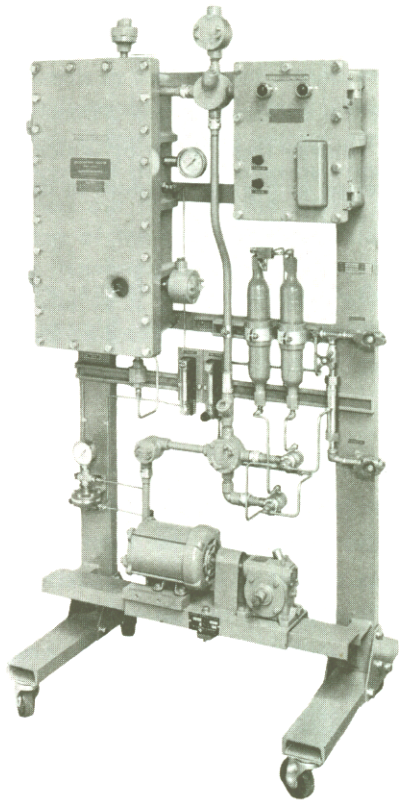
HALLIKAINEN Instruments
INDUSTRIAL and SCIENTIFIC
1341 SEVENTH STREET, BERKELEY, CALIFORNIA 94710

REFLUX END POINT ANALYZER

Texaco Development Corp. Design

Model 1353A



Horizontal Feet and Casters not standard equipment

GENERAL

The REFLUX END POINT ANALYZER provides a continuous analysis of a liquid hydrocarbon stream for the determination of the amount of higher boiling constituents present. The test results can be correlated with those from an ASTM #D1837-61T test, better known as Weathering Test. The test results when properly related to the observed vapor pressure and gravities of products, can be used to indicate the approximate concentration of butane in propane type liquified gases or pentanes in propane-butane mixtures of butane type liquified gases.

The value of the REFLUX END POINT ANALYZER lies in its ability to (1) provide a continuous record, (2) correlate with results obtained from ASTM D1837-61T test and, (3) reduce the requirement for laboratory tests. A continuous record always provides more useful information than a number of spot checks and is particularly valuable in showing trends. Additionally, the analyzer is extremely useful in closed loop control of a debutanizer, depropanizer, etc.

DESCRIPTION OF OPERATION

The most prominent use of the analyzer is in measuring the temperature of products coming from debutanizers. depropanizers, etc. in order to determine whether or not heavy ends are being carried over.

Sample preparation is extremely important since in working with temperatures in the range of —100° to +80°F., all free and dissolved water must be removed. This analyzer is equipped with a sampling system incorporating two dryers containing Linde 3A mol-sieve pellets to remove all moisture. Sample flow to dryers is approximately 37.5 to 60 ml./min. The dried sample is then pumped by a metering pump (Hills-McCanna Masterline 15) at a rate of approximately 8 ml./min. to an explosion-proof box containing the analyzing components. As the temperature within this box is extremely important, it is controlled by a Hallikainen THERMOTROL Temperature Controller (see separate brochure for details of this controller) at temperature slightly above the

maximum ambient to be expected, which incidentally, is also above the end point temperature of the sample. The THERMOTROL actuates six strip heaters and a blower located in the analyzer box to achieve temperature control within ±1° F., by bucking the action of the heaters against the constant cooling action of the evaporation tubes and vapor surrounding them.

In the air-tight, moisture-free, explosion-proof box, the sample is vaporized in two similar U-tubes filled with 1/16" O.D. glass beads. One U-tube is elevated above the other to permit liquid to flow by gravity from the upper into the lower. The inlet to the upper tube is approximately in the center of the tube with outlet in the U-bend at the bottom. This outlet connects to the second tube near its center with the U bend of this tube again at the bottom containing its outlet.

The analysis can be considered a distillation test in that the heat in the cabinet causes the light ends to vaporize and exit through the open top of the columns. These vapors are dissipated to the atmosphere through a flame arrester at the top of the cabinet. The temperature of liquid remaining, which drips from the bottom of the second U-tube, is the reflux temperature and will correlate with the results of ASTM D1837-61T test.

