

Density Test of Viscous Liquids

BELPYCNO L

Instrumentation

The BELPYCNO L is a reliable instrument for measuring the density of viscous liquids or powder dense suspensions in water. Many applications have been already investigated leading to an instrument purchase.

- Liquid pastes for ceramics production. The density of the precursor liquid provides important information on the proper formulation.
- Detection of air bubbles trapped in highly viscous compounds, like bitumen.
- Paints in the liquid form.
- Components for lipsticks.
- Adhesives can be measured in the liquid and in the hardened statuses

In all the above cases, the BELPYCNO L was the customer's choice. The BELPYCNO L, for liquid density test, can be considered the best solution available on the market because of two specific

features: the integrated temperature control and the mechanical design.



Fig. 1: The BELPYCNO L density analyzer

Integrated Temperature Control

The BELPYCNO L measuring cell and reference volumes are manufactured in a single aluminium block which is insulated and connected to a powerful Peltier device. The Peltier element can react actively and immediately to the temperature changes of the manifold, keeping the temperature **constant within +/- 0.01°C!** The user can select the measuring temperature in a range between 18 to 35 °C, thus measuring the density of liquids at the real working temperature conditions, in most of cases. All the new instruments delivered from January 2016 will have an important improvement in the temperature range which will be selectable from 14 to 40 °C!

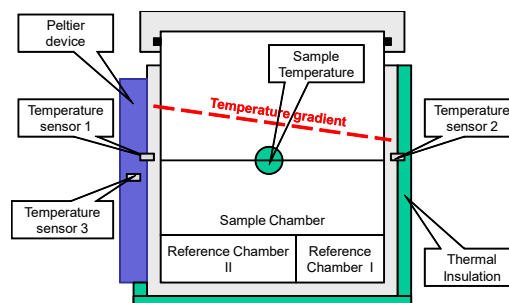


Fig. 2: Temperature control of BELPYCNO L

Mechanical Design

BELPYCNO L has the most important feature for analyzing liquids; it is the only pycnometer on the market that loads the measuring gas (helium, nitrogen, etc.) at high pressure (2 bars) in the calibrated reference volume, and then expands it into the sample chamber at a lower pressure (at about 1.6 / 1.7 bar) whereas most of the other commercial equipment does the opposite (Fig. 3). The advantages of such procedure, making make the BELPYCNO L machine unique on the market, are mainly two:

1. The higher gas pressure is measured in the reference chamber where there is no sample, while the gas is getting in contact with the viscous liquid at the expanded lower pressure. This operation limits the dissolution of the gas into the liquid that can generate erroneous density results or, in some cases, makes impossible to reach an equilibrated and stable pressure.
2. With most of commercial equipment the gas is first loaded at high pressure in the sample chamber then expanded in the calibrated reference chamber. This design and procedure are not recommended when analyzing liquids. In fact, when the

gas gets first in contact with the liquid and stays there for some time waiting the equilibration, it saturates with the vapor released by the sample. Then, when the gas is expanded into the reference chamber, the pressure drops, and the temperature locally also drops. After some cycles, the humidity coming from the sample condensates in the reference chamber! Therefore, the instrument must be regularly dismantled and cleaned by service technicians. The BELPYCNO L is practically "maintenance free" in this sense because the gas, after the equilibration in the sample chamber is just discharged outside through the vent valve.

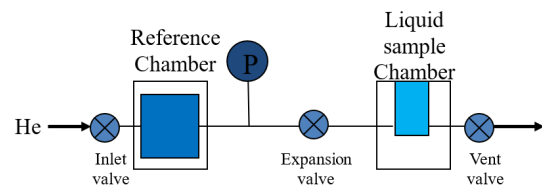


Fig. 3: Gas flow of the BELPYCNO L

Example of Density Test on Liquid Pastes for Ceramic Production

The following density tests were made on two different formulations of a ceramic precursor paste in water solution (Fig. 4). The samples have a composition containing various powders like quartz, kaolin, clay, etc. water and some binders. The density test does not require any special requirements, just pour the liquid in the aluminium sample vessel, take the weight, and place the vessel in the analysis chamber of the BELPYCNO L. The Peltier device immediately operates bringing the temperature of the liquid paste to the analysis set temperature, in our example 20 °C. It is possible to program up to 10

automatic repeated runs to check the instrument repeatability and a reliable density result.



Fig. 4: Paste samples

Measurement Results

PYCNOMATIC - DENSITY MEASUREMENT REPORT

Sample Name: Ceramic precursor 2
Analysis start: 11.12.15 10:46
Analysis end: 11.12.15 10:52
Sample weight: 35.99700 g

ANALYTICAL PARAMETERS

Reference volume: 41.46311 cc
Cell volume: 40.78512 cc
Repeated analyses no.:5
Temperature set: 20.00 °C

RESULTS

Average Sample Density: 1.87011 g/cc
Density Standard Deviation: 0.00033 g/cc
% Standard Deviation on Density: 0.01779:%

MEASUREMENT RAW DATA

Patmh	Prh	Pch	Temp	Volume	Aver.Vol	Aver.Dev.
bar	bar	bar	°C	cc	cc	cc
1.02379	2.02877	1.68519	19.99	19.24640	19.24640	0.00000
1.02380	2.02906	1.68545	19.99	19.25259	19.24949	0.00437
1.02383	2.02919	1.68549	20.00	19.24694	19.24864	0.00342

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