



Specifications Monograph prepared by the meeting of the Joint FAO/WHO
Expert Committee on Food Additives (JECFA), 97 Meeting 2024

Titanium dioxide

This monograph was also published in: Compendium of Food Additive Specifications. Joint FAO/WHO Expert Committee on Food Additives (JECFA), 97th meeting 2024. FAO JECFA Monographs 32

Titanium dioxide

Revised specifications prepared at the 97th JECFA (2023) and published in FAO JECFA Monographs 32 (2024), superseding specifications prepared at the 76th JECFA (2012) and published in FAO JECFA Monographs 13 (2012). The Committee reaffirmed the ADI “not specified” established at the 13th meeting (1969).

SYNONYMS

Titania; INS No. 171

DEFINITION

Titanium dioxide (TiO₂) is a white crystalline powder used as a colour in various food categories. Food-grade TiO₂ is produced from titanium-containing minerals by either the sulfate or chloride processes.

In the sulfate process, sulfuric acid is used to digest ilmenite (FeTiO₃) or ilmenite and titanium slag. Purification steps include removal of the iron sulfate and crystallization of the TiO₂ into either anatase or rutile forms based on the seed crystals used to induce it. The isolated TiO₂ is finally washed with water, calcined, and milled to a powder.

In the chloride process, titanium-containing mineral is reacted either with chlorine gas or concentrated hydrochloric acid to form titanium tetrachloride, which is purified and thermally oxidised or hydrolysed to give TiO₂. The compound crystallizes in the rutile form. It is then filtered, washed, and calcined.

The article of commerce is primarily produced via the sulfate process and is in the anatase crystal structure and in powder form. Its desired properties are attributed to particles (including aggregates and agglomerates) with size that ranges between 200 and 300 nm. The particle size distribution of food-grade TiO₂ is broad. Typical samples have been shown to contain particles that range approximately from 30 nm to 400 nm.

C.A.S. number

13463-67-7

Chemical formula

TiO₂

Formula weight

79.87

Assay

Not less than 99.0% on the dried basis

DESCRIPTION

White to slightly coloured powder

FUNCTIONAL USES Colour

CHARACTERISTICS

IDENTIFICATION

Solubility (Vol. 4) Insoluble in water, hydrochloric acid, dilute sulfuric acid, and organic solvents. Dissolves slowly in hydrofluoric acid and hot concentrated sulfuric acid.

Colour reaction Add 5 ml sulfuric acid to 0.5 g of the sample, heat gently until fumes of sulfuric acid appear, then cool. Cautiously dilute to about 100 ml with water and filter. To 5 ml of this clear filtrate, add a few drops of hydrogen peroxide; an orange-red colour appears immediately.

PURITY

Loss on drying (Vol. 4) Not more than 0.5% (105 °C, 3 h)

Loss on ignition (Vol. 4) Not more than 1.0% (800 °C) on the dried basis

Acid-soluble substances Not more than 0.5%
Suspend 5.0 g of the sample in 100 ml 0.5 N hydrochloric acid and place on a steam bath for 30 min with occasional stirring. Filter through a suitable tared Gooch crucible fitted with a glass fibre filter paper. Wash with three 10-ml portions of 0.5 N hydrochloric acid, evaporate the combined filtrate and washings to dryness, and ignite at 450 °C ± 25 °C to constant weight. [Caution – Do not expose the crucible to sudden temperature changes.]

Water-soluble matter (Vol. 4) Not more than 0.5%
Proceed as directed under acid-soluble substances (above), using water in place of 0.5 N hydrochloric acid.

Impurities soluble in 0.5 N hydrochloric acid
Antimony: Not more than 2 mg/kg
Arsenic: Not more than 1 mg/kg
Cadmium: Not more than 0.5 mg/kg
Lead: Not more than 5 mg/kg
See description under TESTS

Mercury (Vol. 4) Not more than 1 mg/kg
Determine using AAS (Cold vapour generation technique). The selection of sample size and method of sample preparation may be based on principles of methods described in Volume 4 (under “General Methods, Metallic Impurities”).

TESTS

PURITY TESTS

Impurities soluble in 0.5 N hydrochloric acid

Antimony, arsenic, cadmium and lead (Vol.4)

Transfer 10.0 g of sample into a 250-ml beaker, add 50 ml of 0.5 N hydrochloric acid, cover with a watch glass, and heat to boiling on a hot plate. Boil gently for 15 min, pour the slurry into a 100- to 150-ml centrifuge bottle, and centrifuge for 10 to 15 min, or until undissolved material settles. Decant the supernatant through Whatman No. 4 filter paper, or equivalent, collecting the filtrate in a 100-ml volumetric flask and retaining as much as possible of the undissolved material in the centrifuge bottle. Add 10 ml of hot water to the original beaker, washing off the watch glass with the water, and pour the contents into the centrifuge bottle. Form a slurry, using a glass stirring rod, and centrifuge. Decant through the same filter paper and collect the washings in the volumetric flask containing the initial extract. Repeat the entire washing process two more times. Finally, wash the filter paper with 10 to 15 ml of hot water. Cool the contents of the flask to room temperature, dilute to volume with water, and mix.

Determine cadmium, and lead using an AA-Electrothermal atomization technique, antimony by ICP-AES technique and arsenic using atomic absorption hydride technique.