ANALYSIS REPORT ON MICROFLUIDIC VISCOMETERS FOR BIOCHEMICAL APPLICATION

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ABSTRACT
The history of viscosity measurement is outdated and it is believed that the viscosity of motor oils was measured when the car industry came about[1]. A rotating viscometer for measuring viscosity at various temperatures is one which may be used. The CCTRV was designed, constructed and compared to the existing one to obtain more accurate viscosity information from any liquid in this treatise. The microfluidic device offers a range of features, such as simple to use, portable, operational transparency and a quick and marginal reaction volume detection.This review discussed the development and application of various microfluidic viscometers, mainly for biomedical uses. The state-of-the-art approach is used to manufacture microviscometers for point of care diagnosis on a commercial scale. This review summarizes the limits of the presented conventional viscometers and value chain, including designs, manufacturing techniques and other related methods.It has been found that microfluidic viscometers have unbelievable uses for controlled and selective regular monitoring and personalized point of care devices.
Keywords:*materials ,3D printing ,technologies, solid cylinder.*

1. Introduction

The coaxial cylindrical rotational viscometer is such that a solid cylinder (inner) is rotated inside a hollow cylindrical viscometer that contains liquid test samples[1]. The torque in the solid cylinder is measured and the viscosity of the test sample can be measured. Some of these advantages are: constant measurements, repeated samples measuring at different shear rates with the same sample, ongoing measuring of material whose properties can depend on the temperature and with a small or no change in shear rate during the sample measurement, shear rates are constant and can be tested both in Newtonian as well as non-Newtonian fluids.Shears dependent behavior, permitting time-dependent liquid analysis and simple operation, stable performance, easy maintenance, which are suitable for measuring the viscosity of different fluids like engine oil, water, kerosene, oil, paint, printing ink[3], can be analyzed by turning the spindle or inner cylinder at different speeds.

Micro-fluidics have recently become an influential technology for the transformation of biological, biochemical, [2] biomedical,[3] analysis and biomedical studies by replicating a miniaturized chip-size laboratory procedure[4]. In terms of the fields of medicinal products, tissue culture, amplification of nucleic acid, electrocatalytic domains the microfluidics are used widely[5, 6]. The benefits of Microfluidics include sample delivery, accurate dosing, controlled and sustainable release, multiple dosages, with insignificant side effects[7].

Figure 1.Universal applications of microfluidic technology in diverse fields.

These compensations have a significant impact on biology and biochemistry[8].Due to their distinctive advantages, such as low reagent, portability in-situ, versatility in design, small reaction time and potential for simultaneous functioning microfluidic-based research has made significant progress in recent years and has become a hot topic [9]. They are also used for integration with other miniaturized devices and have therefore received significant attention from microfluidic devices for biological cell analysis and sample analysis. In neurology, cell biology, tissue engineering, amplification of DNA, and pharmacology, the microfluidic technique has begotten to play an increasingly important role [10–12].

2. Literature Review

A. Anjorin, 2019. Anjorin. In this paper, a local viscometer is designed and tested. The requirement of a locally manufactured viscometer to measure lubricant viscosity is based on the prohibitive costs of imports of laboratory equipment such as viscometers. The filmic viscosity ofSAE 40, Palm oil and Soja oil were measured with the manufactured viscometer. Results from the experiments showed a 40.87 mm2/s and 32.01 mm2/s viscosity of palm and soja oil at 40oC. The viscosity of the engine oil, SAE 40 at 100oC was 13,65 ± 0,013 mm 2/s.
Ququazeh, 2016: Mohammad 2016. The task nowadays is urgently required to develop the measuring procedure and the general purpose control equipment that can be used to analyze the rheological properties of the fluid and to determine its dependence on the deformation tensor over a wide range of strain rates. At the same time, it is a matter of principle that products properties should be continuously inspected subject to high precision and measures automation.

GokceSariyerli, 2018: GokceSariyerli. This study was conducted to measure viscosity of referral fluids with capillary viscometers and StabingerViscosimeter SVM 3001 with viscosity ranges from 1 mm2/s to 5000 mm2/s at temperatures from 20 °C to 80 °C. We determine the viscosity values and compare the two results using our measurement of different liquid. The aim of the study is to evaluate the results of the primary level viscosity measuring system and stabinger viscometer and to compare the results of the measurement due to Stabinger viscometer traceability by TUBITAK UME.More and more national institutes of metrology and accredited laboratories offer viscometers of reference liquids for a wide range of viscosity. The viscosity of water as the metrological basis of viscometry is a common practice. TUBITAK UME's National Viscosity Standard is a set of ubbelohde viscosity viscometers covering the measurement range from 0.5 mm2 / s to 100 000 mm2 / s. At low viscosity, the primary standards for long capillary viscometers are directly calibrated water.

