

Appendix XVII: Determination of Sulphur Dioxide Residues

Sulphur fumigation is conducted to preserve the Chinese Materia Medica. However, the residue of sulphur dioxide in CMM would cause allergic reaction to certain people. The harmonized method is developed to study the content of sulphur dioxide residues in CMM.

Methods

(1) **Analysis of sulphur dioxide residues** – The analytical procedures must be verified and satisfy with all of the following criteria –

- (a) the method is suitable for the analysis of sulphur dioxide residues;
- (b) the limits of detection and quantification are determined for sulphur dioxide residues;
- (c) the limit of quantification for sulphur dioxide residues is 10 mg/kg;
- (d) the recovery for sulphur dioxide residues is between 80 and 115%;
- (e) the acceptance limit for relative deviation of precision analysis is $\pm 15\%$;
- (f) include the determination of blank.

(2) **Reagents**

6 M Hydrochloric acid

Slowly dilute 618 g of hydrochloric acid to 1000 mL with water.

Methyl red indicator

Weigh 250 mg of methyl red and dissolve in 100 mL of ethanol.

Phenolphthalein indicator

Weigh 1 g of phenolphthalein and dissolve in 100 mL of ethanol.

0.01 M Sodium hydroxide titrant

Weigh accurately 40 g of sodium hydroxide and place it in a 1000-mL volumetric flask. Make up to the mark with water. Pipette 10.0 mL of the solution to a 1000-mL volumetric flask and make up to the mark with water.

3% (v/v) Hydrogen peroxide solution

Pipette 10.0 mL of hydrogen peroxide solution (30%, v/v) to a 100-mL of volumetric flask. Make up to the mark with water. Just prior to use, add 3 drops of methyl red indicator and titrate with 0.01 M sodium hydroxide titrant to yellow end point. If end point is exceeded, the solution should be discarded.

(3) Standardization of sodium hydroxide titrant

Weigh accurately 60 mg of potassium hydrogen phthalate, previously dried to constant weight at 105°C, and place it in a 250-mL conical flask, then add 50 mL of water. Shake it well. Add 2 drops of phenolphthalein indicator. Titrate the solution with the sodium hydroxide titrant until pink colouration can be observed. Towards the end of titration, potassium hydrogen phthalate should be completely dissolved. Measure the volume of the sodium hydroxide titrant used and calculate the concentration of the sodium hydroxide titrant according to the following equation:

$$C_{\text{NaOH}} = \frac{W_{\text{C}_8\text{H}_5\text{KO}_4} \times P_{\text{C}_8\text{H}_5\text{KO}_4} \times 1000}{V_{\text{NaOH}} \times \text{Mw}_{\text{C}_8\text{H}_5\text{KO}_4}}$$

| | | | |
|-------|---|---|---|
| where | C_{NaOH} | = | Molarity of sodium hydroxide titrant (mol/L) |
| | V_{NaOH} | = | Volume of sodium hydroxide titrant used (mL) |
| | $\text{Mw}_{\text{C}_8\text{H}_5\text{KO}_4}$ | = | Molecular weight of potassium hydrogen phthalate (204.22 g) |
| | $W_{\text{C}_8\text{H}_5\text{KO}_4}$ | = | Weight of potassium hydrogen phthalate used (g) |
| | $P_{\text{C}_8\text{H}_5\text{KO}_4}$ | = | Purity of potassium hydrogen phthalate (%) |

(4) Preparation of test sample

Take a representative CMM sample and cut it into pieces, if necessary, before grinding. Powder the sample before the analysis. Whenever possible, the quantity of the sample to be powdered should be of at least five times as much as those needed for the analysis.

(5) Apparatus

The apparatus (Fig. 1) consists of a 1000-mL round-bottomed flask with two standard tapered joints (diameter 29 mm and 24 mm) (A), a reflux condenser (B), a graduated 50-mL separating funnel (C), inlet for nitrogen gas (D) and outlet for sulphur dioxide gas (E). The apparatus should be cleaned before use and all the joint of apparatus should be tightly sealed during use.

The titration apparatus consists of calibrated burette filled with known concentration of titrant, a conical flask containing the solution of the analyte, a suitable indicator to show the end point of titration, and a magnetic stirrer for mixing the reaction solutions, or using appropriate method for mixing when necessary.