A thermocouple inserted at the bottom of the second column at the entrance to the U-bend measures the temperature of the residue. Presence of hydrocarbon compounds less volatile than those of which the liquified petroleum gas product is primarily composed is indicated by an increase in the temperature at the 95% evaporated point.

The analyzer consists of two explosion-proof boxes mounted on a vertical steel frame with associated components. The explosion-proof box on the left contains the evaporator tubes, heaters, blower and thermocouple and the right-hand box contains the THERMOTROL Temperature Controller. The analyzer is suitable for use in Class 1, Group D, Division 1 hazardous areas.

To reduce sample transportation lag a sweepstream configuration is used. A high velocity stream of the sample to be analyzed passes through the inside hollow alundum tube in the filter, then through a throttling valve and returns to the process stream at some point where the pressure is less than that at the inlet side of the filter. The throttling valve is partially closed in order to force a part of the sweepstream through the walls of the filter tube and into one of the three-way solenoid valves that supply the dryers. The sample takes a circular path through the dryers; this flow is reversed by a timer at the end of each minute in order to aid in the process of self-regeneration of the mol-sieve pellets in the dryers.

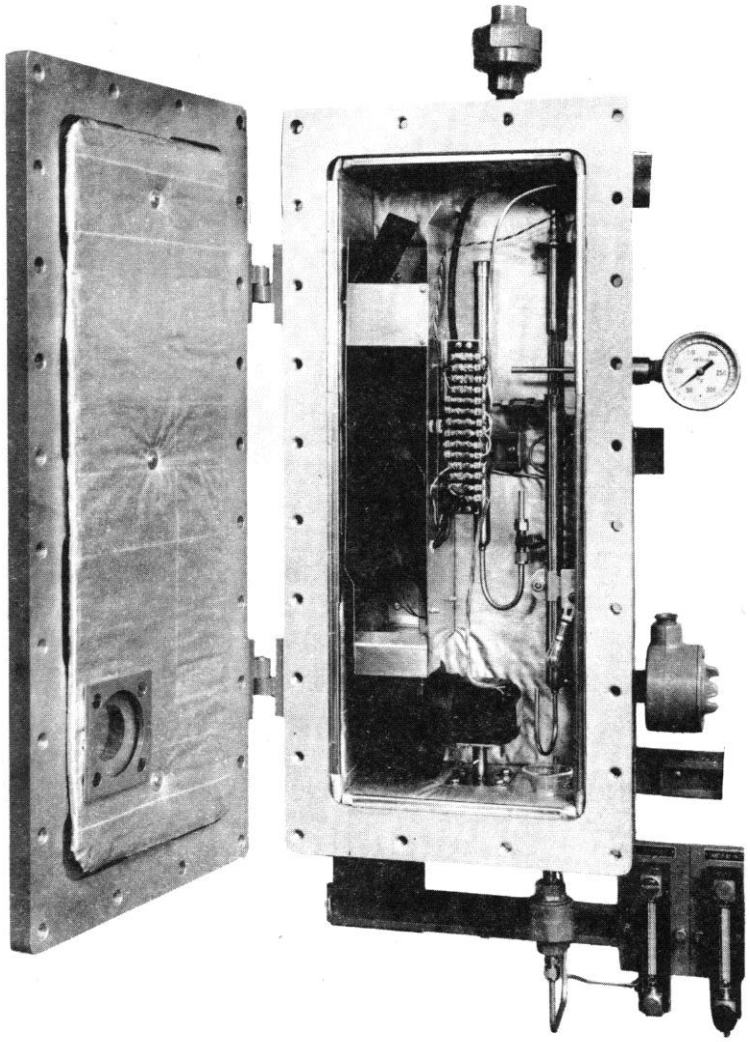
It is essential that the sample flow to the evaporator be kept constant and of a predetermined exact volume. A piston type metering pump driven at a constant speed by an explosion-proof motor delivers a constant volume.

A differential pressure controller is used to maintain the pump outlet pressure equal to the pump inlet pressure. With this arrangement the only function the pump serves is to meter the sample and, by monitoring an essentially zero pressure drop across the pump, the flow rate is unaffected by upstream line pressure changes.

