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SHORT COMMUNICATION

GREEN CHEMISTRY VOLUMETRIC TITRATION KIT FOR PHARMACEUTICAL FORMULATIONS: ECONOBURETTE

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ABSTRACT. Stopcock SC and Spring Sp models of Econoburette (Calibrated, RTC (NR), Ministry of Small Scale Industries, Government of India), developed for semimicro volumetric titration of pharmaceutical formulations are reported. These are economized and risk free titration where pipette is replaced by an inbuilt pipette and conical flask by inbuilt bulb. A step of pipetting of stock solution by mouth is deleted. It is used to allow solution exposure to user's body. This risk is removed and even volatile and toxic solutions are titrated with full proof safety. Econoburette minimizes use of materials and time by 90 % and prevent discharge of polluting effluent to environment. Few acid and base samples are titrated and an analysis of experimental expenditure is described in the papers.

KEY WORDS: Econoburette, Risk free, Microscale, Resource saving

INTRODUCTION

Titration is indispensable part of pharmaceutical chemistry, cosmetics, drug formulations, soaps, detergents and food engineering for estimation of acidity or basicity of the products. In chemistry, the titration is basic step of learning the chemical sciences. Usual titration apparatus require many experimental resources, infrastructure and risk of inhale of chemicals. To make it safe, green and microscale technologies [1] are being evolved for saving electricity, water, solvents, chemicals and infrastructure of laboratory. Their smart uses [2-4] at microscale are a key for environmental safety [4-6]. For ordinary titrations a burette of 50 mL capacity and 150 mL conical flask containing 20/10 mL titrant is used.

An indicator for end point detection of titration reaction or mixture is taken in same proportion [7]. In general, a user repeats at least 3 titrations for concordant readings for the reproducibility in results. Hence "n" number of users in a class would require "3 x n" times of resources but the econoburette saves them almost 90 % as compared to 50 mL burette. It is a semimicro volumetric kit. A 10 mL RB flask and funnel of size 20 mm diameter of conical with 25 mm tubular parts are used. An indicator is directly filled in its inbuilt tube. For safety a wooden box with another slightly smaller wooden box is used to maintenance after use. The flasks, funnel, and stainless steel (SS) stand are kept in a smaller box. The econoburette apparatus is safe for both the liquid state and precipitation titrations and even heating of titrating mixtures could be performed if required.

EXPERIMENTAL

HCl, NaOH, oxalic acid (AR, Merck, India) were used for solution preparation in tripled distilled water. The NaOH was standardized with standard oxalic acid and the HCl was standardized with NaOH. The sketch diagrams of both the models of the econoburette are illustrated in Figures 1 and 1* and, assembled unit in Figure 2. These are made up of borosil

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glass material. With the SC model, the limbs L1, L2, L3 and L4 graduated with 0.05 mL open in L5 flask. Each is of 5 mL and fitted with Teflon stoppers S1, S2, S3, S4, respectively. The S5 is fitted with flask L5. Each limb opens to common flask number L5 with open end for pressure control. An upper end of each limb is fitted with standard joint and movable stoppers and lower ends are fitted with air and liquid proof rotating Teflon stoppers opening to a common flask number L5. The L1, L2, L3 and L4 limbs open to bulb L5 connected to a high quality airtight stopper S5 which discharge a mixture out of a flask after finishing a titration. Both the titrant and titer are taken in limbs L1 and L2, respectively and indicator in L3. The econoburette is vertically mounted on a SS stand rod fitted with an outer box (Figure 2). The SS rod is in parts number 1 and 2 with nut and bolt arrangements to assemble part 1 on 2 for mounting econoburette with ordinary burette clamp. The L4 limb is used for an additional liquid for completion of a reaction or control of pH of a titration mixture in L5.

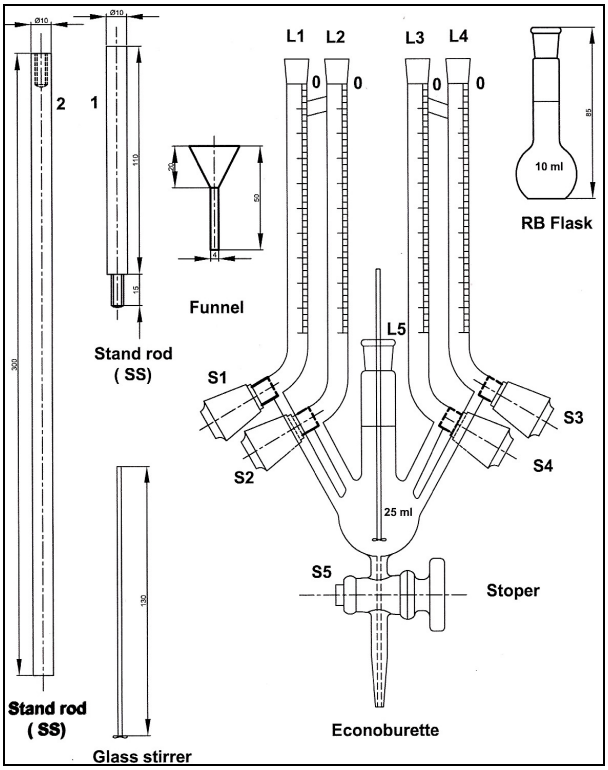

Figure 1. Sketch diagram of the semimicro volumetric kit: Stopcock model.

