



The Power of Applied Science.

Operating Procedure (SOP-01)

Metall:X® Adsorbent Treatability Test

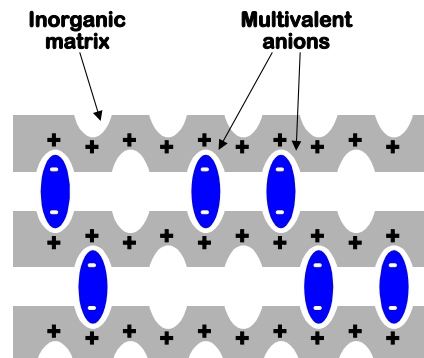
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Introduction

This Operating Procedure describes a simple method for determining if Metall:X® will remove metal from your wastewater. To determine the cost savings by using Metall:X®, please contact us at SolmeteX. We would be happy to work with you to optimize the conditions and dose that meet your discharge levels and save you money.

Metall:X® is available as a powder or in granular form. The powder is dosed into the water to be treated and removed by standard settling/clarification or filtration after a specified contact time. The granular product is packed in a column and the water is pumped through.

Metall:X® is supplied in an active dried state, from which surface adsorbed and chemically bound water have been removed. Prior to use for adsorption of multivalent anions, the adsorbent must be fully rehydrated to obtain maximum binding capacity.



Testing Metall:X® powder simply involves rehydrating the adsorbent, mixing Metall:X® with the wastewater, maintaining contact for a specified period, removing the Metall:X® by settling or filtration, and testing for removal of the desired metal.

Chemistry

Metall:X® adsorbents are manufactured from a non-toxic inorganic mixed metal oxide which contains "charged molecular cavities" that very selectively bind multivalent anions (compounds with 2 or more negative charges), while not binding monovalent anions to any significant extent. The multivalent anions are usually incorporated irreversibly into the platelike crystal structure of the material. Anion binding capacity is typically ~10% of the dry weight of the adsorbent.

Optimizing the performance of Metall:X® usually involves pH control. If possible, it is useful to keep track of pH. Details of what pH range works best for each metal is available upon request. Metall:X® will also bind non-metallic anions such as carbonate, phosphate and sulfate.

Directions for Powdered Metall:X®

Store Metall:X® in an air tight container away from moisture.

1. Make a rehydrated slurry of Metall:X® (in the lab we often use a 100 g of Metall:X®/liter of water slurry) by adding water to Metall:X®. This slurry concentration is convenient for dosing in the range of a few grams of Metall:X® per liter of wastewater. Use whatever concentration of slurry (up to a maximum concentration of 300 g/l) is convenient for your application. Use a container that has an air tight lid. Use clean water for rehydration; distilled or deionized water is recommended if available.
 - Note:** Rehydration releases heat. On the scale of one liter of slurry this should not cause boiling of the water. Rehydration rate is a function of temperature. The higher the temperature, the faster Metall:X® rehydrates and releases heat.
 - Caution:** Metall:X® is basic in nature. The pH of the hydrated material is near 12. Use gloves, safety glasses and avoid splashes!
2. Tightly close the lid. Shake well.
 - Note:** The Metall:X® will pull CO₂ out of the air if not covered. This will reduce its capacity.
3. Let the Metall:X® rehydrate for a minimum of 12 hours.
 - Note:** This will ensure complete rehydration at lab scales.
4. Measure the pH of the wastewater sample to be tested, record.
5. Fill the test bottle with the desired amount of wastewater. Add the desired dose of Metall:X® slurry. Before adding the slurry to the wastewater, make sure that the slurry is well mixed to ensure accurate dosing. If pipetting the slurry, ensure that the tip is wide enough not to get clogged with solids. Thoroughly mix the dosed Metall:X® slurry with the wastewater sample. Metall:X® settles relatively quickly, so some agitation (at least every few minutes) will be needed during contact. The use a magnetic stir bar will grind the Metall:X® into fine particles and is not recommended.
6. Measure the pH of the mixed wastewater and Metall:X® immediately after mixing and record.
7. Allow the Metall:X® powder to remain in contact with the sample for at least 10 - 15 minutes. Some samples may take longer to reach full equilibrium.
8. Measure the pH and record.
9. Separate the Metall:X® from the sample, either by filtering or allowing the sample to settle unagitated until clear.
 - Note:** The settling may take overnight if there is significant unused capacity. Filtering is recommended for quick results.
10. Assay both treated and untreated sample for the metals of interest.
11. The concentration of the Metall:X® slurry can confirmed by quantitative drying. Pipette an aliquot of known volume of slurry onto a pre-weighed watch glass. Dry in a vacuum oven at 60° C for 12 hours. Weigh the watch glass and dried Metall:X®. Subtract the weight of the watch glass to get the weight of the dried Metall:X®. Divide the weight of the dried Metall:X® by the volume pipetted into the watch glass to get the slurry density.

Directions for Granular Metall:X®

Store Metall:X® in an air tight container away from moisture.

1. Using a separate container that has an air tight lid, rehydrate enough Metall:X® to fill your column by adding water to the Metall:X®. Rehydrate with a three fold excess of water. Use clean water for rehydration; distilled or deionized water is recommended if available.
Note: Rehydration releases heat (~250 BTUs/lb). On the scale of one liter of material this should not cause boiling of the water. Rehydration rate is a function of temperature. The higher the temperature, the faster Metall:X® rehydrates and releases heat.
Note: Metall:X® will swell approximately 1.4 times the original volume upon rehydration.
Caution: Metall:X® is basic in nature. The pH of the hydrated material is near 12. Use gloves, safety glasses and avoid splashes!
2. Close the lid tightly. Shake well. Set aside.
Note: The Metall:X® will pull CO₂ out of the air if not covered. This will reduce its capacity.
3. Let the Metall:X® rehydrate for a minimum of 12 hours.
Note: This will ensure complete rehydration at lab scales.
4. The minimum recommended column size is 2.5 cm (~1 inch) I.D. (inner diameter) for this size granule. The packed bed must be at least 10 cm (~4 inches) long. Larger columns may also be used for testing. We have found that a column height to diameter ratio of between 2:1 and 5:1 ratio of works well.
5. Fill the empty column ~1/2 way with clean water. Scoop the hydrated Metall:X® into the column being careful to limit the exposure of the Metall:X® to air. Avoid getting bubbles in the column. In small diameter columns, tap the column on a hard surface while the column is held vertically in order to settle the bed. Allow 1/3 of the column for head space. This aids flow distribution. A flow distributor/deflector or frit is strongly recommended to prevent "jetting" and channeling.
6. Flush the column with 5 to 10 bed volumes of clean water.
7. Measure the pH of the wastewater sample to be tested, record.
8. Begin to pump wastewater through the column. Recommended sample flow is in the range of 1 to 5 minutes of residence time. Thus, a 50 ml bed volume (2.5 cm ID X 10 cm length) can support a 10 ml/minute flow. The recommended linear velocity less than 500 cm/hr (linear velocity is defined as flow rate (ml/hour) divided by the cross sectional area of the column).
9. Filtration after the column is often necessary to remove particles that may carry contaminants. Post-filtration to the 0.5 micron level is common.
10. Run at least 5 - 10 bed volumes of sample through the column prior to the first sample collection (or any time conditions are changed) to allow the column to equilibrate.
11. Measure the pH of the treated sample and record.
12. Assay both treated and untreated sample for the metals of interest.

Technical Support

If you have any questions or problems regarding the testing or use of Metall:X® adsorbents, or would like to discuss your test results, please contact SolmeteX directly at 508-393-5115 (or 508-393-1795 fax).