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Efficacy of a Washing Machine for Small Volume Glass Vial Used in Pharmaceutical Analysis

Theera Rittirod[1], Arom Tattawasart[2], Kongpan Kumkainam[3], Weerapat Setsomboon[4], Jatuphon Thongchai[4], Thanee Tessiri[1], Alissara Ruengsang[5] and Sumon Sakolchai[1]

[1] Associate Profess, Faculty of Pharmaceutical Sciences, KhonKaen University, 40002
[2] Assistant Profess, Faculty of Pharmaceutical Sciences, KhonKaen University, 40002
[3] Technical Staff, Faculty of Engineering, KhonKaen University, 40002
[4] Lecturer, Faculty of Engineering, KhonKaen University, 40002
[5] Assistant Profess, Faculty of Technology, KhonKaen University, 40002

Abstract

The dimension of a small volume glass vial (SGVs) used with auto-injector HPLC for Pharmaceutical analysis is 3.5 cm. height, 0.6 cm. in diameter and 1.5 ml in volume. Washing process of such vials takes a lot of time and consumes much water and solvent. This study was to design and construct a washing machine which is time saving and economical. The time and amount of water and detergent, used in both manual and semi-automatic washing process were recorded. The main components of the washing machine were high pressure pump, time controller and reservoir of detergent, water, and distilled water. After fitting 40 used SGVs with the machine, the washing process was started. Firstly, the water was pumped to wash SGVs prior to wash by the detergent solution. The rinsing process was automatically performed by water and distilled water. Finally the vial was blown and dried with air pump system. The data showed that the washing machine gave high efficiency. One cycle of washing process (40 vials) consumed less than 1 minute and required only a few liters of water and detergent solution. While manual process took longer times in immersing overnight, 25 minutes in washing and consumed 100 liters of water. The solvate of residue from washed SGV was injected to HPLC. It was indicated that there is no contamination of residue which was left in washed SGV from both methods.

Keywords: Small volume glass vial, Washing machine, auto-injector HPLC.

Introduction

High performance liquid chromatography (HPLC) with an auto-injector; one of the common drug concentration determination system, is widely used in pharmaceutical analysis.(Wangboonskul, 1994 and Anon, 1999) However, the small volume glass vials (SGVs), (capacity 1.5 ml., 3.5 cm. height, 0.6 cm. in diameter) are necessary to keep solution samples during analytical process (Fig.1). In our

research, 100-200 of SGVs are used for one experiment to keep solution samples in such pharmaceutical analytical process. Most of scientists, research students and researchers wash SGVs by hand which consume a lot of water and 4-6 hr to clean all used SGVs (Fig.2). (Rittirod T. et.al, 2000) In this study, the cleaning machine is designed and constructed.

Experimentals

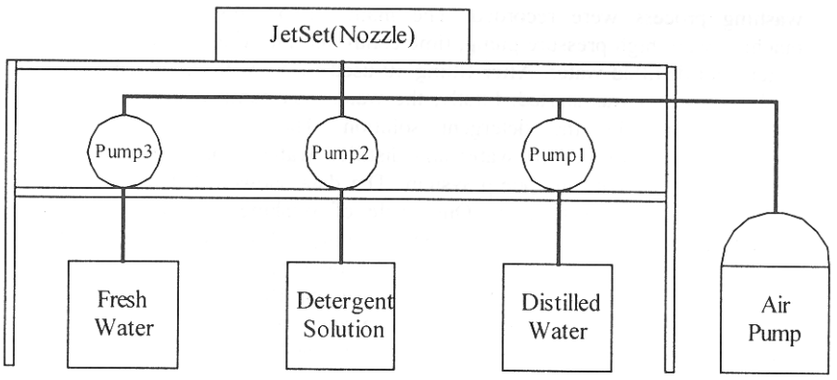
Materials

A new set of 100 SGVs , were purchased from Shimadzu Kyoto; Japan, and used as trial samples during constructing the washing machine. The other components of washing machine were obtained from the company and constructed in the university.

