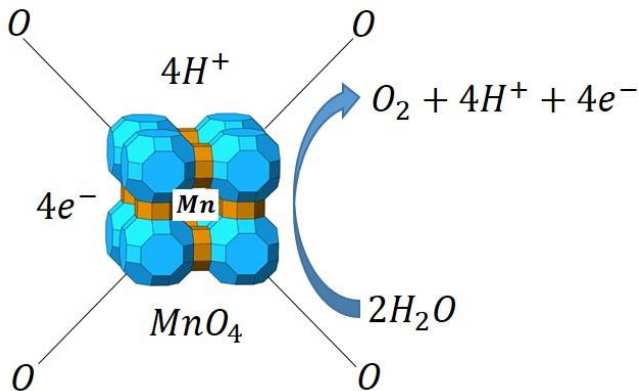


KATALYST - LIGHT

IRON AND MANGANESE REMOVAL FROM GROUND WATER

Watch Water has created a revolutionary catalyst with the highest negative charged surface **for Hydrolysis and for Ions' splitting.**

A) Hydrolysis and Water splitting



All hydrogen Ion's (H^+) are attracted on the surface of Katalyst-Light media as shown in above figure. One **big secret** to the success of the Katalyst-Light is the **extremely large surface of the Gamma-MnO₄**, which is highly negative charged surface media than all previously known manganese based media's.

Subject - pH

- A) Hydrolysis and Water splitting
- B) Precipitation of hydroxides
- C) Precipitation of Carbonates
- D) Oxidation – Reduction reaction
- E) Precipitation of sulfides

Relation among **Redox potential, pH and Ion's content** of water, which is high on hydrogen and bicarbonates.

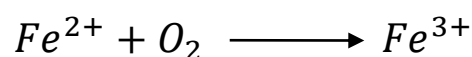
KATALYST
LIGHT™

Sources of Iron, Manganese and pH

Chemistry of Iron in water supplies can exist in either of the following states:

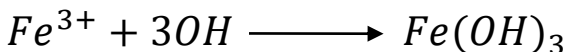
- 1) Divalent ferrous iron Fe^{2+} (soluble)
- 2) Trivalent ferric iron Fe^{3+} (insoluble)

The process of oxidizing divalent ferrous Ion (Fe^{2+}) to trivalent ions (Fe^{3+}) can be described by

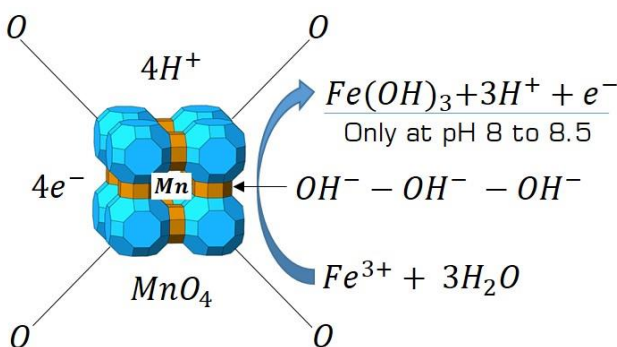


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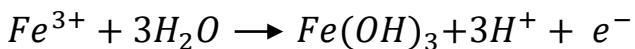
Ferrous iron + oxygen = ferric form
oxidation of ferrous iron into ferric iron
under influence of oxygen $Fe = Fe + e$
but trivalent ferric ion need hydroxyl
group to precipitate in solid form and
the whole sequence of oxidation.



B) Precipitation of Hydroxide



Reduction reaction can be written as



2

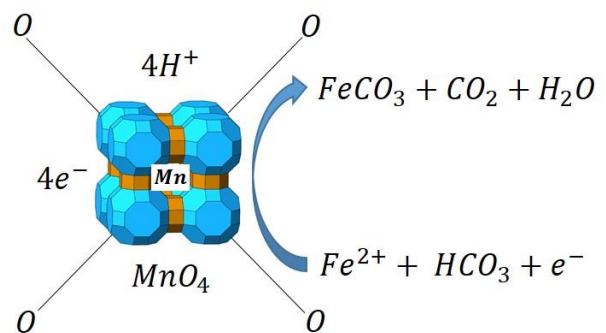
Important to know

The stability of iron depends;

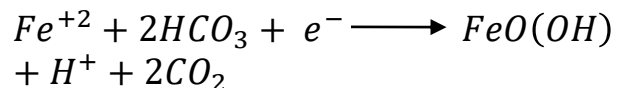
- I. Only on pH of water. (8-8.5)
- II. Activity of electrons which is represented by a redox potential pE.
- III. High positive value of pH indicates oxidizing conditions where iron is insoluble at low pH and value (7-7.5) indicates reducing conditions where Iron is soluble.

C) Precipitation of Carbonates

Most of the iron found in ground water is in the form of bicarbonate by the process of weathering. Iron carbonate reacts with CO_2 and get Fe into the solution.



