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SSI-TOC-103

Measuring Samples Per USP 26 Using Shimadzu TOC-V*W

Introduction:

The United States Pharmacopoeia has established guidelines for determining system suitability and established the acceptance of Water For Injection (WFI) purposes and Purified Water (PW) (USP Revision 26 Method <643>).

Shimadzu's TOC-V*W analyzer is perfectly adapted to meet the requirements of USP Rev. 26 Method <643>. The TOC-V*W analyzer utilizes three forms of oxidation (heat, UV, and persulfate) to provide a low maintenance instrument with a detection limit of 0.0005 mg per liter.

USP Rev. 26:

The requirements for passing the system suitability test is to obtain results for the control standard minus the reagent water that are within $\pm 15\%$ of the sucrose standard minus the reagent water as shown in **equation 1**.

$$\%R = [(r_{ss} - r_w) / (r_s - r_w)] * 100 \quad (\text{equation 1})$$

r_{ss}	1,4-Benzoquinone (area counts)
r_s	Sucrose (area counts)
r_w	Reagent Water (area counts)
$\%R$	Percent Recovery (%)

Samples are acceptable for Purified Water (PW) or Water For Injection (WFI) if **equation 2** is satisfied.

$$(\text{Sample Area Counts}) = (r_s - r_w) \quad (\text{equation 2})$$

Procedure:
Standard Preparation

Sucrose and 1,4-Benzoquinone were purchased from Sigma-Aldrich and prepared in the following manner (see **Tables 2, 3, 4**):

First 1.187 mg of sucrose was accurately weighed out and brought to 1000 mL with purified water; this is a 0.5000 mg per liter carbon solution. This was used as the high standard in calibration. Second 0.7500 mg of 1,4-Benzoquinone was accurately weighed out and brought to 1000 mL with purified water. This is also equal to a 0.5000 mg per liter solution of carbon and was used as the system suitability check standard.

Table 2- Elemental breakdown of Sucrose: C₁₂H₂₂O₁₁			
Element	Molar Mass (g/mol)	# of Atoms in Sucrose	Sucrose Formal Mass (g/mol)
Carbon	12.01	12	144.1
Hydrogen	1.008	22	22.18
Oxygen	16.00	11	176.0
		Total	342.3

Table 3- Elemental breakdown of 1,4-BQ: C₆H₄O₂			
Element	Molar Mass (g/mol)	# of Atoms in 1,4-BQ	1,4-BQ Formal Mass (g/mol)
Carbon	12.01	6	72.06
Hydrogen	1.008	4	4.032
Oxygen	16.00	2	32.00
		Total	108.1

Table 4 – Calculations for generation of standards	
500 ppb C from Sucrose	500 ppb C from 1,4-BQ
C / Mol. wt. = 144.1 g carbon /342.3 g sucrose = 0.4210	C / Mol. wt. = 72.06 g carbon /108.1 g 1,4-BQ = 0.6666
1.187 mg 1,4-BQ * 0.6666 = 0.5000 mg carbon	0.7500 mg 1,4-BQ * 0.6666 = 0.5000 mg carbon
$\frac{1.187 \text{ mg sucrose}}{1000 \text{ mL}} = \frac{0.5000 \text{ mg carbon}}{1000 \text{ mL}}$	$\frac{0.7500 \text{ mg 1,4-BQ}}{1000 \text{ mL}} = \frac{0.5000 \text{ mg carbon}}{1000 \text{ mL}}$

Standard Analysis

The standards were analyzed on the Shimadzu TOC-V*W. The instrument parameters are shown in **Table 5**.

Table 5-Parameters	
Analysis	NPOC
Injection Volume	3000 μ L
Spare Time	2.00 minutes
Spurge gas flow	200 mL / min.
Acid added	3.0 %
Injections	3
Max injections	5
Carrier gas flow	200 mL / min.

Standard Results

Table 5-Results	
Standard	Mean Area Counts
r_w	5.446
r_s	78.50
r_{ss}	79.51

System Suitability

$$\%R = [(r_{ss}-r_w) / (r_s-r_w)] * 100 \quad \text{(equation 1)}$$

$$\%R = [(79.51-5.446) / (78.50-5.446)] * 100 = \underline{101.4 \%} \quad \text{(equation 3)}$$

Conclusion

According to the requirements outlined by USP, the Shimadzu TOC-V*W is suitable for the analysis of purified water and water for injection. The three forms of oxidation give a %R of 101.4%; validating the instrument's ability to accurately measure TOC in the ranges of 0.5000 mg per liter TOC. This is combined with TOC-V*W's low maintenance and yearly ownership of cost \$888.00.