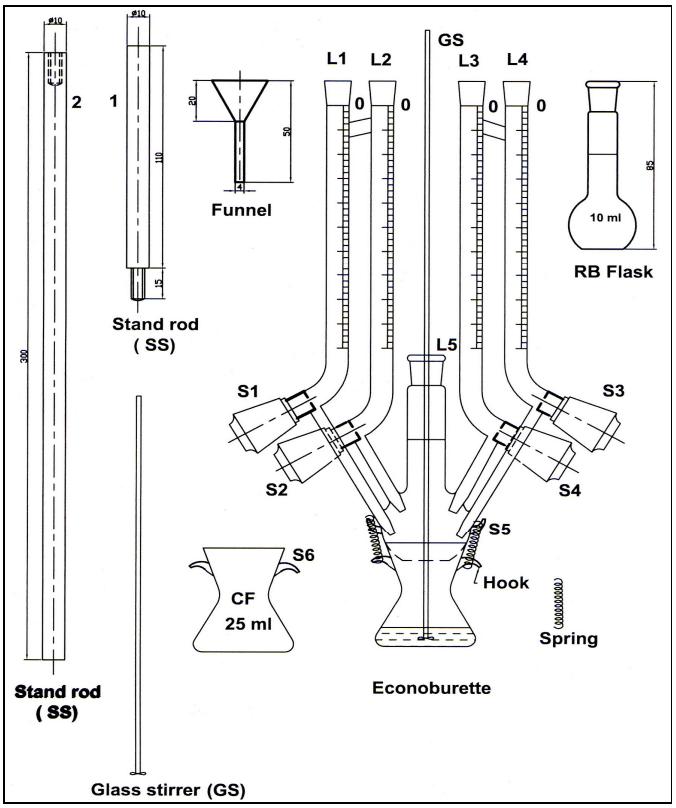

Figure 1*. Sketch diagram of a semimicro volumetric kit: Spring model.

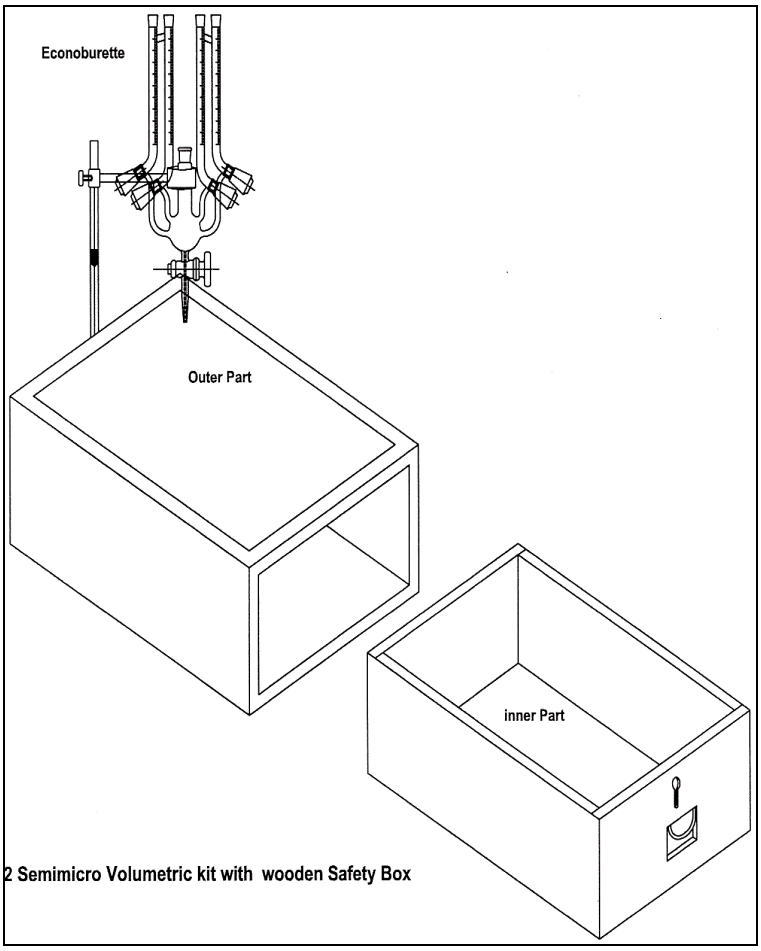

Figure 2. A sketch diagram of a wooden safety boxes for semimicro volumetric kit.

