

SILICON DIOXIDE, AMORPHOUS (TENTATIVE)

Prepared at the 80th JECFA and published in FAO JECFA Monographs 17 (2015), superseding tentative specifications prepared at the 77th JECFA (2013) and published in FAO JECFA Monographs 14 (2013). An ADI 'not specified' for silicon dioxide and certain silicates was established at the 29th JECFA (1985).

Information required on:

- *Raw materials used and methods of manufacture for different forms of silicon dioxide (pyrogenic silica, precipitated silica, hydrated silica, silica aerogel and colloidal silica)*
- *Identification methods allowing the differentiation between the above forms of silicon dioxide*
- *Functional uses of different forms, and information on the types of products in which it is used and the use levels in these products*
- *Data on solubility using the procedure documented in "Compendium of Food Additives Specifications, Vol.4, Analytical methods"*
- *Data on the impurities soluble in 0.5 M hydrochloric acid for all forms of silicon dioxide used as food additives, from a minimum of five batches. If a different extraction and determination method is used, provide data along with details of method and QC data.*
- *Suitability of the analytical method for the determination of aluminium, silicon and sodium using the proposed "Method of assay" along with data, from a minimum of five batches. If a different method is used, provide data along with details of the method and QC data.*
- *In addition to the above information, data on pH, loss on drying and loss on ignition for hydrated silica, silica aerogel and colloidal silica*

SYNONYMS

Silica; INS No. 551

DEFINITION

Silicon dioxide is an amorphous substance, which is produced synthetically by either a vapour-phase hydrolysis process, yielding pyrogenic (fumed) silica, or by a wet process, yielding precipitated silica (silica gel). Pyrogenic silica is produced in an anhydrous state, whereas the wet process products are obtained as hydrates or contain surface absorbed water.
(information required on hydrated silica, silica aerogel and colloidal silica)

Chemical names

Silicon dioxide

C.A.S. number

7631-86-9

Chemical formula

(SiO₂)_x

Formula weight

60.08 (SiO₂)

Assay

Pyrogenic (fumed) silica: Not less than 99% of SiO₂ on the ignited basis
Precipitated silica (silica gel): Not less than 94% of SiO₂ on the ignited basis

Hydrated silica: *Information required*
 Silica aerogel: *Information required*
 Colloidal silica: *Information required*

DESCRIPTION

Pyrogenic silica: a pyrogenic silicon dioxide occurring as a fine, white amorphous powder or granules
 Precipitated silica (silica gel): a precipitated, hydrated silicon dioxide occurring as a fine, white, amorphous powder, or as beads or granules
 Hydrated silica: *Information required*
 Silica aerogel: *Information required*
 Colloidal silica: *Information required*

FUNCTIONAL USES

Anticaking agent (information on other functional uses required)

CHARACTERISTICS**IDENTIFICATION**

Identification of different forms *Information required*

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

Test for silicon Passes test
 See description under TESTS

PURITY

pH (Vol. 4) Pyrogenic silica and precipitated silica: 3.5 – 7.5 (5% slurry)
Information required for other forms

Loss on drying (Vol. 4) Pyrogenic silica: Not more than 2.5% (105°, 2 h)
 Precipitated silica (silica gel): Not more than 8% (105°, 2 h)
 Hydrated silica: *Information required*
 Silica aerogel: *Information required*
 Colloidal silica: *Information required*

Loss on ignition (Vol. 4) Pyrogenic silica: Not more than 2.5% (1000°, 1 h) on dried sample
 Precipitated silica, silica gel and hydrated silica: Not more than 8.5% (1000°, 1 h) on dried sample
 Hydrated silica: *Information required*
 Silica aerogel: *Information required*
 Colloidal silica: *Information required*

Impurities soluble in 0.5 M hydrochloric acid Lead : Not more than 5 mg/kg (*Information required*)
 Arsenic: Not more than 3 mg/kg (*Information required*)
 See description under TESTS

TESTS

IDENTIFICATION TESTS

Identification tests for different forms *Information required*

Test for silicon Prepare the test solution as shown under method of assay. Analyze silica 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 20 g of finely ground sample under reflux conditions (to prevent loss of mercury) with 100 ml of 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. Combine the filtrate and wash solution in a 200 ml volumetric flask and make up to volume with 0.5 M hydrochloric acid.

Determine arsenic using an AAS (Hydride generation) technique and lead using an AAS (Electrothermal atomization) technique. See “Metallic impurities” in the Combined Compendium of Food Additive Specifications (Volume 4).

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. Analyze 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:

$$\text{SiO}_2 (\%) = \frac{2.139 \times C \times 250 \times \text{DF}}{W \times 10^6} \times 100$$

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