

CHEM-BAC *Laboratories, Inc.*

P. O. BOX 19198 CHARLOTTE, N. C. 28219
TEL: 704-394-6381 • FAX: 704-394-6382

Certificate of Analysis

Client: Greensorb
200 S. Wacker Drive, Suite 1500
Chicago, IL 60606
Attn: Tom Uskup

Client Number: 9999
Work Order: 1750-11
Sample Date: 06-20-11
Report Date: 07-12-11

GreenSorb Product Study – Hydrochloric Acid Study

Chem-Bac Laboratories was requested by Mr. Tom Uskup to perform a product study on “GreenSorb”. The product study would encompass the absorbent properties of the product when subjected to common acids used in commercial industry. The acid covered in this report will be Hydrochloric Acid. The report will detail the ratio of GreenSorb to Hydrochloric Acid for complete encapsulation. The report will also reveal data for the neutralization of the encapsulated acid waste product. The neutralization data will include the selection of a neutralizing agent and pH measurements of the waste product with varying concentrations of the neutralizing agent.

Hydrochloric Acid Data

Hydrochloric Acid was selected as one of the test liquids based on its wide commercial use. Hydrochloric acid is used in the chemical industry as a chemical reagent in the large-scale production of vinyl chloride for PVC plastic, and MDI/TDI for polyurethane. It has numerous smaller-scale applications, including household cleaning, production of gelatin and other food additives, descaling, leather processing, and swimming pool maintenance. The most common concentration sold on the market is a 38% (W/W) concentration. Chem-Bac Laboratories selected this concentration as the test liquid for the GreenSorb study. The 38% mass concentration will be referred to as “Hydrochloric Acid” in the remainder of the report.

Determination of Encapsulation Ratio: The encapsulation ratio outlined in this section of the report will be considered the ratio of “GreenSorb” to Hydrochloric Acid required to pass the EPA paint filter test (Method 9095B). The ratio will initially be reported on a weight basis for both the “GreenSorb” and the Hydrochloric Acid. Using the density of the Hydrochloric Acid a volume conversion is also included in the report.

<i>Encapsulation Data – Hydrochloric Acid</i>				
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Weight of GreenSorb (lb)	Weight of Hydrochloric Acid (lb)	Weight Ratio	Time Required for Complete Absorption	Surface Condition Following Absorption
2 lb	1 lb	2:1	3.0 min.	Clean and Dry

Based on an average density of Hydrochloric Acid of 9.92 lb/usgal – It would require 19.8 lbs of “GreenSorb” to absorb 1 gallon of Hydrochloric Acid.

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It should be noted that the GreenSorb did not react violently when subjected to the Hydrochloric Acid. No reaction byproducts such as heat or noxious fumes were noted upon contact with the GreenSorb. The GreenSorb encapsulated the Hydrochloric Acid in a safe and controlled manner. Good ventilation is still necessary during the encapsulation due to the hydrogen chloride fumes released from the acid. Hydrogen chloride fumes can be irritating.

The encapsulated mixture was subjected to a Paint Filter test. The results are as follows.

Paint Filter Liquid Test Results – Method 9095B

Analysis	Result	Reporting Limit	Qual	Units	Batch	Dilution Factor	Date Analyzed
Free Liquid	Negative	0	--	ml	Hydrochloric	--	7/08/11

Discussion of Results: No free liquid was observed at a ratio of 2.0 parts “GreenSorb” to 1 part Hydrochloric Acid.

Neutralizing Agent Selection and pH Data

Once the GreenSorb completely encapsulated the Hydrochloric Acid, Chem-Bac Laboratories evaluated several chemicals to determine the most suitable neutralizing agent for the waste product. The most common types of chemicals used to neutralize acids are hydroxides, carbonates and bicarbonates.

Hydroxides tend to be more caustic than carbonates and bicarbonates and can cause severe burns upon contact with skin or eyes. If inhaled, hydroxides can possibly damage the lungs. Hydroxides will produce much more heat when subjected to Hydrochloric Acid than carbonates or bicarbonates. This increase in temperature may be large and instantaneous which may prove to be a hazard. Hydroxides can also be corrosive.

Several carbonates and bicarbonates were evaluated based on neutralization ability, reaction byproducts, cost, and availability.

