Cleaning Method Validation and Determination of Residue Method Validation for Glassware and Sampling Equipment (by UV-Visible spectrophotometer)

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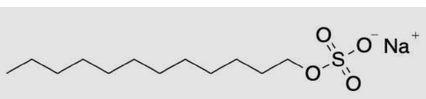
Abstract

The establishment and verification of cleaning methods are crucial in the pharmaceutical manufacturing industry, as they directly impact product quality and consumer safety. This study aims to establish and verify a new cleaning method based on the need to reduce the cost of cleaning agents currently used from 20% to 5%. The verification process begins with assessing the suitability of residue analysis, or Residue Method Validation. The selected residue for analysis is the cleaning agent residue, which can be analyzed using UV-Visible Spectrophotometry. According to standard acceptance criteria in pharmaceutical cleaning processes, the residual amount must not exceed 10 mg/L. The verification of residues in rinse water from sample equipment under two conditions after cleaning and dried glassware was conducted using 50 randomly selected laboratory glassware pieces. The study results showed that the residual amount remained within the acceptable limit, indicating that using only 5% of the cleaning agent is still effective in residue removal and can reduce the current cleaning agent consumption by up to 75%

Introduction

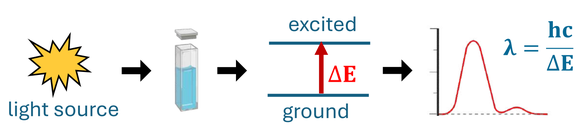
Cleaning Method Validation is a methodology used to ensure that the cleaning process effectively removes residues from active pharmaceutical ingredients produced in the equipment, as well as the cleaning agents used in the cleaning process. Therefore, this study aims to establish a new cleaning method in response to the need to reduce the cost of cleaning agents while considering good manufacturing standards.

Sodium lauryl sulfate (SLS) is a surfactant that functions to remove various contaminants and is a main component of cleaning agents used in factories. SLS is an essential substance for detecting residues from cleaning agents, as it can be analyzed using UV-Vis Spectroscopy.



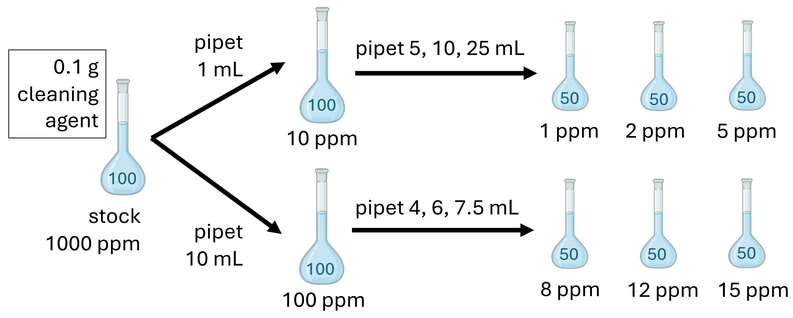
Sodium lauryl sulfate (SLS)

Spectroscopy is a technique based on the principle of light absorption by molecules in a sample. When electrons within these molecules absorb energy that can excite them to an excited state, it results in a specific wavelength characteristic of that molecule, which is used for light absorption analyze



Methodology

Part 1 Determination of Residue Method Validation : Study of the scope of the target substance to be analyzed, which is the residue from the cleaning agent

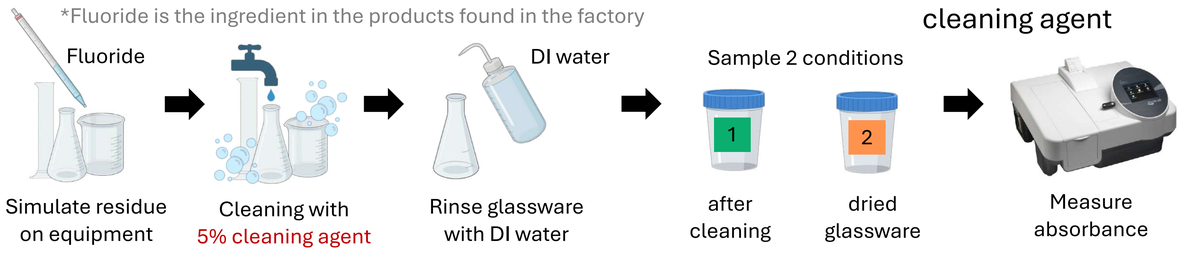


Residue Method Validation

1. Maximum wavelength : 100 ppm
2. Sensitivity and 3. Precision : 10 ppm
4. Linearity : 5, 8, 10, 12 and 15 ppm
5. Limit of detection : 1, 2, 5 and 10 ppm

Part 2 Test with sampling equipment : Detection of residues from cleaning with 5% cleaning agent

*Fluoride is the ingredient in the products found in the factory



Result

Part 1 : Determination of Residue Method Validation

1. Maximum wavelength

Identify the molecular characteristics of the cleaning agent for detecting residues

