conditions. The systems will be composed in different configurations of, among others, the following adsorbates: hexane, heptane, 2-butanone, and 1-propanol. Downstream of the adsorbent bed, the concentration of the individual substances will be studied using a gas chromatograph, which will allow qualitative and quantitative analysis of the gas stream. This in turn will determine the bed breakthrough time, i.e. the time after which the outlet concentration of a given pollutant is more than 5% of the initial concentration. The gas stream will then be directed to a mineral adsorption bed and the effluent gas will again be subjected to chromatographic analysis. Thanks to the tests carried out, it will be possible to determine the selectivity of adsorption, adsorbate - adsorbent interactions, as well as to find a suitable way of modifying the adsorbents for the adsorption of specific VOC mixtures. Due to the combination of a carbon bed with a mineral bed, this type of solution has been called hybrid adsorption beds. A description of the mass movement in the adsorption beds, characterising the kinetics of the process, will be an important part of the research. To avoid generating waste, the activated carbon and mineral adsorbent will be regenerated with a heated inert gas after adsorption, allowing the adsorbent to be reused, its effective reuse performance to be determined and the adsorbed solvents to be recovered. The results of the study will complement existing knowledge and, in addition, will be useful for the planning of industrial adsorption processes, where selectivity towards specific VOCs, as well as process kinetics, will be crucial.