EmekaOchei Stephen,2020: In science and engineering, viscosity plays an important role. In liquid production, quality control and development, knowledge of the viscosity and flow parameters is essential. For different applications the construction industry uses various liquids. The liquid used in the construction industry are plasters, sealers bond breakers, fluid ground hardders, coatings and many more. Conclusions on its processing properties, pumpability, sprayability and flowability as well as application properties can be found through successful measurements.

Consequently, related measurements with equipment which are accurate and less costly should be carried out. This paper presents the design, manufacturing and testing of a viscometer, which measures the viscosity of fluids through an opening. In the design of viscometers, the following considerations were applied: corrosion resistance for material selection, ease of manufacture and use. In order to test kerosene, ethanol and plasma, the fabricated viscometer yielded the following findings; respectively 0.00134, 0.0011 and 0.0034.These values are closely related to various literature and a significant average 5.9% error. This demonstrates that the produced viscometer is reliable and compliant and can be used for laboratory, building, food processing, and education purposes.

3. Methodology

3.1 Basic Requirements in the development of miniaturized microfluidic viscometers

Miniaturisation of every device requires many peripheral devices which are not only small but also compatible to work hand-in-hand, especially in the microfluidic domain. A small amount of fluid, which should be less power consumption and size, sensors, drive units and microelectronics for the analysis of the result are some of the requirements. The examples of different pumping devices used to transfer fluid over the microchannel in the microfluid viscometer are shown in figure 4.

3.2 Microelectronics

Microcontrollers, electronic circuits and other devices such as displays, buttons, pump controls, etc. will be included The primary impetus is to integrate all the above components into a small board with connections and power dissipation.

3.3 Sensors and Actuators

These are omnipresent and have totally dependent on the world, since they respond to physical changes in the environment and are used to analysis and action for the monitoring processor.

3.4 Fabrication techniques

The main requirement for the development of a microfluidic viscometer is enormous optimisation and reliability analysis in this respect. The device is built according to the requirements in many ways.

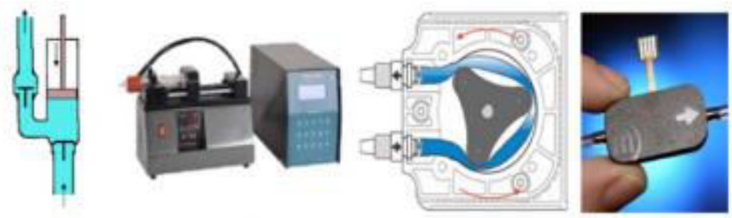

Figure 2. Fluid transfer strategy in the microfluidic channel.(a) Piston Pump (b) Syringe Pump (c) Peristaltic Pump (d) Micro Pumps.

In terms of the manufacture of prototypes every method has its advantage and disadvantage. The techniques of production include photolithography, soft-lithography based polydimethyl siloxane (PDMS), paper-based devices, polymethacrylatecarbone laser engraving (PMMA), and 3D printing. PDMS is a thermal epoxy that can negatively stamp the mold produced in various sources such as SU-8, compression, CD/DVD rarities, etched PCBs, precisely cut thin sheets of plastic. PDMS is biocompatible, transparent and is very useful in the biomedical field.Because of their uniform porous nature, which man-paper is generally used to develop paper based self pumping microfluidic products. The fluid flux must be channelled and a hydrophobic barrier can be introduced. The wax printer, PDMS and paraffin wax can be used to introduce this barrier. For the graving of PMMA channels, high-power CO2 lasers are used. In the end, 3D printers based on resin and plastics were used to automatically generate fine microfluidic devices.

CONCLUSION

In order to determine fluid viscosity, microfluidic viscometers dramatically transformed existing conventional viscometers. These microviscometers have grown quickly and have progressed towards pointof-care. This is due to the deficiencies of traditional devices such as the bulky, costly, time consumption and the need for human action to evaluate viscosity. These microfluid viscometers offer a number of advantages over conventional technologies like compact size, portable, simple to use, rapid processing and smaller volume of fluid.

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