Viscosity: an open problem of actual science*

Despite the fact viscosity has a clear definition, even in elementary school books, its actual measurement is based on a wide variety of instrument approximating more or less this definition.

The main problem of viscosity is its metrology = the science of measurement.

This means periodical calibration of instruments using working liquid standards defined on their turn on fundamental standards. Standard liquids have a well known value of viscosity associated with an uncertainty, both defined according to metrological procedures. Fundamental standards are characterized by the smallest uncertainties and are defined only by basic quantities. These are the basic rules of all kinds of measurements.

There is a huge number of technical standards (ISO, ASTM, DIN, etc.) describing in very details instruments and measurement procedures, in general by neglecting the above mentioned metrological aspects, but they are optional while the metrology rules are compulsory in all fields of activity!

Water is the unique fundamental standard for viscosity since the prior measurements on U-capillary viscometers performed by a research team from National Bureau of Standards (actual NIST) in 1952.

NO ONE FURTHER MEASUREMENTS CONFIRMED OR IMPROVED THIS VALUE.

On the other hand, water has a small value of viscosity (1 mPa*s @ 20 ^{0}C) in comparison with majority of technical fluids (for instance approximately 250 mPa*s @ 20 ^{0}C for motor oil).

THERE IS NO METROLOGICAL PROCEDURE ESTABLISHING FUNDAMENTAL STANDARDS FOR VISCOSITY COVERING THE PRACTICAL RANGE OF VALUES.

All actual standard liquids for viscosity on the market are characterized by successive measurements on a series of U-capillary viscometers starting with the one suitable for water (primary viscometer). In this way, the experimental errors are growing with the increase of viscosity. On the other hand, U-capillary viscometers show a far approximation of the real viscosity according to basic definition.

According to actual national laws, the responsibility to keep in function fundamental standards belongs to national institutes of metrology (NMI-Australia, NIST-USA, PTB-Germany, LNE-France, NMI-Japan, NPL-England, etc.). This leads as the metrological activity to be a "state monopoly", otherwise said a top scientific activity obstructed to a normal and natural progress.

It is important to remind that: IN A HUMAN ACTIVITY WHERE IS NO COMPETITION, THERE IS NO COMPETENCE.

I have initiated in 1998 a project of law for metrology organization both at national and international level, by imposing as compulsory the participation in metrology activity (by legal responsibility to all documents and by financial support) of all legally registered organisms consisting more than 50 employees.

In the latest decade LNE and NMI-Japan have tried to develop a procedure based on the falling ball method, which is also a far approximation of viscosity definition.

PTB has issued ISO/TR 3666-1998 with the viscosity value of water as fundamental standard based on the above mentioned work from 1952. They also issued DIN standards especially for rotary viscometers.

NIST assumes such a research in the last 2 years, but they have no published works and do not answer to any enquiry on this subject.

FOR ALL OTHER NATIONAL METROLOGY LABS VISCOSITY DOES NOT EXIST.

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* This paper was presented and distributed to all participants at Brookfield technical presentation, 6th August 2010, Mantra Hotel Parramatta, Sydney Australia. It is important to mention the reaction of lecturers from Brookfield company:

Barry Ridley
Brookfield Viscometers Ltd
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and

Nilay Shah (BE, MBA)
Marketing Manager India & Asia-Pacific Region
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by asking „what's that metrology?"