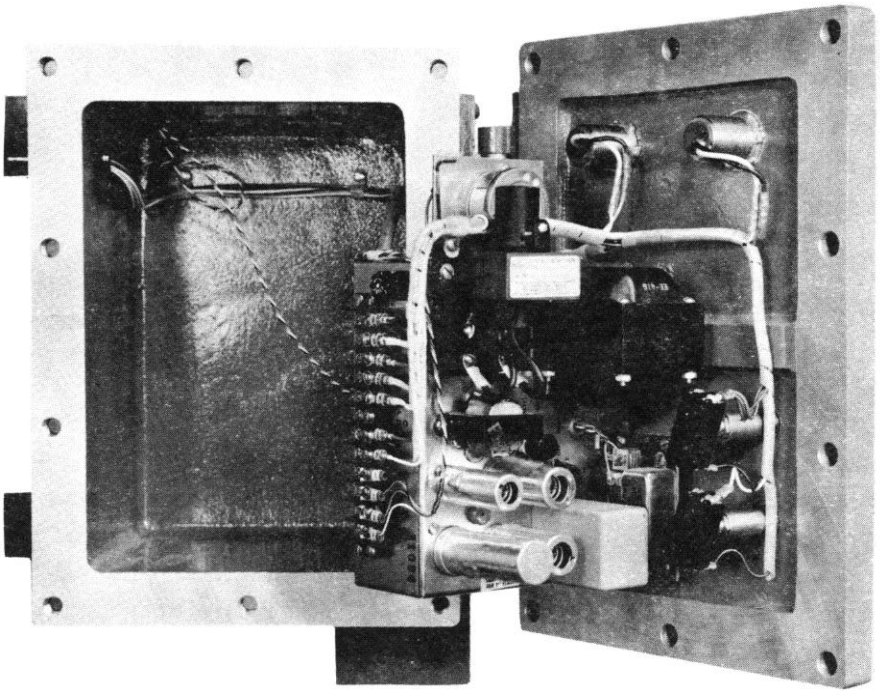
A rotormeter is provided for a visual check of the sample flowing to the evaporators.

Upon introduction of the normally gaseous liquid into the first vaporizing tube, a portion evaporates, cooling the remaining liquid by auto-refrigeration. Liquid flowing down over the packing is contacted in countercurrent flow with vapor generated by ambient heating of the descending liquid. This countercurrent contact in the first zone effects a stripping action so that any components having a lower boiling point than the main body of a normally gaseous liquid are removed. This stripping prevents variation in quantity of low

boiling constituents which may be in the liquid mixture from affecting the evaporation in the following zone. The stripped remaining liquid from the first zone is introduced into a similar vaporizing zone through a tee joining the U-bend of the first tube with the midpoint of the second tube. The top of the tee provides an overflow and air vent. Further vaporization is effected in the second column in a similar manner. Vapor escapes from the top of the tube and the liquid residue settles to the bottom where it drips at the rate of about 4 to 6 drops per minute. This residue is at its boiling point temperature at atmospheric pressure and the value of this boiling point temperature corresponds to the proportion of higher boiling constituents in the original liquid mixture. This distillate or liquid drops into a funnel below the U-bend of the second evaporator tube. Some of this will also be vaporized and carried out through the flame arrester at the top of the box. The remaining liquid residue, however, is carried from the funnel by a tube to a flame arrester which allows it to drain from the bottom of the box.



Boiler Case



Temperature Controller

SPECIFICATIONS

ANALYZER RESPONSE — 2 to 3 minutes.

DIMENSIONS — 69" high x 35" wide x 12¾" deep. (not including horizontal feet and casters)

OPERATING RANGE — −100°F. to +80°F.

ELECTRICAL — 115 volts, 60 cycles, 10 amp - ½" NPS conn.

SAMPLE INLET & OUTLET — ⅜" NPT female conn.

SAMPLE INLET TEMPERATURE — 120°F. maximum Inlet (Cooler may be required.)

SAMPLE INLET PRESSURE — to 350 pounds maximum.

RECORDER OUTPUT CONN. — ½" NPT conduit box, female.

RECORDER OUTPUT SIGNAL — Type J iron constantan thermocouple.

NITROGEN PURGE — ¼" NPT conn., male.