HALLIKAINEN *Instruments*
INDUSTRIAL and SCIENTIFIC
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GRAVITROL DENSITY ANALYZER

Mark IV

Model 1373

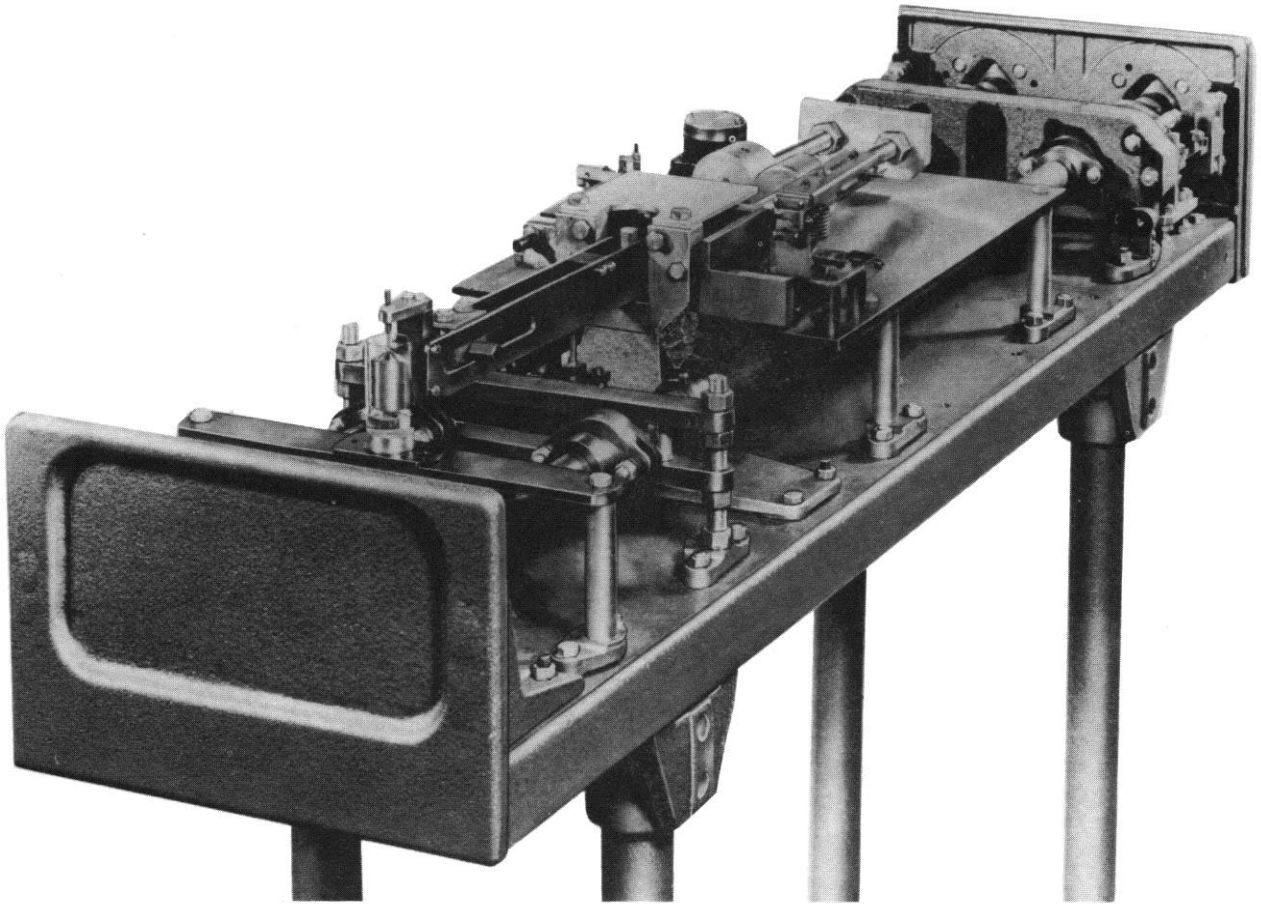
This instrument has been successfully applied to a great many industrial density measurement problems. It provides the most practical method of measuring the density of a slurry and is, of course equally suitable for use with clear liquids.

