

## IRON OXIDES

*Prepared at the 69<sup>th</sup> JECFA (2008), published in FAO JECFA Monographs 5 (2008), superseding the specifications prepared at the 63<sup>rd</sup> JECFA (2004), published in the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs 1 (2005). An ADI of 0-0.5 mg/kg bw was established at the 53<sup>rd</sup> JECFA (1999).*

### SYNONYMS

Iron Oxide yellow: CI Pigment Yellow 42 and 43; CI(1975) No. 77492; INS No. 172(iii)  
Iron Oxide Red: CI Pigment Red 101 and 102; CI (1975) No. 77491; INS No. 172(ii)  
Iron Oxide Black: CI Pigment Black 11; CI (1975) No. 77499; INS No. 172(i)

### DEFINITION

Iron oxides are produced from ferrous sulfate by heat soaking, removal of water, decomposition, washing, filtration, drying and grinding. They are produced in either anhydrous or hydrated forms. Their range of hues includes yellows, reds, browns and blacks. The food-quality iron oxides are primarily distinguished from technical grades by their comparatively low levels of contamination by other metals; this is achieved by the selection and control of the source of the iron or by the extent of chemical purification during the manufacturing process.

### Chemical names

Iron Oxide Yellow: Hydrated ferric oxide, hydrated iron (III) oxide  
Iron Oxide Red: Iron sesquioxide, anhydrous ferric oxide, anhydrous iron (III) oxide  
Iron Oxide Black: Ferroso ferric oxide, iron (II,III) oxide

### C.A.S. number

Iron Oxide Yellow: 51274-00-1  
Iron Oxide Red: 1309-37-1  
Iron Oxide Black: 1317-61-9

### Chemical formula

Iron Oxide Yellow:  $\text{FeO(OH)} \cdot x\text{H}_2\text{O}$   
Iron Oxide Red:  $\text{Fe}_2\text{O}_3$   
Iron Oxide Black:  $\text{FeO} \cdot \text{Fe}_2\text{O}_3$

### Formula weight

88.85  $\text{FeO(OH)}$   
159.70  $\text{Fe}_2\text{O}_3$   
231.55  $\text{FeO} \cdot \text{Fe}_2\text{O}_3$

### Assay

Not less than 60% of iron

### DESCRIPTION

Yellow, red, brown or black powder

### FUNCTIONAL USES

Colour

### CHARACTERISTICS

#### IDENTIFICATION

#### Solubility (Vol. 4)

Insoluble in water and organic solvents; soluble in concentrated mineral acids

#### PURITY

#### Loss on drying (Vol. 4)

Iron Oxide Red : Not more than 1.0% (105°, 4 h)

<u>Water-soluble matter</u>	Not more than 1.0% See description under TESTS
<u>Arsenic</u> (Vol. 4)	Not more than 3 mg/kg Determine by the atomic absorption hydride technique. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").
<u>Cadmium</u> (Vol. 4)	Not more than 1 mg/kg Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").
<u>Lead</u> (Vol. 4)	Not more than 10 mg/kg Determine using an atomic absorption/ICP technique appropriate to the specified level. The selection of sample size and method of sample preparation may be based on the principles of the methods described in Volume 4 (under "General Methods, Metallic Impurities").
<u>Mercury</u> (Vol. 4)	Not more than 1 mg/kg Determine by the cold vapour atomic absorption technique.

## TESTS

### PURITY TESTS

Water-soluble matter Weigh accurately 5.0 g of iron oxide, transfer to a 250 ml beaker, add 200 ml of water and boil for 5 minutes; stir to avoid bumping. Cool the mixture, transfer the contents to a 250 ml volumetric flask, rinse the beaker with 25 ml of water, adding the rinsings to the flask; bring to volume with water and mix. Allow the mixture to stand for 10 minutes and filter the solution. Transfer 100 ml of filtrate into a clean dry tared beaker and carefully evaporate the solution to dryness on a boiling water bath. Dry the residue at 105 -110° for 2 hours, cool the beaker with residue in a desiccator, weigh the beaker, and calculate the amount of residue.

$$\text{Water-soluble matter (\%)} = 250 \times W_R/W_S$$

where  $W_R$  is the weight of residue (g) and  $W_S$  is the weight of sample taken (g).

**METHOD OF ASSAY** Weigh accurately about 0.2 g of the sample, add 10 ml of 5 N hydrochloric acid, and heat cautiously to boiling in a 200-ml conical flask until the sample has dissolved. Allow to cool, add 6 to 7 drops of 30% hydrogen peroxide solution and again heat cautiously to boiling until all the excess hydrogen peroxide has decomposed (about 2-3 min). Allow to cool, add 30 ml of water and about 2 g of potassium iodide and allow to stand for 5 min. Add 30 ml of water and titrate with 0.1 N sodium thiosulfate adding starch TS as the indicator towards the end of the titration. Each ml of 0.1N sodium thiosulfate is equivalent to 5.585 mg of Fe (III).