Sodium Bicarbonate was selected as the best neutralizing agent for the encapsulated Hydrochloric Acid waste product. The reaction with the encapsulated Hydrochloric Acid has a very low heat of reaction and only gives off carbon dioxide as a byproduct. The Sodium Bicarbonate is readily available as “Baking Soda” and is very cost effective.

Sodium Bicarbonate was placed into contact with the Hydrochloric Acid waste product at different concentrations. The pH of the waste product was measured. A table showing the pH of the waste product and different concentrations of the Sodium Bicarbonate is shown below. The addition of the Sodium Carbonate was stopped when a pH of 7.00 was achieved.

The following table will show the weight of Sodium Bicarbonate added to an encapsulated waste mixture containing 10 lbs of GreenSorb to 5 lbs of Hydrochloric Acid (2:1 ratio) and the resulting pH values.

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Neutralization Data Table (Sodium Bicarbonate)

Weight of Sodium Bicarbonate added to 15 lb Encapsulated Mixture of GreenSorb and Hydrochloric Acid (lb)	Resulting Waste pH
1	1.21
1.5	1.26
2.0	1.33
2.5	1.46
3.0	1.73
3.5	4.46
3.75	5.74
4.0	6.15
4.25	6.38
4.5	6.54
4.75	6.66
5.0	6.81
5.25	6.92
5.45	7.00

If 5.45 pounds of Sodium Bicarbonate are added to 15 pounds of encapsulated waste, the resulting pH will be 7.00. A more simplified ratio would be 1 part Sodium Bicarbonate to 2.75 parts encapsulated GreenSorb waste.

A noticeable pH jump occurs at the 1 part Sodium Bicarbonate to 4.3 parts GreenSorb waste ratio. Depending on the pH requirements of the waste, the ratio selection of the Sodium Bicarbonate can be made from the table above.

In conclusion the GreenSorb effectively and safely encapsulated the Hydrochloric Acid solution. Once encapsulated, the Hydrochloric Acid waste can be safely neutralized by the addition of Sodium Bicarbonate. The encapsulated waste product does not produce a high heat of reaction or demonstrate any of the violent carbon dioxide release that may be seen if the GreenSorb is not used. The ability of the GreenSorb to encapsulate the Hydrochloric Acid makes the neutralization process cleaner and safer.

Chem-Bac Laboratories used a 38% solution of Hydrochloric Acid as the test liquid. GreenSorb will also encapsulate different concentrations of Hydrochloric Acid other than the 38% solution, including Muriatic Acid and other weaker dilutions used to lower pH values in swimming pools. The encapsulation ratio may vary slightly, and adjustments to the neutralizer must be made based on the strength of the acid. The same advantages seen with the 38% solution are expected to occur with weaker concentrations of Hydrochloric Acid. The neutralization process will be safer and cleaner because of the encapsulating ability of GreenSorb. The versatility of GreenSorb to encapsulate varying concentrations of Hydrochloric Acid allows for broad based application use throughout the commercial marketplace.

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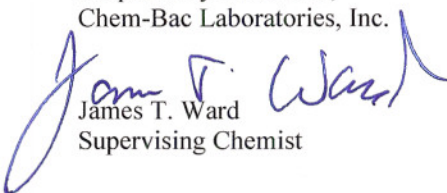
It should be noted that standard personal protection equipment and ventilation should be used when cleaning up acid spills with GreenSorb. Although the GreenSorb reduces the reactivity of the acid, all of the dangers experienced with the handling and contact with acids still exist.

Crushed Clay Comparisor

A sample of crushed clay was also subjected to the Hydrochloric Acid encapsulation testing for comparison purposes. The crushed clay absorbed the Hydrochloric Acid. The physical integrity of the GreenSorb product remained intact following the encapsulation of the Hydrochloric Acid. The physical integrity of the crushed clay granules were compromised. The crushed clay/Hydrochloric Acid mixture resulted in a thick "cement like" mixture. The lack of physical integrity of the crushed clay will most likely affect its encapsulating ability over time.

It should also be noted that the dry, hard granules of the GreenSorb product are easier to clean up and handle following encapsulation than the crushed clay product.

Respectfully Submitted,
Chem-Bac Laboratories, Inc.


James T. Ward
Supervising Chemist