RESULTS AND DISCUSSION

The cost incurred with use of 50 mL burette, for a class of 40 students for the HCl vs NaOH titration was estimated using 1 M HCl and NaOH. Each student fills up the 50 mL burette with 1 M NaOH. Hence a total solution used in titration comes out to be 40 x 50 = 2000 mL (2 L) NaOH. Each student uses 10 mL 1 M HCl in conical flask for titration with 1 M NaOH. For 3 concordant reading with use of 10 x 3 x 40 = 1.2 L HCl. The 1.2 L of 1 M HCl needs 100 mL of 12 M HCl. Similarly an amount for a 1 M NaOH for 40 students = 10 x 3 x 40, = 1.2 L, it requires 48 g NaOH.

Thus the 40 students fill 50 mL burettes with 1 M NaOH. The 2 L of 1 M NaOH requires 80 g NaOH. Apart from chemicals the water is distilled with 2000 watt heating element. It requires an h for a liter of water, it consumes about 20 units, each unit costs about rupees 4/- only. The

1.2 L + 2 L = 3.2 L distilled water was used for acid-base titration costing about 3.2 x 20 x 4 = rupees 254.00 only or about $ 5.50 USD.

For 3 concordant readings with 1 M HCl vs 1 M NaOH, the 120 mL 1 M HCl and 120 mL 1 M NaOH were used with 10 mL of 12 M HCl and 4.8 g NaOH, respectively. The econoburette saved about 90 % experimental cost and time as compared to other burette. For titration with the econoburette (Figure 1), the limbs between L1 and S1, L2 and S2, L3 and S3, L4 and S4 hold 5 mL solution, respectively. The flask L5 holds 25 mL solution, the 1 M HCl was taken in L1, 1 M NaOH in L2 and phenolphthalein as an indicator in L3. Limbs are graduated in 0.05 mL, initially 1 mL HCl was taken from a limb L1 to flask L5 by opening S1 and phenolphthalein (1-2) drops from limb L3 to the L5. Then the 0.01 mM NaOH is taken from limb L2 to the flask to titrate the 1 M HCl till a pink color appears with a complete acid and base neutralization. It is repeated for 3 concordant readings. After finishing each titration the mixture was removed from flask via valve S5. The addition was stirred with glass stirrer.

The SC model, when a titrant and titrand are allowed to flask L5 via their respective stoppers. Smaller volume of titrant and titrand stick to an inner wall a flask, it is removed by washing the flask and tube of stopper S5 with water using an ordinary wash bottle. For washing the valves S1, S2, S3 and S4 are tightened and about 2 mL water is poured from a top of the L5. The spring model contains movable conical flask (CF) of 25 mL with 10 $ ground glass joint and downward hooks. The flask S5 has entries of S1, S2, S3 and S4 in a form of jets to drop down a solution. The S5 is standard ground glass cone fitted in S6 and springs in their respective hooks. The S5 is fitted on S6 with springs, the solution is let into it. For acid and base titration with phenolphthalein indicator, the acid is filled in S6, base is in S2 and an indicator in S3. The 1 mL acid is taken from S1 to CF with few phenolphthalein drops from S3 with stirring with GS inserted in CF. The base is dropped from S2 in fractions of 0.1 mL with stirring in CF till a pink color appears with repetition of other readings. The springs are removed to withdrawn CF to discard the solution. The econoburette is noble, economic, easily operational apparatus. In general, quantity of many expensive samples is restricted but analysis becomes an urgent need so for such situations, this apparatus is useful with highly precise and accurate results. The results presented in the paper are compared with those of the 50 mL burette. The work is still continued for the toxic and volatile chemical compounds for their titration.

CONCLUSIONS

The SP model is for precipitation, colloidal and gels titrations, and also for the $KMnO_4$ vs oxalic acid as it requires heating of a titrating mixture which is done directly in the CF. An ordinary burette, measures volume with 0.1 mL but econoburette with 0.01 mL. A radius of an ordinary burette is about 7 mm with an escape larger solution due to evaporation against least evaporation with econoburette due to 2 mm radius. No sucking of a solution with user's mouth. The econoburette is highly recommended for the expensive pharmaceutical formulation, syrups and checking acidity or basicity of fruits juices, etc. It is highly handy and easily potable and so is recommended to farmers for checking acidity or basicity of the soil samples.

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