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創新的消費者化學實驗：應用於普通化學實驗課程
Innovative Consumer Chemistry Experiments: Applications in General Chemistry Laboratory Course

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中文摘要

普通化學實驗使用的藥品和器材絕大多數取自於制式的實驗室，鮮少利用消費者產品，其缺點是實驗的探究過程過於理想化而不切實際，常常不能推廣到複雜的自然世界，也無法融入真正的生活化學之中，因而導致學生學習的興趣和意願低落，以及解決化學的能力不足。由文獻資料得知，氣體分析法很少出現在普通化學實驗教科書的消費者化學實驗中，也極少出現在化學教育的期刊中。本研究計畫的目的是開發兩個創新的氣體分析法之消費者化學實驗運用於普通化學實驗課程並評估其可行性。第一個實驗名稱為〝利用氣體分析法測定發泡錠中碳酸氫鈉的含量〞。第二個實驗名稱為〝利用重量分析法和氣體分析法測定賈凡尼鐵線表面鋅的含量及鋅的厚度〞。此二實驗的氣體分析裝置都是由研究者所設計，其特色是使用精密的量管可以得到較高的氣體測量之精確值，以及在量管中形成泡沫層可以得到較高準確度。在評估其可行性方面，主要有(1)研究者和學生的實驗結果以 standard deviation 統計方法來評估實驗偏差程度，(2)以 two tailed t test 或 F test 做比較分析考驗研究者與學生的實驗結果之間的差異是否未達到顯著水準。

關鍵字：設計實驗; 普通化學實驗; 消費者化學實驗; 消費者產品; 氣體分析法;碳酸氫鈉; 發泡錠; 賈凡尼鐵線

Abstract

Chemicals and materials, which students rarely exercise using consumer products, used in general chemistry laboratory are mostly obtained from the chemical stock room. The shortcomings are too idealized to be realistic with the nature, and not truly agree with life in chemistry. Thus students' interest becomes lower, and the ability of their problem solving is insufficient. At present, household products have been utilized in everyday life so that some of the consumer chemistry experiments are presented in journals of chemical education and textbooks of general chemistry laboratory. According to the literature, gasometry is rarely used in general chemistry laboratory and is seldom developed in quantitative analysis in article. The subject of this research is to develop two innovative consumer chemistry experiments by gasometry in general chemistry laboratory and the evaluation for its feasibility. The first experiment is entitled 「Gasometric Determination of the Bicarbonate Content in the Effervescent Tablets,」 and the second one is entitled 「Gravimetric and Gasometric Determination of the Thickness of Zinc Layer Coating on the Galvanized Iron Wires.」 Two assemblies for determination of the volumes of produced gases in the two experiments are designed by the researcher of this proposal. The features of the assemblies are that good precisions may be gained due to using buret and pipet, as well as nice accuracies can be obtained consequent to the bubble layer in measure tubes. In the evaluation for its feasibility, the mainly process including: (1) Precisions of innovative experiments are analyzed by standard deviation using results that researcher and undergraduate students are performed two experiments, and (2) Compared results of two experiments gained by researcher with that by students is evaluated by two tailed t test or F test.

Key words：Designing Experiment; General Chemistry Laboratory; Consumer Chemistry Experiment; Consumer products; Gasometry; Sodium Bicarbonate; Effervescent Tablet and Galvanized Iron Wire