Flue gas contents

The components to be found in flue gases are shown below in the order of their usual concentrations.

Nitrogen (N2)

Nitrogen is a colourless, odourless and tasteless gas and it does not take a major part in the combustion process. It is the main component of air (79 %) and it reduces the efficiency of the burning process since it is heated and blown out of the stack without actual function for the process.

typical flue gas content: approx. 78 to 80%

Carbon dioxide (CO2)

Carbon dioxide is also a colourless and odourless gas that is to be found in human breath as well as in every common combustion process. The maximum allowed concentration of carbon dioxide in offices in Europe is 5000 ppm. A carbon dioxide level of 1000 ppm will reduce the ability to concentrate by about 30%. Concentrations above 15% (150000 ppm) cause immediate unconsciousness.

typical flue gas contents: gas burners / boilers 10 - 12%
oil burners / boilers 12 - 14%

Oxygen (O2)

Is, of course a very important part since otherwise combustion could not take place. The oxygen content of the air partly reacts with the hydrogen (H2) content of the fuel and forms water (H2O). This water content is, dependent on the flue gas temperature, condensed and collected in a water trap or it remains in the flue gas as water vapour. The rest of the consumed oxygen reacts with the carbon in the fuel to form carbon dioxide and, less desirably, carbon monoxide. These escape as heated gases through the flue pipe.

typical flue gas oxygen concentrations: gas burners / boilers 2- 3%
oil burners / boilers 2 - 6%

Carbon monoxide (CO)

A highly toxic gas which is very nasty because it is also colourless and odourless. The maximum permitted concentration in offices is 50 ppm.

typical flue gas contents: gas burners / boilers 70 - 110 ppm

oil burners / boilers 70 - 160 ppm

Nitrogen oxides (NOx)

Nitrogen oxides occur in all combustion processes where fossil fuels are burned, partly through oxidation of the nitrogen content of the air, as well as the organic nitrogen content of the fuel. (The whole process needs high temperatures, therefore one possibility to reduce NOx contents is to try to keep furnace temperatures and temperatures at metallic surfaces inside the combustion chamber as low as possible.)

The nitric oxide formed oxidises with time and forms nitrogen dioxide (NO2).

Nitrogen dioxide is a brown, toxic, water-soluble gas that can seriously damage the lungs if inhaled, as well as contributing to acid rain. In connection with the UV-rays in sunlight it helps to form ozone.

typical flue gas contents: gas burners / boilers 50 - 70 ppm
oil burners / boilers 50 - 110 ppm

Sulphur dioxide (SO2)

The SO2 content is pretty much dependent on the type and quality of the fuel being used. It is again a toxic gas which contributes to the formation of acid rain. The maximum allowable concentration in offices is 5 ppm. Together with water, sulphurous acid (H2SO3) and sulphuric acid (H2SO4) are formed.

typical flue gas contents: oil burners / boilers 180 - 250 ppm

When poor quality coal is being fired, the SO2 concentration can sometimes exceed 2000 ppm.

Hydrocarbons (CXHY)

Combustibles like methane (CH4) and butane (C4H10) occur when incomplete combustion takes place. They are to a large extent responsible for global warming. These are part of a chemical family technically known as alkanes.

typical flue gas contents: oil burners / boilers below 60 ppm

Soot (smoke)

Smoke is another sign that incomplete combustion is taking place. It is measured by comparison with the well-known Bacharach scale (0 - 9). The smoke in the flue gas will cause soot to form on the internal parts of the burner.