The soils can have iron content of 1% - 10% depends upon the rocks from where soil was derived. Important Iron minerals are iron carbonate = $FeCO_3$ if the H^+ donors are attracted on the negative surface of Katalyst-Light then CO_2 gas escapes and the pH increases as follows



and iron precipitates. Releases carbon dioxide (CO_2) from the ground water. When this happens, the pH values are increased and hence the Fe^{2+} and Mn^{+2} are changed into the insoluble Fe^{3+} and Mn^{4+} minerals, which are in the form of either

- i. Hydroxide or
- ii. Carbonates

The most dominant form of dissolved iron is the soluble Fe^{2+} under the pH of 5 to 8.

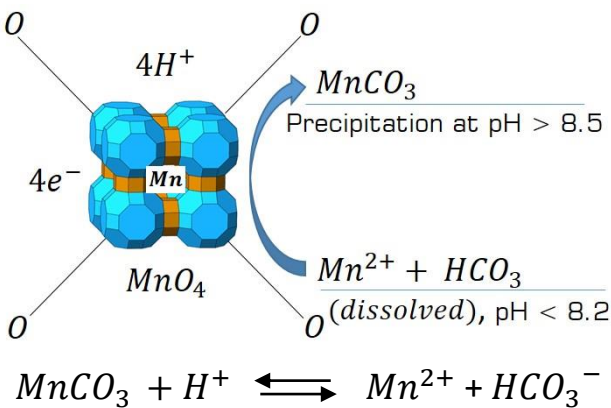
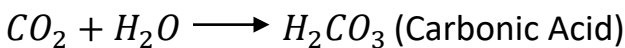


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Chemistry of Manganese

"The two elements Iron and Manganese are often considered together, particularly in the technology of water treatment, because they cause similar problems and any technology should remove both. (BIRM) is bad at removing Manganese. The reason are because Manganese chemistry is different from that of Iron in several important aspects. Manganese is much more difficult to remove from water than Iron. Most of the iron and manganese filter media's fail to remove both at the same time. "

In ground water, Manganese exists in two forms. If bicarbonate species are present in the system and such species are present in practically all natural water because of the widespread availability of carbon dioxide in water.

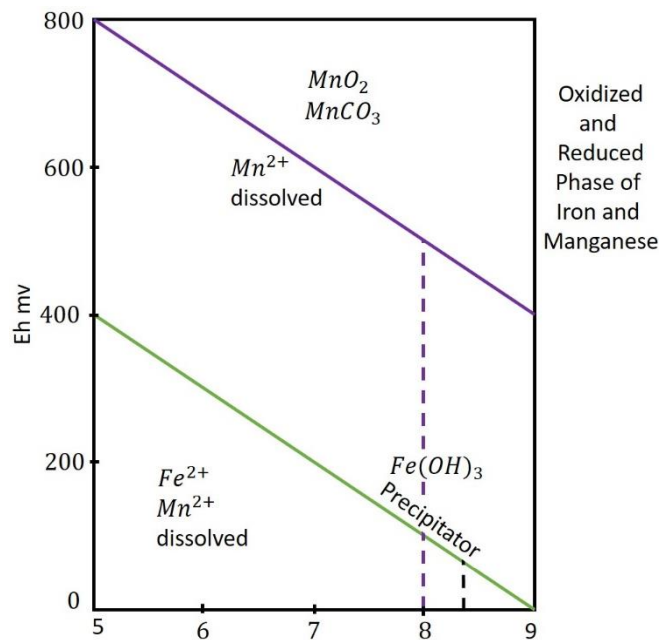


Iron and Manganese Precipitation

"Function of pH and Eh"

The presence of constant total activity of bicarbonate species equivalent to

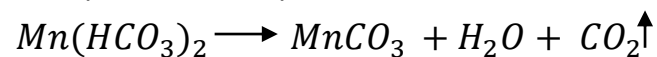
100 mg in HCO_3^- . Figure 2 represents any water with contact with air or from other sources that could supplement the amount of carbon dioxide will dissolve Manganese in Surface water or Ground Water. The pH at which Mn^{2+} activity is 1.8×10^{-7} molar is than at computed be 9.0 as shown in Picture 1.



Picture 1

As the activity of bicarbonate decreases with increasing pH above 8.2, the $MnCO_3$ boundary curves. So any changes of pH in a treated water system containing bicarbonate and changing into carbonate solids will alter the amount of dissolved bicarbonate so that pH shift's can be huge.

The solid of Manganese carbonate is freshly precipitated varies the CO_2 escapes and the pH is increased.



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Also, the equilibrium equation for water of precipitated applies.

$$\frac{[Mn^{2+}][HCO_3^-]}{[H^+]} = 1$$

And the ionic product of treated water is involved.

$$[H^+][OH] = 10^{-14}$$

Manganese involving sulfate

"Manganese sulfate"

Watch Water has made the iron and manganese removal so simplified by coating Gamma Manganese dioxide on very high surface of Zeosorb, where $[Mn^{2+}] = 1.8 \times 10^{-7}$. This is in the pH range, where the concentration of CO_3^- and OH^- can be neglected.

$$[HCO_3^-] = \frac{4.7 \times 10^{-7} \times [H_2CO_3]}{[H^+]} = \frac{6.0 \times 10^{-12}}{[H^+]}$$