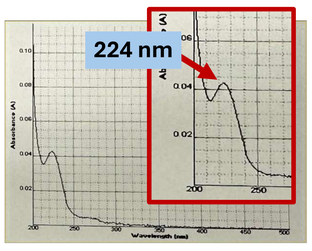


Fig. 1 Maximum wavelength of **SLS**

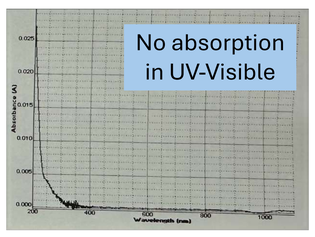


Fig. 2 Wavelength scan of **Fluoride**

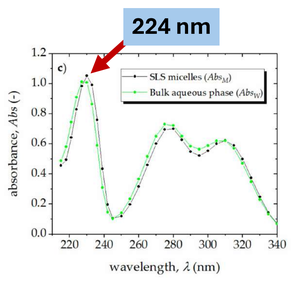


Fig. 3 Reference from Maximum wavelength of SLS

- The λ_{max} observed is 224 nm, which corresponds to SLS, and no absorption of fluoride in the same range. Therefore, this technique can be directly used to detect residual cleaning agents

2. Sensitivity

Verify the accuracy of the obtained λ_{max} by measuring ±2 nm of 224 nm

Table 1 Absorbance at difference wavelength

Wavelength (nm)	222	223	224	225	226
Absorbance	0.021	0.021	0.022	0.021	0.021

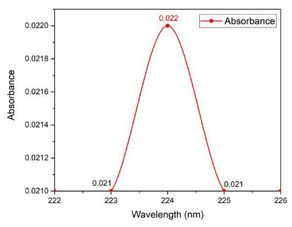


Fig. 4 Absorbance at difference wavelength

- at wavelength of 224 nm, the absorbance is at its highest

3. System precision

Stability testing of the cleaning agent

Table 2 Precision of standard solution

Measurement	Absorbance
1	0.023
2	0.023
3	0.023
4	0.023
5	0.023
6	0.023

mean	0.023
S.D.	0
% RSD	0

- The cleaning agent is stable

4. Limit of detection

Study the minimum concentration that UV-Visible spectrophotometer can detect

Table 3 Limit of detection of standard solution

Measurement	Absorbance of standard solution			
	1 ppm	2 ppm	5 ppm	10 ppm
Mean of absorbance (6 times)	0.000	0.002	0.007	0.023

- 2 ppm is the lowest concentration that a UV-Vis spectrophotometer can detect

5. Linearity

Study the relationship between absorbance and increasing concentration

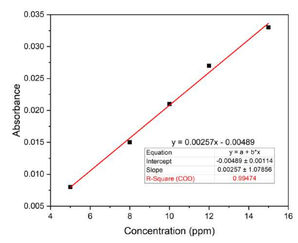


Fig. 5 Calibration curve

- The concentration increases, the absorbance also increases, showing a linear relationship with a coefficient of 0.9947

Part 2 : Test with sampling equipment

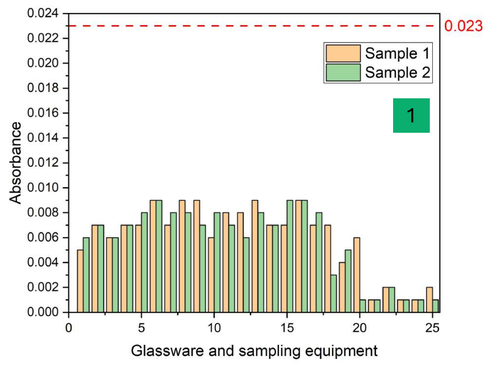


Fig. 6 Absorbance of after cleaning

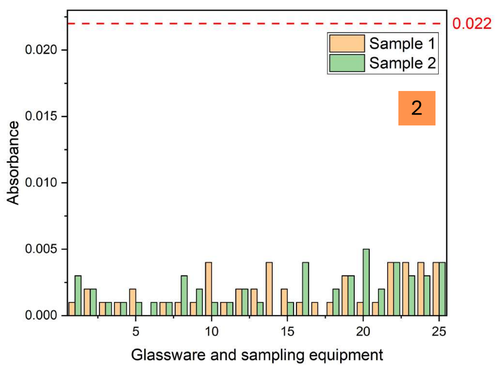


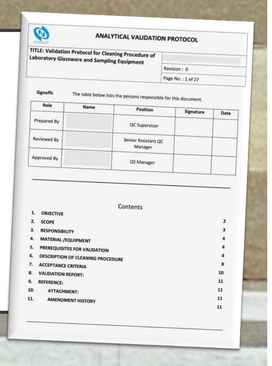
Fig. 7 Absorbance of dried glassware

- In both conditions, the absorbance obtained does not exceed of a 10 ppm cleaning agent

Discussion & Conclusion

Residues from cleaning agents can be detected using a UV-Vis spectrophotometer. Based on the results of the Residue Method Validation, the maximum wavelength can be determined from the SLS molecule, which is at 224 nm. Experimental results measuring the absorbance of water samples under two conditions showed no residue exceeding 10 ppm, or the standard limit. Therefore, it can be concluded that the cleaning method using a 5% cleaning agent provides the efficiency standards of the pharmaceutical manufacturing industry

- The company can reduce cleaning agent import costs by 75%
- A protocol for cleaning procedures has been developed, and the cleaning method is currently being implemented
- A cleaning agent with a 5% concentration can effectively remove residues without leaving its own residues. It falls within acceptable standards and does not pose any danger


ANALYTICAL VALIDATION PROTOCOL

TITLE: Validation Protocol for Cleaning Procedure of Laboratory Glassware and Sampling Equipment

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Signoffs: The table below lists the persons responsible for this document.

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Contents

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