This latest version of the instrument embodies a number of improvements resulting from field experience.

- Temperature compensation now equivalent to 100% of the working span.
- Pneumatic or electrical output signals linearly related to the density span.
- Robust construction, reliability, simple maintenance with a minimum of servicing.
- Higher sensitivity with long term stability.
- All components are easily accessible—the instrument can be recalibrated on site for any density span within the range of the meter.

THEORY OF OPERATION

The process fluid flows through a hairpin loop of a tube pivoted on flexures about the horizontal axis which passes through flexible connectors. The weight of this assembly (i.e. the tube and its contents) is transferred to a weigh-beam and counterpoised by the balance weight which is adjustable along the beam. A change in density of the process fluid produces an additional force on the weigh-beam which is directly proportional to the density change. This force is measured by a force balance transmitter which may provide either a pneumatic or an electrical output signal.



APPLICATIONS

GRAVITROL Density Analyzers are being used in: brewing, china clay, cement, food processing, chemical processing, mining, pulp and paper manufacture, petroleum refining, sugar refining industries, water treatment plants, and others.

GENERAL

Since the meter measures the true mean density of all liquid and solid material contained in the loop; in the case of a slurry, measurement will not be affected by particle size or even by the gradual settling out of the solid phase, which happens to be a common source of error in buoyance types of density measuring devices. Naturally, a slurry must be circulated in the measuring loop at a flow rate high enough to prevent deposition of solid material. As long as pressure limits are not exceeded, velocity or viscosity variations have no effect on the meter. Recommended flow for clear liquids is approximately 200 gal./hour. For slurries, this is approximately 700 gal./hour corresponding to a velocity of 8 feet/second.

The instrument is free standing (legs and feet are provided). Flange connections are 1" or 1½", however, others may be available on special request.

For cleaning purposes the density meter may be flushed with clean water or appropriate solvents.

TEMPERATURE COMPENSATION

In most cases the density meter is used to measure or control the concentration of a solution; i.e., to measure specific gravity. For this purpose some method of compensating for the effects of temperature changes, may be required. Temperature compensation is secured by applying to the force balance an additional signal derived from the fluid temperature. The range of temperature over which this compensation can be made effective is that which by itself would produce a density change equal to the span of the instrument. For example, assuming a density meter has a span of 0.05 gm./ml. and if the liquid has a coefficient of thermal expansion of 0.0005 per degree C., the compensation would be effective over a range of 100°C.

The necessity for temperature compensation is a matter to be considered separately for each application, with reference to the required sensitivity and the temperature changes which are likely to be experienced. Because of this, temperature compensating equipment is suggested as an optional addition to the standard GRAVITROL.

GENERAL SPECIFICATIONS

PNEUMATIC TRANSMITTING MODEL

Output signal - 3 to 15 psig.

Density span - adjustable between .025 gm./ml. full scale and 0.25 gm./ml. full scale or alternatively 0.05 and 0.5 gm./ml.

Maximum density measurable 2.5 gm./ml.

ELECTRICAL TRANSMITTING MODEL

Output signal - 0-10 MA, DC, or 4-20 MA, DC on special order, with live zero.
(External resistance can be up to 1,000 ohm for 0 to 10 and 600 ohms for 4-20 MA.)

