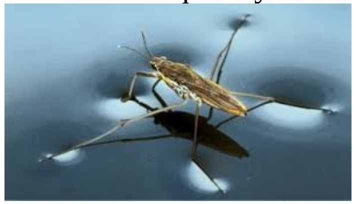
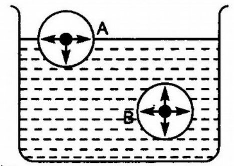
CB101 : Experiment 1 : Determination of surface tension of a liquid by stalagmometric method

I- INTRODUCTION

The surface tension of a liquid results from an imbalance of intermolecular attractive forces, the cohesive forces between molecules : molecules prefers to be surrounded by their own kind. As a result, to increase a surface of a liquids costs energy. That is why a liquid behaves in such a way to minimize its surface area. In daily life, it explains why drops are spherical or certain insects can walk on the surface of water and the action of detergent for clothes.

Surface tension is defined as the energy required to increase the surface area of a liquid by a unit of area, and called γ .

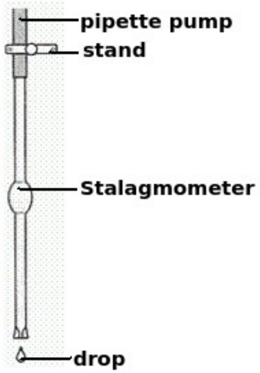




Phenomenon of surface tension

The weight of a drop of liquid coming out from the stalagmometer is proportional to the surface tension of the liquid. Therefore, for two different liquids 1 and 2 of surface tension γ_1 and γ_1 we have :

$\frac{\gamma_1}{\gamma_2}=\frac{m_1}{m_2}$ where m_1 and m_2 are the masses of a drop for liquids 1 and 2



Objective: **Determine the volume percent concentration of an unknown solution of detergent (methanol-water) by surface tension measurements.**

II- PRELIMINARY WORK

Read carefully the lab manual, and think about a procedure to achieve the objective.

III- PROCEDURE

Chemicals required:

- Distilled water

- Standard solution of Methanol 20%

- Solution of methanol with unknown volume percent concentration.

Apparatus and laboratory glassware required: See appended.

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1) How to measure surface tension with the use of a stalagmometer:

- A clean and dry beaker is weighted.
- A pipette pump is attached to the upper mouth of the stalagmometer.
- The studied liquid is sucked inside the stalagmometer.
- The stalagmometer is fixed on a stand for better stability. The beaker is placed underneath.
- The pressure is very carefully released so that 10-15 drops per minutes come out from the lower end of the stalagmometer.
- The number of drops is counted until all the liquid inside the bulb is drained.
- The beaker is weighted again in order to find the mass of the previously determined number of drops.
- The average mass of one drop can be calculated.
-To calculate the surface tension from this measurement, the experiment has to be repeated for a liquid for which the surface tension is known. For this experiment this is the water : Surface tension of water at 25°: 72 mN/m.
- The surface tension of one liquid can then be calculated with the relation : $\frac{\gamma_{liquid}}{\gamma_{water}} = \frac{m_{liquid}}{m_{water}}$ where m_{liquid} and m_{water} are the mass of one drop of liquid, and the mass of one drop of water.

Using the same procedure, find the surface tension of <u>different volume percent concentration of</u> methanol (2.5%, 5%, 10%, 15% and 20%) in water. Plot a graph of surface tension VS volume percent concentration. Use this graph to determine the volume percent concentration of methanol in the unknown solution.

2) Further questions and experimentations.

- Using a spatula, carefully place a paper clip on the surface of water and make it float (you may need a few trials to get it to work). Make similar attempts on the standard solution of 20% methanol provided. Interpret the observation.

- How will the surface tension change upon increasing temperature?

<u>APPENDED:</u>

<u>Apparatus and glassware required:</u>

- paperclip	- wash bottle
- pipette pump	- 10 mL graduated cyclinder
- stand	- 50 mL graduated cylinder
- balance	- 4 beakers
- stalagmometer	- 4 watch glasses
- 500 mL beaker for waste	