Abstract template for MSB 2020

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Development of a miniature and air-transportable liquid chromatograph with UV detector: Crude oil characterisation by GPC-UV

Over the last decades, liquid chromatography (LC) has experienced an evolution to smaller columns and particles, new stationary phases and low flow rate instrumentation. However, the development of air-transportable and robust LC systems has not followed, mainly due to difficulties encountered in miniaturizing pumps and detectors, as well as reinforcing each element to ensure system performances after transport.

In this work we present the production and optimization of a miniaturized GPC instrument built-in two suitcases of 23kg per unit: one containing the analytical part constituted of an HPLC pump, the column oven, the UV detector, the multiplexer and injection valve, and the other one the computer. The whole system has been designed to make sure the analytical module and electronics can withstand vibrations and impacts of air plan transport including luggage handling (military standard AECTP 400 / GAM EG13 C). The analytical module can be installed on a laboratory bench in 10 min and the whole system can be operational in less than 1h to start the analysis. The integrated chromatography software allows a complete automation of the system, signal acquisition, and data treatment.

To validate the system performances, we have worked on characterization of crude oil. Gel permeation chromatography (GPC), a type of size-exclusion chromatography (SEC) in organic mode, with UV detection is widely used in the petrochemical industry to obtain information on the molecular weight (more concretely on the hydrodynamic volume) of the molecules of liquid hydrocarbons. There is a need to design a high performance miniature liquid chromatograph easily transportable (by plane, in luggage hold) and deployable on oil platform. First the performances of the system were evaluated using Toluene (retention time, quantification, and column resolution). After that, different crude oil samples were diluted in tetrahydrofuran (THF) (1:3). 0.5µL of the solutions were injected in 2 PlGel columns carried by the mobile phase (THF) at 0.2mL/min and detected by UVD (254 nm). Chromatograms were obtained after a cycle time of 40min. A good relative standard deviation (RSD) of 1.5% for the retention time was obtained on 5 replicates of the samples 2 hours after restarting the system. This shows the high stability of the air-transportable LC system.

Figure 1.- Overview of the control suitcase of the GPC air-transportable analyser .