International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

LOW COST FOOD VISCOMETER

R.ARUN CHENDHURAN[1], B.S.MADHUSUDHANAN[2], K.E.PRASANNA[3], V.P.SHREENATH[4]

[1]Assistant Professor, EIE Department, Bannari Amman Institute of Technology, Tamil Nadu, India
[2,3,4]BE Student, EIE Department, Bannari Amman Institute of Technology, Tamil Nadu, India

---

Abstract - *This project deals with the design and fabrication of simple viscometer at low cost for viscosity measurement of different food samples. As we know that viscosity is the measure of resistance to flow due to internal friction of the fluid. This method employs a DC motor coupled with a spindle which when rotated at a constant speed reads different current rating depending upon the viscosity of the fluid. The rotating speed of the motor in the fluid changes depending upon the internal resistance of the fluid so the motor draws different from the source in order to maintain a constant speed this change in current rating is related with the viscosity of the fluid. This viscometer is also useful in determining the nature of the fluid based on its behavior to flow.*

Key Words: **DC Motor, Spindle, Viscosity, Viscometer.**

1. INTRODUCTION

Problem Statement

Viscosity is an important characteristic in fluids and semi-solid, it determines the adhesiveness, texture, consistency, lubrication and nature of the substance. In food industry viscosity measurement is necessary to ensure that high quality food product is produced with desired consistency and texture thereby maintaining the standard of the product. The viscosity measurement for food products is generally done with Brookfield viscometer which is of high cost and can't be afforded by small scale industry.

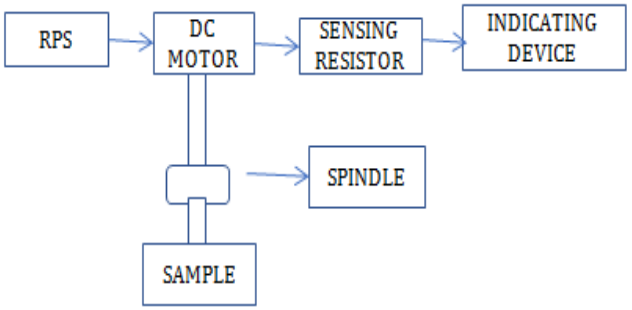
Objectives

- To design and fabricate a low cost food viscometer.
- To measure the viscosity of given food sample.
- To relate the voltage value for different samples to respective viscosity.
- To develop a viscometer as efficient as that of the existing one.

2. PROPOSED SYSTEM

Block Diagram

The overall block diagram of the low cost food viscometer is as follow.



Configuration of the System

The system structure represents the blocks in the individual components.

Hardware Components

- RPS
- DC Motor
- Sensing resistor
- Spindle
- Samples
- Indicating Device
- Breadboard
- Connecting wires

Description of Components

RPS

In this project Regulated Power Supply (RPS) is used as power source. The RPS is a device that is used to convert the alternating current into direct current through a rectifier circuit. RPS is generally used to limit a power supply to a desired voltage to operate at a fixed rate value so that we can keep track of the voltage supply to the motor. The RPS consists of a two terminals one the positive and other a negative terminal through which the supply is given to the motor. The Regulated Power Supply is kept at 12V since it is the voltage rating of the dc motor used so it is set at 12V and the voltage drop is noted.

DC motor

The Permanent magnet DC motor is utilized here it is a device that converts. The Permanent Magnet DC motor can be considered as a two pole rotor that is excited by a direct current supply. These DC motor comprise of a stationary permanent magnet along with a current carrying conductor placed between them. The current carrying conductor between the permanent magnet gets repelled or attracted depending on the magnetic field between them thus enabling the motor to rotate. The motor used here is with a rated speed of 60 rpm and the voltage rating is 12V.

Sensing Resistor

The sensing resistance is the resistance that is connected across the motor to sense the voltage drop across the motor. The resistance of the resistor connected across the motor is 10 kΩ. A sensing resistor is generally placed in a circuit to know the current drop in the circuit in cases where the change in current is minimum and so the voltage drop is measured in order to know the change in current. The voltage drop is due to the change in the viscosity of the liquid-samples used and this affects the spindle coupled along with the motor.

Spindle

The spindle is a standard shaft that is coupled with the motor. It is generally made up of stainless steel or mild steel but in the proposed low cost viscometer the spindle used is made up of aluminium which is low cost and durable comparatively. The proposed aluminium spindle was done with a compact lathe with the dimensions of a standard Brookfield viscometer. The spindle is the important component in a rotating type viscometer. It is the part that gets immersed in the sample that gets obstructed by the sample's internal friction which in turn reflected in the motor couple with it.

Samples

Sugar solution was used as a sample here. Since the sample has to have different viscosity equal amount of water was mixed with equal amount of sugar and the solution was heated at different duration to get five different samples. The samples had different sucrose content and so different viscosity.

Indicating Device

Right now multi-meter is utilized as indicating device. Multi-meter also VOM (volt-ohm--milliammeter) is a multipurpose measuring device. It can be used to measure voltage, resistance and current. Here it is used as a voltage measuring device that shows the change in voltage across the resistance connected in series with the motor. The multi-meter is kept in voltage mode and the dc voltage drop is noted in the multi-meter.

Bread Board

A breadboard is a construction base for electronic prototypes of circuits. It doesn't require soldering and can be used for experimental circuits and is reusable. A variety of electronic circuits can be designed as a prototype using breadboard. Here we have used bread board as a base for resistor to be connected across the motor.

Methodology

The low cost food viscometer is useful in testing the quality of the products in food production industries. The spindle coupled with the motor is immersed inside the liquid-food-sample to measure its viscosity. The motor is rotated at a constant speed by setting it up in a constant voltage.

