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BROOKFIELD VISCOMETER: A DETERMINATION OF VISCOSITY

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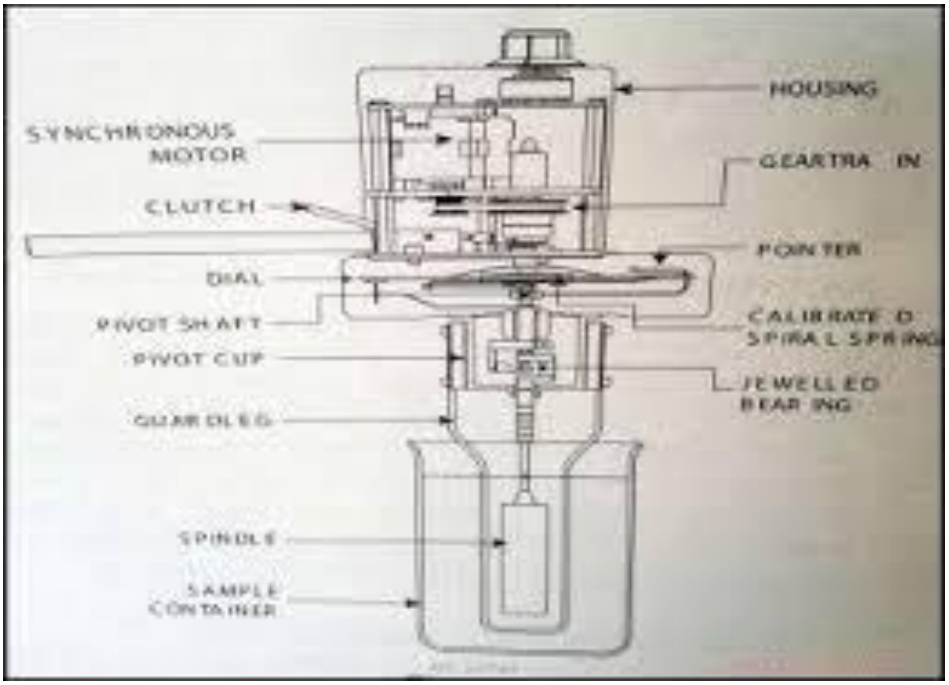
ABSTRACT
This paper analyzes various techniques to use viscometers equipped with vane spindles to characterize rheological properties of yield stress fluids. Specifically, an application of Brookfield viscometer to this end is discussed. A wide selection of toothpaste and lotions were tasted. It is shown that a simple method based on apparent shear rate and stress, commonly referred to as a representative viscosity method, works well for moderately non-Newtonian samples but may significantly underestimate viscosity for sample with more pronounced yield stress behavior.

KEYWORDS: Yield stress, vane, Brookfield viscometer, toothpaste.

INTRODUCTION
Brookfield viscometers are often used within the food processing sectors where accurate bench-top analysis of product viscosity is needed.[1] These viscometers use the principle of 'rotational viscometers. I.e. their measurement of product viscosity is based upon immersing a specifically selected spindle within a sample of the product followed by measurement of the torque required to rotate the spindle at a set speed whilst immersed within the product sample. As the torque required will be proportional to the quantity of viscous drag upon the spindle, this therefore provides an assessment of the product viscosity, reported in centipoises units (cP).[2]

Brookfield viscometers employ the well-known principle of rotational viscometer; they measure viscosity by sensing the torque required to rotate a spindle at constant speed while immersed in the sample fluid. The torque is proportional to the viscous drag on the immersed spindle, and thus to the viscosity of the fluid.[2]



Principle

Brookfield viscometers employ the well-known principle of **rotational viscometer**; they measure viscosity by sensing the torque required to rotate a spindle at constant speed while immersed in the sample fluid.[4] The torque is proportional to the viscous drag on the immersed spindle, and thus to the viscosity of the fluid. Classical Brookfield viscometers employ the principle of **rotational viscometer** - the torque required to turn an object, such as a spindle, in a fluid indicates the viscosity of the fluid.[5]

SOP {Standad Operating Procedure}[6]

- Turn on viscometer and allow standing, must be auto zero. After seconds the screen appears which indicates 2 digits.
- Now press the key. The screens display the instructions to remove spindle. After removing the spindle and pressing the key the instrument begins. It is auto zeroed.
- After approximately 15 second the screen display the instructions to replace spindle.
- Attach the spindle to viscometer by screwing them on the lower shaft using left hand thread.
- Press select spindle key and up and down arrow keys. When the desired code is displayed release the arrow key.
- To select spindle, first press either up and down key which cause the area to show current speed, press the set speed key for adjusting the speed.
- Insert center of this spindle in the test material until the fluid level is at the fluid level is at the immersion groove on the spindle shaft. Tilt the spindle slightly while immersing to avoid air entrapment.
- To measure high viscosity choose a small spindle and to slow speed if the chosen spindle/speed result in torque above 100% and then reduce the value.
- Allow time for the individual reading t stabilize, record the value.
- Press the motor on/off/escape key to turn off motor.
- The time mode allows the user to record the reading for fixed period of time or until a set torque value is attained.
- Then enter/auto turnkey allows determining maximum calculated viscosity possible with current spindle/speed.
- Pressing the up and down arrow keys will allow the viscometer data to be examine, pressing and other key [except enter/ print key] will bring back normal display.
- Turn off the mains after use.

Uses and Applications

The Brookfield Viscometer use to determine viscosity of viscous liquids like semisolids, cream, ointment, shampoo, face wash etc.[7]

MATERIALS AND METHODS

Materials

All tests reported in this paper were performed on commercially available products, toothpaste and lotions, listed in hereafter they will be referred to by their numbers, 1to 15. The first eleven were toothpaste and toothpaste, the other four were lotions.[8]

Methods

The products were taste d on a rheometer, ARG2, by TA Instruments using coquette [concentric cylinder, the so-called DIN standard] geometry. Serrated cup and cylinder were used to avoid slippage.[9]

Some Brookfield Viscometers

DV Next Rheometer

The DVNext Rheometer is Brookfield's latest model that incorporates new advanced features. It is an easy to used, stand alone instrument for measuring viscosity and yield stress. It's available in a standard version and a 21 CFR Part 11 complaint version.[10]

DVNext Cone/Plate Rheometer

The DVNext Wells Brookfield Cone/Plate Rheometer gives researches a sophisticated instrument for routinely determining absolute viscosity of fluids in small sample volumes. Its cone and plate geometry provides the precision necessary for development of complete rheological data.[11]

DV2T Brookfield viscometer

The New DV2T Viscometer features a 5-inch color display to guide users through test creation and data gathering for fast easy viscosity measurement.[12] The DV2T also offers powerful new programming capabilities and results analysis including data averaging and QC limits with alarms. Users instructions with multi-step test protocols can be created using the new program generator software and uploaded to the DV2T through a USB flash drive.[13]

DV1 Digital Viscometer

A continuous sensing capability for rapid viscosity measurement makes its economical DV1 digital viscometer a standout.[15] Measures viscosity and temperature simultaneously with a choice of 18 difference speeds.[16,17] With its timed measurement function, data can easily be sent to a pc or printer.[18] The DV1 is available in a choice of languages such as English, French, German, Portuguese, Russian and Spanish. Optional software allows the DV1 to collect analyze and record test data.[19]

CAP1000 Viscometer

The cap 1000+ viscometer is a compact, heavy-duty instrument that is ideal for fast, easy, repetitive testing on the production floor in the QC lab. Small sample size is plug, along with integrated temperature control built into the sample plate.[24,25]

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