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On-line gas chromatograph

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ON-LINE GAS CHROMATOGRAPH

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INTRODUCTION

Gas chromatography is a physical method of separation where the components to be separated are distributed between two phases - a stationary bed of large surface area, and a fluid that moves through the stationary bed. A gas or vaporized liquid mixture is physically separated into its individual components through this stationary bed.

HISTORY

Chromatography began in 1850 where F.F. Runge, a German chemist, demonstrated the Principle of Chromatography by observing the migration of inorganic cation through capillary porous material. Contributors through the years were recognized, D. T. Day 1900 (American) Tsweet 1903 (Russian), but modern chromatography began in 1952 by James and Martin (England) who developed gas-liquid partition chromatography.

KEY ELEMENTS IN A GAS CHROMATOGRAPH

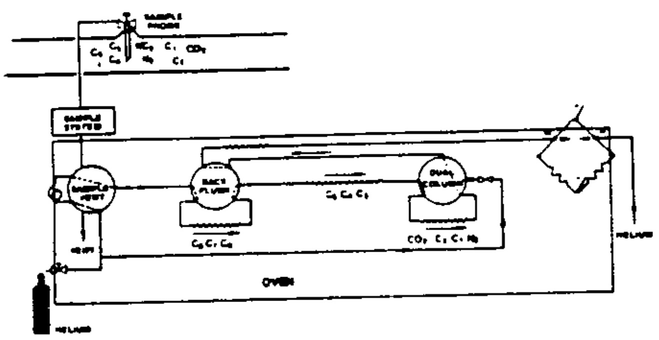

FIGURE #1

Sample Probe: To remove a representative sample from the process pipe. Usually 1/4" stainless steel tube extending into the pipe approximately one-third of the pipe diameter. A pressure regulator is used in conjunction with the probe to reduce line pressure to between 2 and 30 psi.

Sample Conditioning System for preparing the sample for injection into the chromatograph by filtering and regulating the sample.

Carrier Gas System to transport the sample through the columns and switching chromatograph valves.

Sample Valve for sizing and injecting the sample into the carrier gas ahead of the column.

Chromatographic Column - to separate the sample into individual componennts.

Chromatograph Oven - a temperature controlled chamber housing the sample valve, column and detector.

Detector - for detecting the eluted components in the carrier gas. The detectors are part of a Wheatstone bridge which provides an input into the controller.

Chromatograph Controller - for controlling the functions of the chromatograph and processing data.

Recorder and Printer - for recording the data.

HOW DOES THE CHROMATOGRAPH WORK?

The sample stream is continuously flowing from the sample probe through the sample conditioning system and to the sample valve. The sample loop is exhausted through the sample vent. The sample valve "fixes" the sample size for injection into the carrier gas for transport through the column across the detector and exits through the measured vent. The volume of the sample is determined by size and length of columns and volume of the detector assembly. Columns vary in size from 1/4" to 1/16" (micropacked, low volume). The speed of analysis is determined by the volume of sample and carrier velocity. As the sample is carried through the column by the carrier gas, the physical separation of the components occurs. Light molecular weight components will elute first, followed by heavier molecular components.

The components elute from the columns, pass across the measuring thermal conductivity detector where heat is removed in direct proportion to the thermal conductivity of the gas flowing across the element (Figure 2 T/C Detector). The thermal conductivity detector consists of two elements, typically a thermistor bead, two element bridge detector, measure and reference.

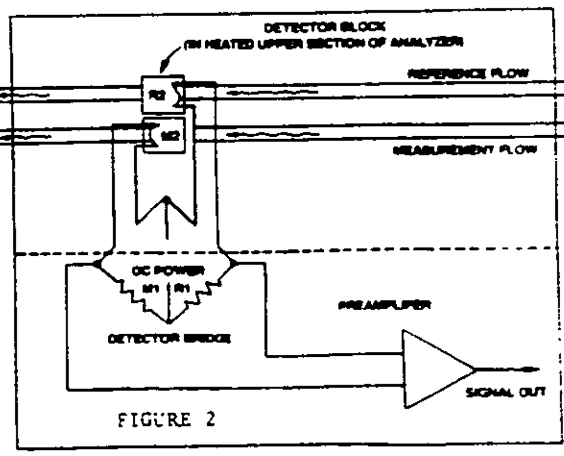

FIGURE 2

The reference detector typically measures zero grade helium. During the time no components are being measured, both detectors are measuring helium which results in a null signal or referred to as zero base line. As the components elute from the column, as mentioned, heat is removed causing an imbalance of current flowing through the detectors. This difference is amplified and used by the controller and recorder. The recorder produces a chromatogram which graphically displays each component. (Figure 3 Chromatograph)

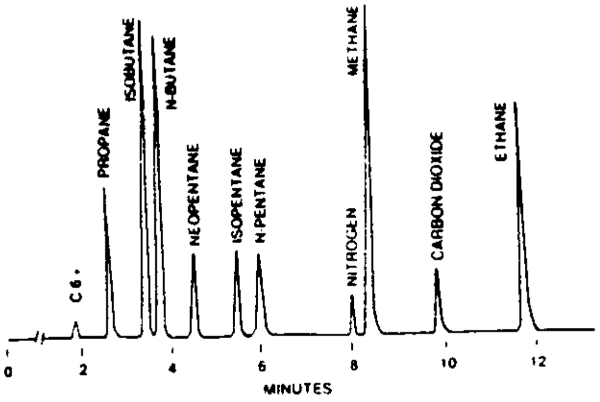

FIGURE 3

The microprocessor based controllers provide all control parameters for chromatograph, valve switching, stream selection, monitor oven temperatures and calculations. When natural gas is measured, the microprocessor calculates BTU, compressibility, specific gravity and Wobbe index if desired. Also, automatic calibration, analog and digital output to printer, recorder and host computer. Increased accuracy has been achieved in BTU measure, plus or minus 1/2 BTU in 1000.

The gas chromatograph, when properly applied, is rugged, reliable and accurate for a wide variety of applications for the gas and process industry.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.