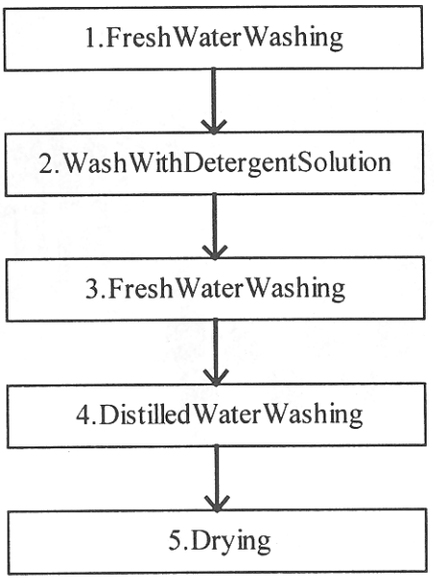
Methods

Construction of washing machine

The washing machine was designed and constructed in the Department of Industrial Engineering. The stucture and washing step of this washing machine is shown in scheme 1and 2 respectively. The components were connected and locked in fixed position. The time controlled system was also combinded. The washing machine was tested many times to check both mechanic and electronic system.



Scheme 1 Diagram of Washing Machine



Scheme 2 Operating steps of Washing Machine

The Test of Contamination

Five cleaned SGVs from both machine and manual washing were randomed sampling to test the contamination of residues. Each SGV was rinsed by 1.0 ml of 50% methanol and then the solvate will be injected into HPLC to check the contamination or impurities after cleaning process. The chromatogram will be compared with standard to assess the contamination.

Efficacy Test

Forty of used SGVs were put in locked position between trays.Then the semi-automatic washing machine was started. The consumed time and water of manual washing and washing machine.

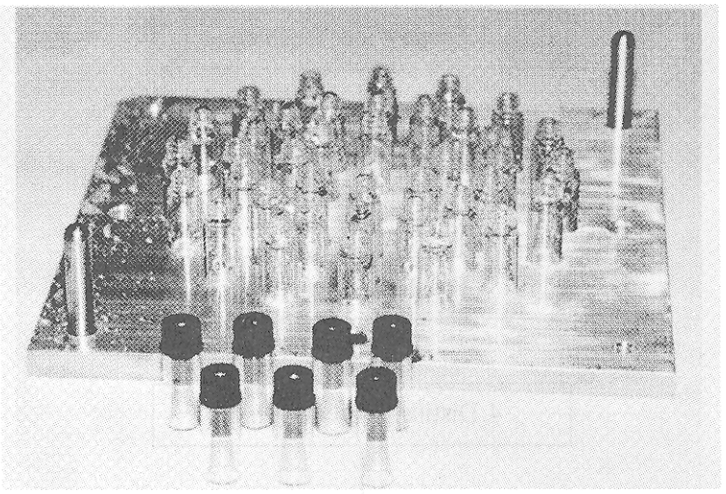


Figure 1 Small volume glass vial (SGVs) which used with auto injection HPLC

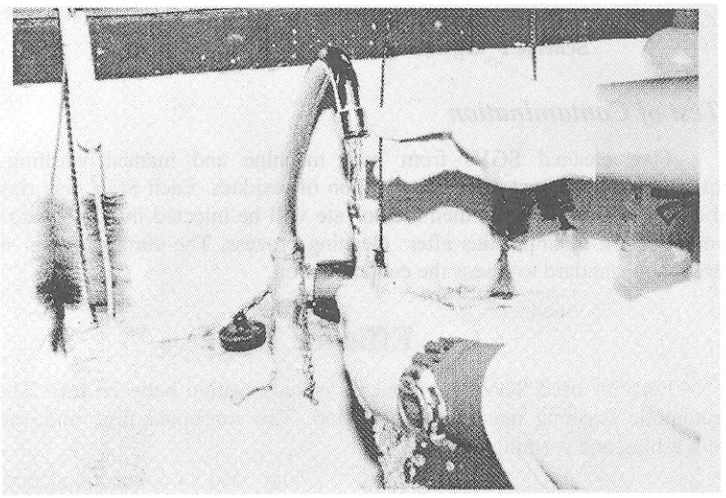


Figure 2 Manual washing the small volume glass vials (SGVs) used a lot of water and time

