Detector options and separation effectiveness

Detector options

The GC955 can be supplied with the following detectors:

* Photo Ionisation Detector (PID)
* Thermal Conductivity Detector (TCD)
* Flame Ionisation Detector (FID)
* Pulsed Discharge Electron Capture Detector (PDECD)

A combination of two detectors is possible. This is not always possible in the standard housing, ask for special offer.

PID

Standardly the instrument will be provided with a Photo Ionisation Detector, 10.6 eV, with a measuring cell of 50 μl.

This detector will achieve a high resolution and allow the measurement of very low concentrations: for aromatic hydrocarbons, alkadienes and sulfur compounds down to 150 ppt, i.e. 0,4 $\mu g/m^3$.

Photo ionisation is the process by which a photo excited electron absorbs enough radiant energy to be ejected from the atom or molecule. Photo ionisation is initiated by the absorption of a 10.6 eV photon by the molecule. If the molecule has an ionisation potential equal to or less than 10.0 eV, the following process occur.

R + hv -----> R+ + e-

where hv is a photon with approximately 10.6 eV and R is the species of interest.

Molecules with ionisation potentials greater than 10.6 eV will yield a lesser response

The detector source is a low pressure discharge lamp filled with noble gas. It provides a stable monochromatic source of high energy photons suitable for ionisation of the various components in gas chromatography.

The UV source is contained in a vacuum-tight envelope with a UV grade magnesium fluoride window maintaining isolation of the UV source from the gas chromatograph's carrier gas. The lamp’s output is approximately 100 microwatts of 10.6 eV photons contained in a beam 6 degrees wide.

The PID-signal is amplified, the signals are then stored as a value of 0 - 10 V. On the LCD-screen the chromatogram can be followed. Peak height and peak area can be quantified and stored for those peaks that are of interest.

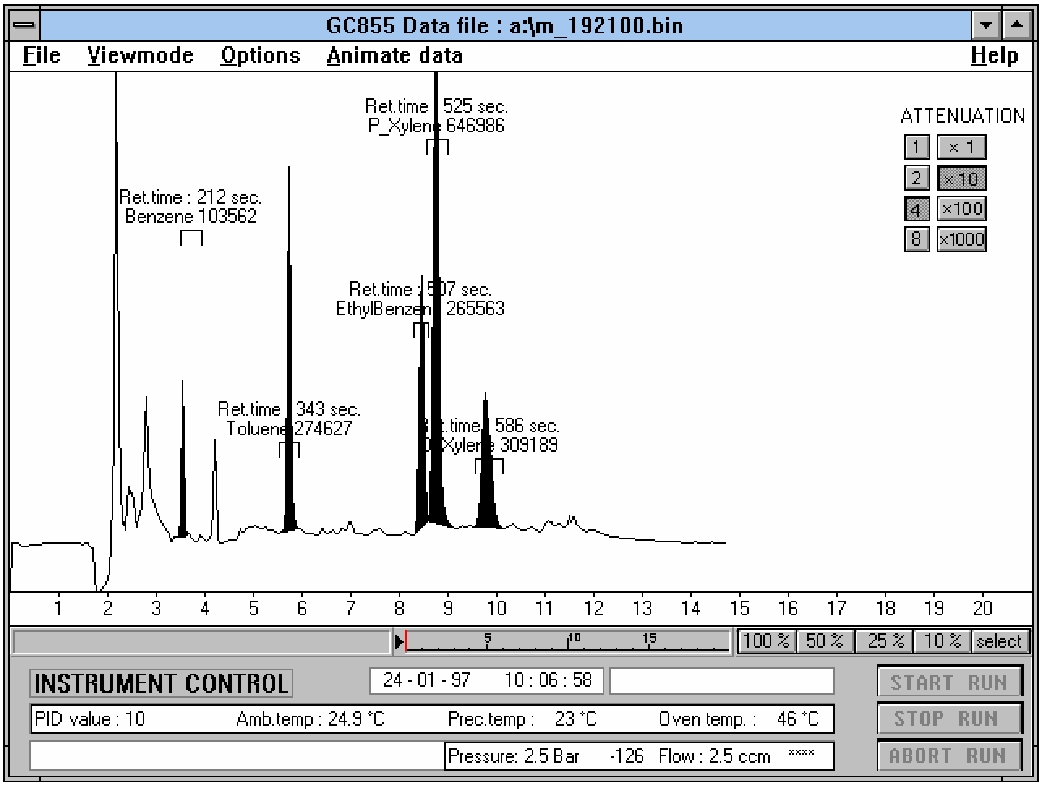


Figure 3.5: An analysis of an airsample loaded with paint residues as a result of painting activities one day before

The PID has a low sensitivity for saturated hydrocarbons. This detector is however specifically sensitive for aromatic hydrocarbons, unsaturated compounds and heterogeneous hydocarbons like sulphur compounds. Because of this, a group of interesting substances in the fields of environmental pollution, process monitoring and industrial hygiene can be assessed.

The photo ionisation detector is ideally suited for continuous monitoring with a gas chromatograph: it is a stable, sensitive detector, requiring no special gases.

