Seacole Specialty Chemical

Technical Data Sheet

SAT Etch Solution
Ferric Chloride Etchant

Product Description
SAT Etch Solution is a ferric chloride based etchant designed for the photochemical machining process.

Physical Specifications

Baumé at 68°F (20°C)	47.0° to 49.0°
Assay	Anhydrous Ferric Chloride 45.5% to 47.0%
Free Acid as HCl	Negligible
Insoluble Matter	Maximum .005% Through An 8 Micron Filter
Clarity	Sparkling Clear
Specific Gravity (20/4°C)	1.49 to 1.51
Weight per Gallon	12.45 lbs. to 12.55 lbs.
FeCl3 per gallon	5.7 lbs. to 5.9 lbs.

Equipment Requirements
SAT Etch Solution is highly corrosive to all common metals. Therefore, etching machines, tanks and piping for handling this material should be constructed of plastics such as polyvinyl chloride, Koroseal®, Saran, Uscolite, Teflon®, etc. Equipment constructed of titanium, hard rubber or rubber-lined steel is also satisfactory.

Product Make-Up
SAT Etch Solution is used undiluted as an etchant for nickel and nickel alloys, and for various types of stainless steels. It can be modified by the addition of water and hydrochloric acid for the etching of various ferrous and copper alloys.

Operating Parameters
Excellent etching results can be obtained when the etchant is operated at a temperature of 120 to 130°F (49 to 55°C), and the operating Baumé is maintained by the addition of water. Metal alloys that contain a high percentage of iron will quickly consume the available HCl in SAT Etch Solution. Therefore, it is recommended that periodic additions of 20° Baumé hydrochloric acid be made to SAT Etch Solution when alloys of this type are etched in quantity. This will prevent a premature drop in etch rate and the formation of rough etched surfaces.

The following simple procedure can be used to determine if there is sufficient free acid in solution and if not, how to attain the proper mixture.

Procedure

1. Remove 5 milliliters of etchant from the etcher sump and dilute with water to 100 milliliters.
2. If the resulting solution is clear, sufficient free acid is present. If it is murky or cloudy more acid must be added.

To determine the quantity of acid to add to the etchant solution, use the following procedure.

Procedure

1. Remove 100 milliliters of etchant from the etcher sump.
2. Add 1 milliliter of 20° Bé hydrochloric acid and shake or stir for 1 to 2 minutes.
3. Take 5 milliliters of this solution and dilute with water to 100 milliliters and check for clarity.
4. If the sample is not clear repeat Step A, then Step B, except add 2 milliliters of 20° Bé hydrochloric acid.
5. Repeat the above step as many times as necessary to obtain a clear solution, raising the amount of 20° Bé hydrochloric acid in Step B by increments of 1 milliliter each time noting the amounts.
6. When a clear solution is finally reached, the amount of acid to be added to the etcher sump can be calculated as follows:

Calculation

$$\frac{\text{Etcher Capacity (Gallons) X ML of 20° Bé HCL Required to Obtain Clear Sample}}{100}$$

This formula yields the minimum amount in gallons of acid that should be added to bring the free acid up to the same level as that of fresh SAT Etch Solution. Any additions in excess of this amount will depend on the type of alloy being etched and the judgment of the operator.

Control and Replenishment

Analytical Methods For Ferric Chloride Determination

Equipment Needed	Reagents Needed
Stoppered Flask, 250 ml	0.1N Standard Sodium Thiosulfate
	15% Potassium Iodide
	Concentrated HCL
	Starch Indicator

Procedure

1. Weigh accurately 1.5 g of sample into a 250 ml stoppered flask.
2. Add 100 ml of water, 1 ml of conc. HCl, and 20 ml 15% KI.
3. Stopper, mix and let stand in the dark for 10 minutes, add 2 ml of starch.
4. Titrate with 0.1 N Na2S2O3 to a colorless endpoint.

Calculations

$$\frac{(\text{mL Na2S2O3} \times \text{N} \times 16.23)}{\text{sample weight}} = \% \text{ FeCl3}$$

Determination of Free Acid/Alkali

Equipment Needed	Reagents Needed
Beaker, 400 ml	0.1N Standard Hydrochloric
Beaker, Plastic	0.1N Standard Sodium Hydroxide
Top Loading Balance	Potassium Oxalate

Procedure

1. Add 60 g of Potassium Oxalate and 120 ml of water to a 400 ml beaker and mix.
2. Adjust the resulting cold slurry to pH 7.80 and remove electrodes and rinse them to waste.
3. Weigh 10 g of sample in a plastic beaker on a top loading balance. Add sample to slurry, reweigh beaker; the difference is the net weight.
4. Mix 5 minutes. Insert electrodes and mix 5 more minutes
5. Titrate mixture to pH 7.80 using 0.1 N HCl if pH is higher, or 0.1 N NaOH if pH is lower

Calculations

(mL HCl x N x 4.0) / weight = % NaOH
(mL NaOH x N x 3.65) / weight = % HCl

Safety Precautions

Read and understand this product's MSDS before handling.

Waste Treatment

Individual users should verify the nature of spent solutions to assure compliance with local, state, and federal regulations. Contact Seacole for specific details and/or further waste treatment recommendations.

Ordering Information

SAT Etch Solution is available in 375 lbs or 688 lbs drums.

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