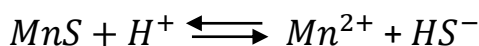
$$[HCO_3^-] = \frac{[H^+]}{[Mn^{2+}]} = \frac{[H^+]}{1.8 \times 10^{-7}}$$

$$\text{Hence, } \frac{[H^+]}{1.8 \times 10^{-7}} = \frac{6.0 \times 10^{-12}}{[H^+]}$$

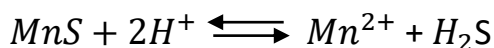
$$[H]^{2+} = 1.08 \times 10^{-14}$$

$$[H^+] = 1.04 \times 10^{-9}, \text{ pH} = 9.0$$

Manganese sulfate is a readily soluble compound as the CO_2 enters the ground water and the pH decreases, MnS (Manganese Sulfide) is dissolved to yield Mn^{2+} as in the equilibrium.

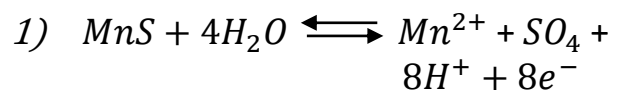
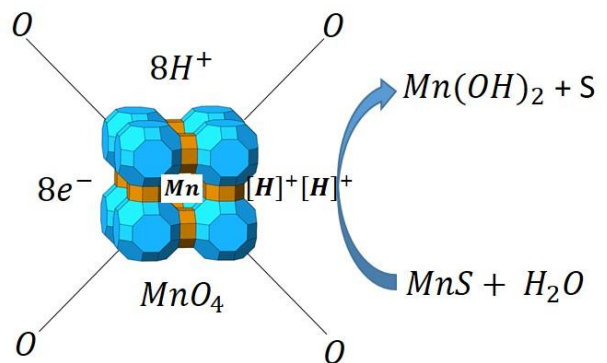


or in equilibrium

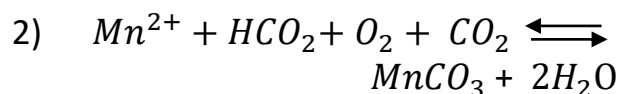


At a high pH, the MnS boundary is affected. Hence, when the pH value is greater than about 10.5 or 11 and when the activity of the sulfur species

is 1000 mg, the MnS field is replaced by the $Mn(OH)_2$ and sulfur as gas leave the water. So pH over 10 in water analysis of Manganese Sulfide is very important. And the simplest explanation of the results seems to be that two-step reaction occurred in which Manganese sulfide was converted to Carbonate.

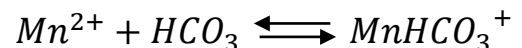


And air released in the system aeration by valve or externally contained some (0.4)% carbon dioxide, as it dissolved, precipitate manganese as the carbonate.



And the pH increased consuming CO_2 and changing the equilibrium

Thus Manganese sulfide dissolved and manganese carbonate precipitate. The dissolved manganese in ground water is always present where certain Anions common in natural water are located.



Is given as 3.0×10^3 . And without the buffering capacity this will upset the pH in water.

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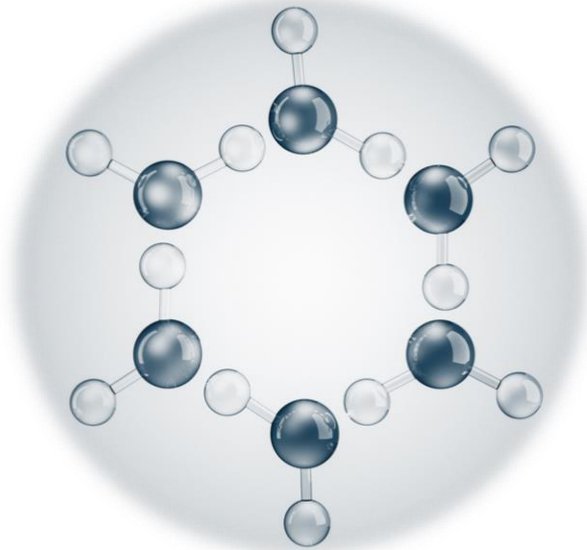
The activity of bicarbonate as shown.

$$\frac{MnHCO_3^+}{[Mn^{2+}]} = 3.0 \times 10^{-3} \times 6.0 \times 10^3 = 9$$

Thus because of no Gas phase is present in treated water raises:

- pH = No CO₂ = Carbon Dioxide
- = No H = HCO₃ = Bicarbonates
- = No sulfur = MnS

Keeps a constant pH of 8-10 depends on buffering capacity of water. The loss of bicarbonate and increase in pH is related in part to equilibrium of the dissolved CO₂ with a portion of previously dissolved CO₂ in Iron, Manganese and SO₄ (sulfate) that has now migrated to the gas phase.



The energy of the Katalyst-Light is very aggressive in the startup of the system and calms down with a continuous backwash of system for 1 to 2 hour's. When a stable pH of 8 to 10 is reached, it retains enough buffering capacity. pH should be all the time over 9.99 to stop HCO₃ complexing.

To know and learn more about this huge potential of **Katalyst-Light** please contact us: