**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 Katalox Light media as shown in above figure. One big secret to the success of the Katalox Light is the extremely large surface of the Gamma-MnO\(_4\), which is highly negative charged surface media than all previously known manganese based media’s.

**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

\[
Fe^{2+} + O_2 \rightarrow Fe^{3+}
\]

**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.

[Diagram of redox reaction with symbols and labels]

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The soils can have iron content of 1%-10% depends upon the rocks from where soil was derived. Important Iron minerals are iron carbonate $\text{FeCO}_3$ if the $\text{H}^+$ donors are attracted on the negative surface of Katalox-Light then $\text{CO}_2$ gas escapes and the pH increases as follows and iron precipitates. Releases carbon dioxide ($\text{CO}_2$) from the ground water. When this happens, the pH values are increased and hence the $\text{Fe}^{2+}$ and $\text{Mn}^{2+}$ are changed into the insoluble $\text{Fe}^{3+}$ and $\text{Mn}^{4+}$ minerals, which are in the form of either

i. Hydroxide or

ii. Carbonates

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

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.

**Important to know**

**B) Precipitation of Hydroxide**

$\text{Fe}^{3+} + 3\text{OH}^- \rightarrow \text{Fe(OH)}_3$

Reduction reaction can be written as

$\text{Fe}^{3+} + 3\text{H}_2\text{O} \rightarrow \text{Fe(OH)}_3 + 3\text{H}^+ + e^-$

**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 $\text{CO}_2$ and get Fe into the solution.
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:

\[ \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \text{ (Carbonic Acid)} \]

\[ \text{MnCO}_3 + \text{H}^+ \rightleftharpoons \text{Mn}^{2+} + \text{HCO}_3^- \]

100 mg in HCO3. 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 Mn2+ activity is \(1.8 \times 10^{-7}\) molar is than at computed be 9.0 as shown in Picture 1.

As the activity of bicarbonate decreases with increasing pH above 8.2, the MnCO3 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 CO2 escapes and the pH is increased.

\[ \text{Mn(HCO}_3)_2 \rightarrow \text{MnCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \]
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.

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

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

Hence,

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

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

Manganese sulfate is a readily soluble compound as the CO2 enters the ground water and the pH decreases, MnS (Manganese Sulfide) is dissolved to yield \(Mn^{2+}\) as in the equilibrium.

\[
MnS + H^+ \rightleftharpoons Mn^{2+} + HS^-
\]

or in equilibrium

\[
MnS + 2H^+ \rightleftharpoons Mn^{2+} + H_2S
\]

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.

\[
MnS + 4H_2O \rightleftharpoons Mn^{2+} + SO_4^- + 8H^+ + 8e^-
\]

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

\[
Mn^{2+} + HCO_3^- + O_2 + CO_2 \rightleftharpoons MnCO_3 + 2H_2O
\]

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.

\[
Mn^{2+} + HCO_3^- \rightleftharpoons MnHCO_3^+
\]

Is given as \(3.0 \times 10^3\). And without the buffering capacity this will upset the pH in water.
The energy of the bicarbonate as shown.

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

\[
pH = \text{No} \quad \text{CO}_2 = \text{Carbon Dioxide}
\]

\[
= \text{No} \quad H = \text{HCO}_3^- = \text{Bicarbonates}
\]

\[
= \text{No sulfur} = \text{MnS}
\]

\[
\text{The activity of bicarbonate as shown.}
\]

\[
\text{Katalox-Light is very aggressive in the start up of the system and calms down with a continuous backwash of system for 1 to 2 hour's. When a stable pH of 8 to 10 is reached, it retains enough buffering capacity. pH should be all the time over 9.9 to stop HCO}_3^-\text{complexing.}
\]

\[
\text{The loss of bicarbonate and increase in pH is related in part to equilibrium of the dissolved CO}_2\text{ with a portion of previously dissolved CO}_2\text{ in iron, manganese and SO}_4\text{ (sulfate) that has now migrated to the gas phase.}
\]

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\text{To know and learn more about this huge potential of Katalox Light please contact us:}
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