(6) Test solution

Weigh accurately 10 g of fine powder sample and place it in a 1000-mL round-bottomed flask, add 300-400 mL of water. When the content of sulphur dioxide residues is higher than 1000 mg/kg, the sample weight should be reduced, as deemed appropriate, but should not be less than 5 g. Connect the

round-bottomed flask to a reflux condenser. Connect the outlet of sulphur dioxide gas with a gas guide tube and then insert the gas guide tube to the bottom of a 100-mL conical flask which contains 50 mL of 3% (v/v) hydrogen peroxide solution. Begin the nitrogen flow at 0.2 L/min with regulator. Open the stopcock of the separating funnel and add 10 mL of 6 M hydrochloric acid to the round-bottomed flask. Heat the flask gently until boiling for 1.5 h. Stop heating. Allow 3% (v/v) hydrogen peroxide solution with oxidized sulphur dioxide residues to cool down to room temperature. Determine the content of sulphur dioxide residues (mg/kg) in the sample.

Prepare the spiked sample by repeating the preparation of test solution with the additional of aqueous solution of sodium hydroxymethylsulfonate.

(7) Titration of test solution

Titrate the test solution in 100-mL conical flask against the sodium hydroxide titrant until yellow colouration can be persisted for more than 20 seconds. The blank determination shall be performed. Measure the volume of the sodium hydroxide titrant used and calculate the content of sulphur dioxide residues (mg/kg) according to the following equation:

$$\text{Content of sulphur dioxide residues (mg/kg)} = \frac{(V_A - V_B) \times C_{\text{NaOH}} \times 32.03 \times 1000}{W}$$

| | | | |
|-------|-------------------|---|---|
| where | V_A | = | Volume of sodium hydroxide titrant used for test solution (mL) |
| | V_B | = | Volume of sodium hydroxide titrant for blank determination (mL) |
| | C_{NaOH} | = | Molarity of sodium hydroxide titrant (mol/L) |
| | 32.03 | = | Milliequivalent weight of SO_2 |
| | 1000 | = | Factor to convert milliequivalents to microequivalents |
| | W | = | Weight of the powdered sample used for the preparation of test solution (g) |

Limit

The amount of sulphur dioxide residues in CMM samples should comply with the limit listed in Table 1, unless in the case of a CMM of mineral origin or as otherwise specified.

Table 1 The limit of sulphur dioxide residues in CMM samples

| CMM | Limit of Sulphur Dioxide Residues (Not more than) |
|--|---|
| All CMM, unless in the case of a CMM of mineral origin or as otherwise specified | 150 mg/kg |

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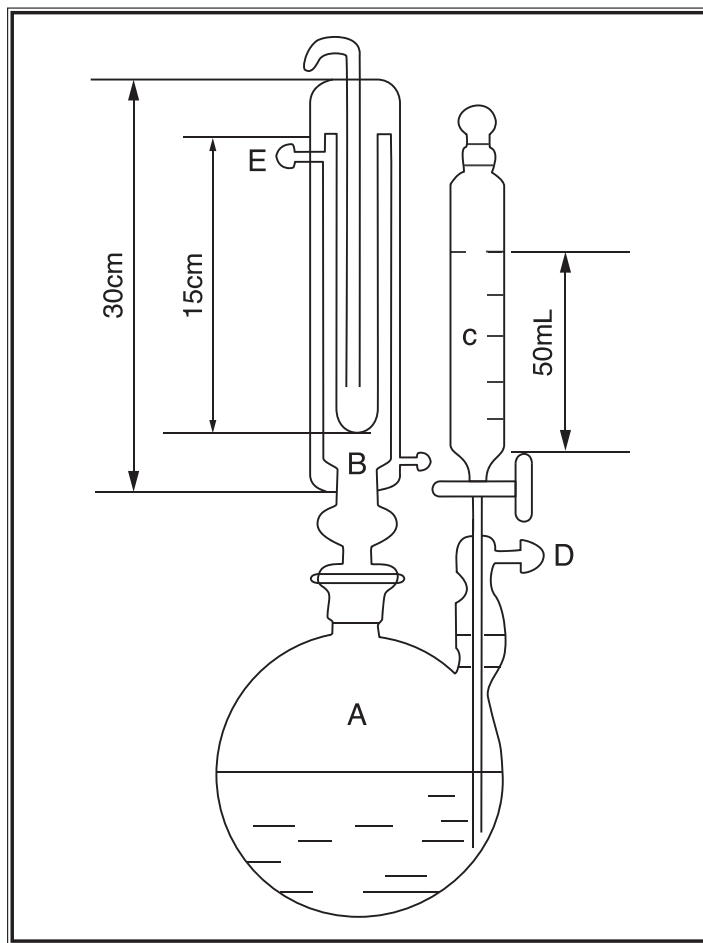


Figure 1 Apparatus for the determination of sulphur dioxide residues