Fig -1: Standard Brookfield viscometer

Due to the internal friction occurring between the layers of the fluid the rotation of the spindle is obstructed in the liquid-sample. This result in an increase in voltage drop across the resistance connected in series with the motor. The voltage drop for each samples are tabulated and the viscosity of the samples are measured using a standard Brookfield viscometer and the viscosity is tabulated respectively.

The graph is plotted between voltage and viscosity and it is noted that with increase in viscosity the voltage drop also increases hence it is clear that viscosity is proportional to the voltage drop and hence the measure of voltage drop gives the viscosity of the substance or liquid-food-sample used in the process.

Fig -2: Designed low cost food viscometer

3. IMPLEMENTATION OF THE PROJECT

In order to obtain liquid-sample of different viscosity sugar solution with various sucrose content was prepared by heating equal amount of sugar with equal amount of water for 5 sample, the samples were heated at 100 C for different duration of time. Then the samples were cooled down to room temperature for measuring viscosity and voltage.

The viscosity of the cooled samples was measured using a standard viscometer along with the voltage for respective samples and tabulated as below.

Tabulation

SOLUTION	VISCOSITY (centiPoise)	BRIX VALUE (°Bx)	VOLTAGE (Volt)
1	3.00	17.00	0.610
2	4.20	25.08	0.614
3	6.00	33.00	0.614
4	11.40	47.00	0.616
5	30.00	59.00	0.624

The graph is plotted against viscosity and voltage obtained and it is observed that when viscosity increases the voltage drop across the resistance also increases this shows that voltage is a direct measure of the viscosity of the sample.

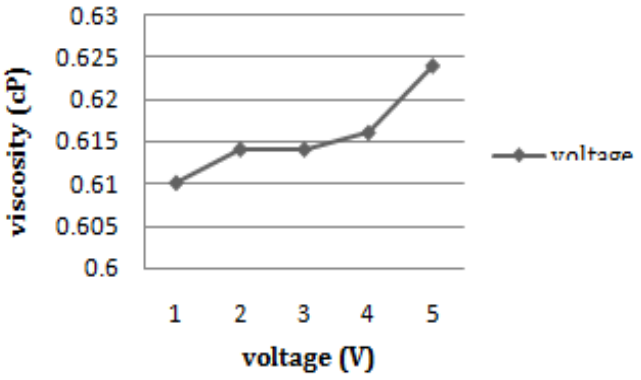


Fig -3: Voltage vs Viscosity

4. RESULT

The voltage reading for individual liquid-food-samples was plotted with that of the standard viscosity as a graph at it was found that viscosity is proportional to the voltage measured and the graph was found to be linear at higher reading. This proves that the designed viscometer is effective for liquid samples for higher viscosity

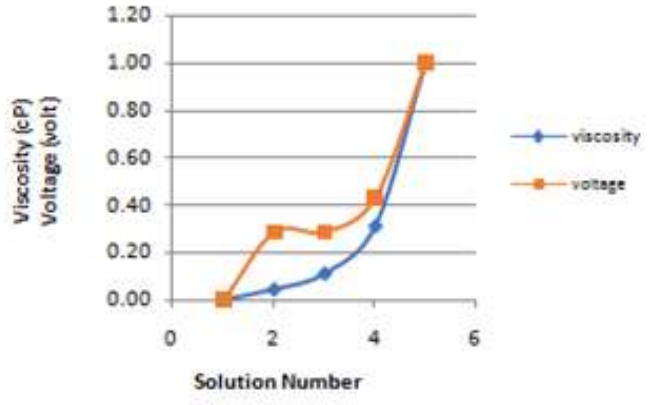


Fig -3: Relationship between Viscosity and Voltage

5. CONCLUSION

Thus the project of developing a low cost viscometer was successful in measuring the viscosity of the sample. The viscosity measured by this method is used to determine the product texture and consistency in food production industries. The main advantage of this proposed design is this is of less cost as well as affordable by all scales of industries. If food viscometers were available in lower cost for industries with this type of viscometer food products of desired quality can be produced in food production units to a large extend there by increasing the production quantity.

6. FUTURE SCOPE

- This project can be implemented in small scale food industries for viscosity measurement of food products to maintain the quality of production.
- This system can be combined with a micro-processor for comparison between voltage and viscosity to display viscosity values.
- The supply can be made to plug in supply rather than regulated power supply.

7. APPLICATION

Generally viscosity measurement is required in various production industries to maintain the standard of the product in production. In food industry viscosity measurement is necessary to ensure that high quality food product is produced with desired consistency and texture to maintain the product efficiency.

REFERENCES

[1] Castell-Perez, M. E., Steffe, J. F. and Morgan, R. G. 1997. Adaptation of a Brookfield viscometer for mixer viscometry studies Journal of Texture Study 18:359–365. 43.

[2] Naoto Izumo, “Physical Quantity Measured by a vibration viscometer”, Tsukuba Center Inc. Tsukuba, Japan, October 23, 2006.

[3] Venkat Ramayya international journal of civil and structural engineering volume 4, no 3, 2014.

[4] A. B. Hassan Federal University of Techno logy, Minna Fabrication and Testing of Viscosity Measuring Instrument.

[5] Riady Siswoyo Jo, Hudyjaya Siswoyo Jo, Almon Chai Development of Low-Cost Vision Based Falling Sphere Viscometer.

[6] Dr. Maria-Isabel Carnasciali, Dr. Samuel Daniels Building and Validating a Rotational Viscometer Brian Chesrrington & Jack Rothstein