Hydrosulfite Bleaching
VERSENE™ Chelating Agents Improve Your Sodium Hydrosulfite Bleaching
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The two most common bleaching agents for mechanical pulps are sodium hydrosulfite and hydrogen peroxide. However, each bleaches the pulp by a different mechanism. Peroxide removes the color-causing components in the pulp by oxidizing them to colorless materials, while hydrosulfite achieves the same goal by reducing the colored components to colorless components. Chelants, such as VERSENE 100 and VERSENEX™ 80 chelating agents, improve the bleaching efficiency of both peroxide and hydrosulfite, although the mechanism of metal ion control differs.

Chelant addition in a peroxide bleaching process results in the removal or deactivation of the transition metal ions, manganese, iron, and copper, which would otherwise waste peroxide by decomposing it to water and oxygen.

Chelant addition in a hydrosulfite bleaching process results in the deactivation or control of iron, which would otherwise participate in the formation of colored compounds. Poor hydrosulfite bleaching has been incorrectly attributed to decomposition of hydrosulfite by transition metals. Hydrosulfite is not decomposed by any of the metals normally encountered in wood pulp.

At the levels normally found in wood, manganese and copper neither affect hydrosulfite stability nor contribute to the poor color of the pulp. Aluminum is often blamed for poor hydrosulfite bleaching, but high aluminum levels, as found when whitewater is recirculated, are almost always associated with high iron levels. Iron is the only metal ion that has an impact on hydrosulfite bleaching due to the formation of Fe^{3+}/phenol complexes. Addition of alum and/or clay on the wet end of the paper machine and the use of recycled fiber, which all contain significant amounts of iron, can result in high iron levels in the whitewater circuit and throughout the mill, depending on the level of water recirculation.

By using VERSENE chelating agents from The Dow Chemical Company, you can control iron and maximize hydrosulfite bleaching efficiency.

Mechanical Pulping and Hydrosulfite Bleaching

There are a number of things that happen to iron during mechanical pulping and hydrosulfite bleaching. In mechanical pulp, particularly TMP, iron is present as colloidal geothite (Fe^{3+}/as FeOOH) formed by heating during the refining of the pulp. The iron is not evenly distributed in the pulp and is very difficult to remove. The iron is not as highly colored as Fe^{3+}/phenol complexes.

Treatment with hydrosulfite reduces Fe^{3+} to Fe^{2+} and Fe^{2+} is considerably more soluble than Fe^{3+}. The Fe^{2+} distributes more evenly in the fiber and becomes associated with the phenols of the lignin.

When hydrosulfite is exhausted, air oxidizes Fe^{2+} to Fe^{3+}, producing deeply colored Fe^{3+}/phenol complexes on the fiber. VERSENE chelating agents used in the hydrosulfite bleaching step will chelate the Fe^{2+} released during the bleaching, thus inhibiting the subsequent association with the phenolic groups. The chelant-Fe complex, even after oxidation by air, is much less colored than the phenolic complex.

EDTA and DTPA can chelate Fe^{2+} as it is released by the action of hydrosulfite. The iron in the chelates is also oxidized by air, but the chelates of iron in this form contribute to less color to the pulp.

![Figure 1: Typical Effect of Chelant Dose on Brightness](image-url)
Recommendations for Hydrosulfite Bleaching
Addition of VERSENE™ chelating agents can be beneficial in the following situations:
- Incoming wood has high iron.
- Refiner plate wear is high.
- Whitewater circulation is high, particularly if:
  - Alum or clay is used.
  - Fines content is high.
  - Recycled fiber is present.
  - Fresh water contains high levels of iron.
  - Sodium hydrosulfite use is high.
  - Brightening efficiency is low/acceptable.

Why You Need VERSENE Chelating Agents
VERSENE chelating agents in a hydrosulfite bleaching process will enable a mill to:
- Meet more demanding brightness targets.
- Reduce brightness reversion.
- Reduce hydrosulfite usage.
- Lower overall chemical costs.
- Increase water recirculation, thus reducing fresh water usage.

How to Use VERSENE Chelating Agents
Use of VERSENE chelating agents can improve your brightening process. The options for addition are:
- Concurrently with hydrosulfite (optimal use).
- Prior to a thickener step before bleaching.
- Split between the above addition points.
- Chelant dose and type determined by lab studies.

Why Use Dow VERSENE Chelating Agents?
Dow can help customers reduce their bleaching costs and make them more competitive. Dow’s pulping and bleaching technical service experts can examine your process, analyze for metal ions, determine the causes of inefficient bleaching and brightness reversion, perform bleaching studies, and make recommendations for optimal operating conditions.

Mill operators know that iron is one possible cause of brightness problems when bleaching with sodium hydrosulfite. If iron is the problem, VERSENE chelating agents from Dow are the solution.

Case Studies

650 ADMT/D Refiner Mechanical Pulp
1 kg/mt VERSENE 100 chelating agent in eye of refiner, mixed and added with sodium sulfite: 0.5 kg/mt. VERSENE 100 chelant added with dilution water at the headbox.
1. Reduced sodium hydrosulfite use by 1.5 mg/mt.
2. Reduced reversion by one brightness point.
3. Reduced corrosion due to thiosulfates.
4. Saved $435 a day.
5. Reduced reversion by 1-2 points across machine.

450 ADMT/D Thermomechanical Pulp (Closed Whitewater)
Startup of Bleach Plant
2-3.0 lbs./ton (1-1.5 kg/mt) VERSENE 100 chelating agent added at latency chest after secondary refiners.
1. Saved 2-4 lbs./ton (1-2 kg/mt) sodium hydrosulfite to achieve target brightness.
2. Controlled metals in closed whitewater system.

600 ADMT/D Thermomechanical Pulp and 40 ADMT/D Deinked Pulp
2-3.0 lbs./ton (1-1.5 kg/mt) VERSENE 100 chelating agent added before deckering. 1-1.5 kg/mt VERSENE 100 chelant added between decker and bleaching tower.
1. Improvements noted after just 3 days.
2. Decreased brightness reversion by 2 points.
3. Reduced hydrosulfite consumption by 3-5 kg/mt to reach target brightness.
4. Saved $800,000 per year.

300 ADMT/D Groundwood & 150 ADMT/D Ultra-High Yield Sulfite (UHYS)
Fines in whitewater contained 630 ppm of iron. 10 kg/mt VERSENE 100 chelant was added to disk filter filtrate.
1. UHYS brightness increased from 47-48 to 51 points.
2. GWD brightness increased from 57-58 to 62-63 points.
3. Paper brightness increased from 58-59 to 60-61 points.
4. Reduced hydrosulfite by 0.4 kg/mt.

600 ADMT/D Thermomechanical Pulp
2.2 kg/mt VERSENE 100 chelating agent added to dilution water prior to bleaching tower.
1. Reduced hydrosulfite usage by 3 kg/mt.
2. Reduced brightness reversion by 3 points.

525 ADMT/D Groundwood & 225 ADMT/D High Yield Sulfite (HYS)
2 kg/mt VERSENE 100 chelating agent was used. 1.45 kg/mt was added to GWD Disk Filter, while 0.55 kg/mt was added to HYS Refiner Chips Screw Feeder.
1. Sulfiti pulp reversion reduced by 64%.
2. Groundwood pulp reversion reduced by 26%.
3. Paper brightness reversion reduced by 43%.
Interested in Learning More?

To learn more about VERSENE™ chelating agents and our supporting services, call us toll-free at +1 (800) 447-4369 or visit www.versene.com. We'll be happy to answer your questions, provide additional literature, and send samples of VERSENE products for your evaluation.

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