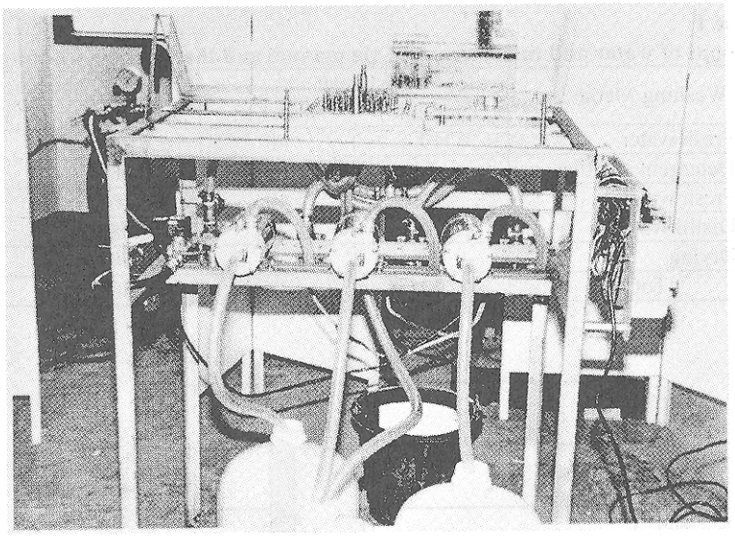


Figure 3 Washing machine for small volume glass vial of HPLC

Results and Discussions

In this study, the semi-automatic washing machine was designed and constructed. The machine is composed of a double plates (Fixture) to lock all 40 SGVs, high pressure pumping machine, waste water draining tray, plastic cover, 3 stored tanks (detergent solution, fresh water and distilled water) and a time controlled system. Scheme 1, shows the diagram of washing machine, which showed the component of complete set of washing machine. For washing process, we have to put all 40 SGVs in locked position. There are 5 operation steps in cleaning process (scheme 2). Firstly, the fresh water is pumped and then detergent solution is pumped. The SGVs will be rinsed with pipe water and distilled water continuously. Finally, the air will be blown in to dry the wet SGV. Table I show the consumed time and water and detergent used in washing process via manual and constructed machine.

Table I
Amount of water and time consumed via manual and the machine washing.

Washing Methods	Manual		Machine	
	Time(min)	Water(L)	Time(min)	Water(L)
1. Fresh water	10	40	0.167	1.6
2. Detergent solution	5	5	0.083	0.8
3. Fresh water	10	40	0.167	1.6
4. Distill water	5	20	0.083	0.8
5. Drying	30	-	0.083	-
Total	60	105	0.583	4.8

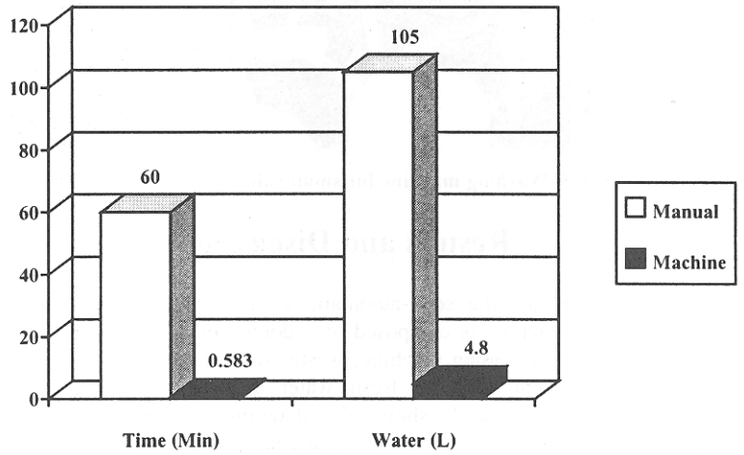


Figure 4 Comparison of consumed water and time between manual and machine washing.

Table I shows amount of water and time consumed via manual washing and the washing machine. It was found that there are much different in time and used-water in washing process between manual and the machine. It is indicated that using washing machine can save time and water in washing SGVs. However, the construction cost of washing machine is quite expensive (70,000 Bath or 1,555 US Dollar).

For impurities or contamination test, the solvate of residue from washed SGV was injected to HPLC. It was indicated that there is no contamination of residue which was left in washed SGV from both methods.

Conclusions

A new model semi-automatic washing machine for small volume glass vial was designed and constructed. Five steps of washing process are operated to wash a group of 40 SGVs. It was shown that less water and time are consumed. However, the cost of production cost of the washing machine still very high. Further study should be done in some issues such as the cost of operation, mobility of the machine, application to wash another type of small glass containers.

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