The selective sensitivity makes possible monitoring of a range of (eco) toxics in the ppt to ppm-range.

Nitrogen or helium can be used as a carrier gas.

FID

The flame ionisation detector is the almost universal detector for the gas chromatograph, often used in the laboratory.

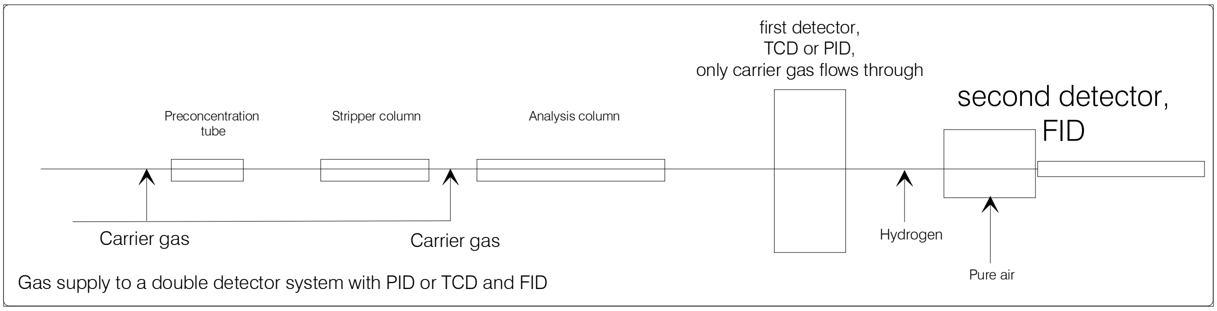
Its sensitivity makes it suitable for the low ppb to ppm range. Needing a hydrogen flame and pure air as a source of oxygen, the running cost of this detector is higher than for a PID. Hydrogen is shut off when the flame does not burn, the flame temperature is monitored for this. Nitrogen or helium can be used as a carrier gas.

The combination of a PID and an FID gives the opportunity to monitor complex mixtures satisfactorily

Principle of flame ionisation: in a flame of oxygen and a burning compound ions are formed. When other molecules than hydrogen pass through a hydrogen flame, these will also burn and increase the amount of ions formed compared to pure hydrogen.

The ions and electrons generated by the ionisation are attracted to the positive and negative side of an electrical field in the detector cell. The electrical current in the detector cell changes, and this change is measured.

Fig. 3.6 With a double detector system, combining an FID with a PID or a TCD, the flow scheme for a system 600 will be as follows:



TCD

The thermal conductivity detector is the oldest detector in gas chromatography. Its sensitivity is less than for the PID's or the FID's, which means the TCD is suitable to monitor compounds in the low ppm to % range.

However, the TCD can measure compounds not detected by the other two (see section 5). The carrier gas is usually helium.

Principle: The temperature of a conductive material wire influences the resistance. A gas flowing through a heated chamber cools the wire.

Depending on the molecules in the gas the uptake of heat changes, this factor is called the thermal conductivity. Changes in the conductivity of the wire are measured.

PDECD

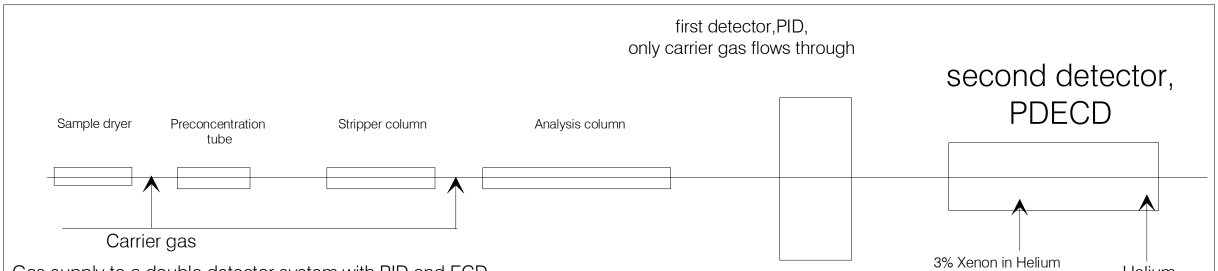
The newest detector in this range is the Pulsed Discharge Electron Capture Detector. It is very sensitive to those compounds that can trap electrons easily and not sensitive to others.

This means in practice that the PDECD is sensitive in the ppb-range to hydrocarbons containing chlorine, bromine, fluorine . This detector needs a steady supply of purified helium and of a dopant gas.

Principle: helium is ionised by a pulsed discharge. High energy photons are emitted in this ionisation. The photons in their turn ionise the dopant, which is Xenon. This results in a Xenon ion and an electron.
The electrons give a standing current, which is diminished when they are captured by the sensitive compounds. The pulsed discharge principle is an electron source without the conventional radioactive Ni-element. Users do not need training in handling radiation risks.

With the combination PID/PDECD a range of interesting environmental and toxic compounds can be measured and identified.

Fig. 3.7 A flow scheme for a system with sample dryer looks as follows:



Gas supply to a double detector system with PID and ECD