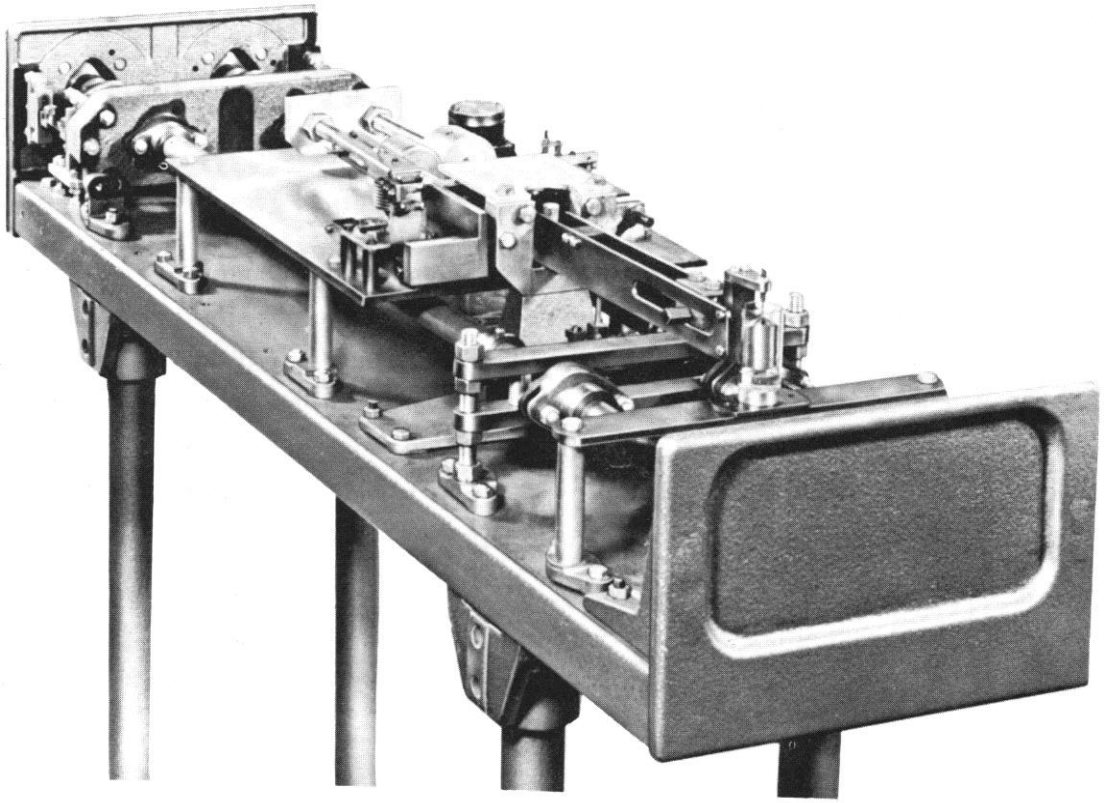
Density span - adjustable between 0.01 gm./ml. full scale and 0.20 gm./ml. full scale.

Maximum density measurable 2.5 gm./ml.

BOTH MODELS CONTACT MATERIALS

Stainless steel, type 316, is the standard material for the tube loop. The flexible connectors are either stainless steel bellows or smooth-bore rubber connections, the latter being used when operating on slurries.

Alternative materials are nickel, monel, rubber lined or ebonite-lined steel, graphite, etc.



WORKING PRESSURE

Instrument with stainless steel bellows connectors will work up to 150 psig. With rubber or PTFE connectors, the maximum working pressure at ordinary tempertaure is 30 psig for rubber and 60 psig for PTFE.

Instruments are carefully aligned during manufacture to ensure that changes in working pressure do not give rise to spurious density signals.

FLOW CAPACITY

In the standard arrangement the tube loop has a bore of 0.9" Alternative instruments are available based on a tube of 1.4" bore, these being used for large flow applications where it is desired to avoid the complication of a sampling system. Sensitivity and accuracy are mainly determined by the quality of the electrical or pneumatic receiving instrument which is employed. It is reasonable to expect a sensitivity (or discrimination) of 1 % of the span, which in the case of the electrical transmitting density meter adjusted to its minimum span, corresponds to a density change of 0.0001 gm./ml.

The inherent accuracy of the density meter itself is actually of a higher order, but in the majority of industrial applications, this is a matter of less importance than the reliable indication of small density changes and the use of the associated signal for control purposes.

GRAVITROL density meters are calibrated at the factory for the specified density range, but readjustment in the field to a different range or span is a simple operation with the aid of a box of gram weights supplied with the instrument. It is also possible to verify the sensitivity at any time while the instrument is in operation.