

GUIDELINE FOR THE TREATMENT OF RAW & POTABLE WATER.

Iron & Manganese

The maximum values for the content of iron & manganese in potable/ drinking waters is 0.2 & 0.05 mgL⁻¹ (200 & 50 µgL⁻¹) respectively. In surface waters, iron and manganese are usually present in their oxidised form and are associated with the suspended solids, which can be removed by filtration. In groundwaters, iron and manganese are usually present as soluble salts: removal is achieved by oxidation of the metal salt to form the insoluble metal and subsequent filtration to remove the insoluble metal oxides.

This guidance note is designed to assist in identifying suitable treatment regimes for improving the quality of raw and potable water with respect to the iron and manganese content only; it is not designed to provide absolute advice, as each individual case must be independently evaluated with respect to cost, value and 'best practice', etc. In this respect Waterfall & O'Brien cannot be held responsible for individual decisions and judgements regarding the supply and installation of equipment and materials to safeguard or improve the quality of their private water supplies.

Scope

This guidance note is only applicable to raw and potable water that is intended for drinking, or for use as an agricultural or horticultural water source. These guidance notes are not intended to be used for the clean-up of effluent and contaminated waters.

Guidelines

Both iron and manganese are essential elements to the human body and are taken in appreciable traces in ordinary foodstuffs. Iron is also one of the most frequent constituents of potable water, but fortunately it usually occurs in such minute quantities that its presence can be ignored. Manganese is often associated, in small quantity, with iron in water

GENERAL PHYSICO-CHEMICAL PROPERTIES OF IRON.

Whenever iron occurs in large amounts it imparts to the water an inky flavour which is so objectionable that no one would willingly drink the water, and it could not be considered as pure, although the amount of iron present may not be sufficient to cause the water to be unwholesome. There are also so many other objections to its presence, such as the production of discolouration and turbidity, that the question of wholesomeness rarely if ever arises.

OCCURRENCE OF IRON

Iron is one of the most important and valuable of all the elements. It is essential for the nutrition and healthy development of most plants and animals and is very widely distributed in nature. Iron is present in practically all soils, gravels, sands and rocks, sometimes in considerable amount, but often only in small traces. It is usually found in the form of oxides but carbonates and sulphides also occur. Rain, in percolating through soils and rocks, acquires iron in addition to other mineral constituents according to the character of the geological formation, and there are very few waters, whether from surface or deep sources which do not contain at least small traces of iron.

Iron is usually dissolved in the form of ferrous bicarbonate: the exposure of water to air results in the oxidation of soluble ferrous bicarbonate to insoluble or colloidal ferric hydroxide. The water thus becomes opalescent and discoloured, and a deposit finally forms which undergoes further oxidation. In the oxidation of ferrous bicarbonate, carbon dioxide is released and again becomes available for further iron-dissolving action.

Waters which have been exposed to the atmosphere are frequently found, therefore, to contain iron, part of which is in solution and part in suspension. When drawn from an underground source, the water may initially be clear and bright, but after a short period of time opalescence and deposition, due to oxidation of the soluble salt to the insoluble form, occurs.

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TREATMENT METHODS

Iron deposits gradually accumulate in most water mains, and periodic 'mains-flushing', particularly of dead-ends is advisable, even if there is no specific water treatment process employed. When the question of iron removal is under consideration, it is important to decide what other treatment of the water, if any, is necessary or desirable, as it may be combined with other water purification procedures.

The means by which iron and manganese are removed from water consist substantially of their precipitation by oxidation and removal of free carbon dioxide, followed by separation of the suspension by sedimentation and/or filtration. Aeration may suffice for the preliminary precipitation, but, when the amounts of free carbon dioxide and iron are high, or relatively soluble compounds of iron and manganese are present the addition of chemicals is necessary. Sedimentation tanks, for the removal of the bulk of the precipitate prior to filtration, are usually required when the amount of iron in the water is high or manganese is present. Filters will become overloaded and impossible to operate efficiently if fed with unduly turbid water.

AERATION.

Open aeration, in which the water is projected, splashed or sprayed into the atmosphere, is a simple and economical process in which free carbon dioxide is dissipated, and iron oxidised and precipitated from solution. Cascading in various ways may be used or passing the water through a tower packed with stones and with forced air draught ventilation; these methods will reduce the free carbon dioxide content by 90%. Aeration also dissipates hydrogen sulphide which is not infrequently present in ferruginous waters. Aeration may not suffice to obtain adequate removal of free carbon dioxide and precipitation of iron, and it is seldom effective when manganese is also present in the water. It is worthy of application, however, as a preliminary to the addition of chemicals, since it increases efficiency of treatment and economises in the consumption of chemicals.

CHEMICAL TREATMENT

Lime is the most efficient and economical chemical for use in the removal of free carbon dioxide, iron and manganese, particularly when preceded by aeration. It should be applied in such a dose that the final pH of the water, after settlement and filtration, is in the order of 7.5 to 8.5 range and thorough mixing of lime and water should take place. Adequate sedimentation of the precipitate may take several hours, particularly when manganese is present, and flocculation and deposition may sometimes be accelerated by the use of aluminium sulphate, sodium aluminate or polyelectrolytes. Manganese salts are slow to precipitate, and for their removal the pH of the water should be maintained above 9. The sedimentation tanks must, of course, be provided with facilities for desludging.

References

- 1) Water Treatment and Examination, W.S. Holden, published J. & A. Churchill 1970.