

NAME: IDAKWOJI ABDULHAMEED ABENELO

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CHE532: Process dynamics and control II

Assignment 1.

Describe in details, compare and contrast gas chromatography and gas chromatography-mass spectrometry.

Gas Chromatography is a commonly used analytic technique in many research and industrial laboratories. A broad variety of samples can be analyzed as long as the compounds are sufficiently thermally stable and volatile enough.

Working principles of the gas chromatography

Like for all other chromatographic techniques, a mobile and a stationary phase are required. The mobile phase (=carrier gas) is comprised of an inert gas e.g. helium, argon, nitrogen etc.

The stationary phase consist of a packed column where the packing or solid support itself acts as a stationary phase, or is coated with the liquid stationary phase (=high boiling polymer). More commonly used in many instruments are capillary columns, where the stationary phase coats the walls of a small diameter tube directly (e.g. 0.25mm film in a 0.32mm tube). The main reason why different compounds can be separated this way is the interaction of the compound with the stationary phase ("like-dissolves-like" rule). The stronger the interaction is, the stronger the compound remains attached to the stationary phase, and the more time it takes to go through the column (=longer retention time).

Gas chromatography-Mass spectrometry (GC-MS) also functions with the same working principle as the GC except that, the addition of the MS detector makes the identification process easier, as the detector decomposes the molecule into ions identified according to their mass, and using the retention times, since we would have certain ideas about the probable molecules we have. We can know which molecules exists in the solution we analyzed.

The GC does not positively identify most samples; and not all substances in a sample will necessarily be detected. It is often needed to check the results of the samples against a GC analysis of a reference sample containing only the substance suspected.

GC-MS can identify trace elements in materials that were previously thought to have disintegrated beyond identification. GC-MS has been widely heralded as a 'gold standard' for forensic substance identification because it is used to perform specific tests. A specific test positively identifies the actual presence of a particular substance in a given sample. While a non-specific test merely indicates that a substance falls into a category of substances.