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Silicon Dioxide, Amorphous

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SILICON DIOXIDE, AMORPHOUS

Prepared at the 84th JECFA and published in FAO JECFA Monographs 20 (2017), superseding tentative specifications prepared at the 80th JECFA (2015) and published in FAO JECFA Monographs 17 (2015). An ADI 'not specified' for silicon dioxide and certain silicates was established at the 29th JECFA (1985).

SYNONYMS	Silica; INS No. 551; Synthetic amorphous silica (SAS); Silicon dioxide
DEFINITION	Silicon dioxide is an amorphous substance, which is produced synthetically by either a thermal process, yielding pyrogenic (fumed) silica, or by a wet process, yielding hydrated silica, precipitated silica and silica gel. Pyrogenic silica is produced in an essentially anhydrous state, whereas the wet process products are obtained as hydrates or contain surface absorbed water.
Chemical names	Silicon dioxide, chemically prepared
C.A.S. number	7631-86-9 112945-52-5 (pyrogenic silica) 112696-00-8 (hydrated silica)
Chemical formula	(SiO ₂) _x
Formula weight	60.08 (SiO ₂)
Assay	Pyrogenic (fumed) silica: Not less than 99% of SiO ₂ on the ignited basis Hydrated silica (precipitated silica and silica gel): Not less than 94% of SiO ₂ on the ignited basis
DESCRIPTION	Pyrogenic (fumed) silica: A pyrogenic silicon dioxide occurring as a fine, white amorphous powder or granules Hydrated silica (precipitated silica and silica gel): A precipitated, hydrated silicon dioxide occurring as a fine, white amorphous powder or granules

FUNCTIONAL USES Anticaking agent, carrier

CHARACTERISTICS

IDENTIFICATION

Test for silicon Passes test
See description under TESTS

Solubility (Vol. 4) Insoluble in water and insoluble in ethanol

pH (Vol. 4) Pyrogenic (fumed) silica: 3.0 – 5.0 (5% slurry, 20°)
Hydrated silica (precipitated silica and silica gel): 4.0 - 9.0 (5% slurry, 20°)

PURITY

Loss on drying (Vol. 4) Pyrogenic (fumed) silica:
Not more than 2.5% (105°, 2 h)

Hydrated silica (precipitated silica and silica gel):
Not more than 8% (105°, 2 h)

Loss on ignition (Vol. 4) Pyrogenic (fumed) silica:
Not more than 2.5% (1000°, 1h on dried sample)

Hydrated silica (precipitated silica and silica gel):
Not more than 8.5% (1000°, 1 h on dried sample)

Impurities soluble in 0.5M hydrochloric acid Lead: Not more than 3 mg/kg
Arsenic: Not more than 1 mg/kg

Determine using a method appropriate to the specified level.
See description under TESTS for sample preparation

TESTS

IDENTIFICATION
TESTS

Test for silicon Prepare the test solution as shown under method of assay.
Analyse silicon in the test solution by ICP-AES technique (Vol. 4). Set instrument parameters as specified by the instrument manufacturer, use the analytical lines for Si (251.611 nm).

PURITY TESTS

Impurities soluble in 0.5 M hydrochloric acid

Extract a known quantity of finely ground sample in a closed digestion system with 0.5 M hydrochloric acid (spectroscopic grade) for 30 min. Let solution cool, then filter through a 0.1 µm membrane filter. Wash the filter twice with hot 0.5 M hydrochloric acid and dilute to a known volume with 0.5 M hydrochloric acid.

METHOD OF ASSAY

Accurately weigh an appropriate quantity of the sample, (depending on the moisture content) equivalent to about 0.5 g of dried sample, in a platinum or nickel crucible, add 5 g potassium hydroxide and 2 g boric acid, mix and melt completely using a torch burner and allow to stand at room temperature.

Place the reaction product along with crucible into 150 mL hot deionized water in a 250-mL PTFE beaker and dissolve residue by agitation. Wash the crucible with hot deionized water and remove it. Add 50 mL hydrochloric acid and transfer the contents into a 250-mL polypropylene volumetric flask. Wash the beaker three times with hot deionized water. Transfer the washings to the volumetric flask and make up to volume (Solution A).

Prepare the test solution by diluting Solution A with 2% hydrochloric acid, to get the readings within the standard curve range.

Analyse silica in the test solution by ICP-AES technique (Vol. 4). Set instrument parameters as specified by the instrument manufacturer, use the analytical line for Si (251.611 nm) and construct standard curve using standard solutions 0.1 – 5.0 µg/mL.

Read the concentration of Si in test solution (as µg/mL) and calculate the silicon dioxide content of the sample using the formula:

$$\text{SiO}_2 (\%) = (2.139 \times C \times 250 \times \text{DF}) / (W \times 106) \times 100$$

Where:

- C is concentration of Si in the test solution, µg/mL;
- DF is dilution factor (dilution of solution A to get test solution);
- W is weight of sample on the ignited basis, g