



**Denver, CO**  
8089 S. Lincoln St., # 207  
Littleton, CO 80122  
Ph (303) 347-6388  
Fax (303) 347-6389

**Charleston, SC**  
2358 Treescap Dr.  
Charleston, SC 29414  
Ph (843) 225-5646  
Fax: (843) 225-4455

**San Diego, CA**  
5922-B Farnsworth Ct.  
Carlsbad, CA 92008  
Ph (760) 918-1860  
Fax (760) 918-1855



Website: [www.bugsatwork.com](http://www.bugsatwork.com)  
E-mail: [bbeattie@bugsatwork.com](mailto:bbeattie@bugsatwork.com)  
Public Trading Symbol: BUGS

December 3, 2001

## TECHNICAL BULLETIN: Bio-Regenerated Activated Carbon (BAC™) Demonstration Results at a California Refinery.

Presented are preliminary results of the BAC™ demonstration project conducted at a California Refinery facility. A brief summary of the field procedures and an interpretation of the results are presented below.

### Pay for Performance Demonstration Procedures

SSWM mobilized a demonstration-scale regeneration unit to the facility on October 29, 2001. The carbon was loaded into the treatment bin from a roll-off bin using a backhoe. Approximately 1,500 pounds of carbon were loaded into the treatment bin. Plant water was used to fill a 55-gallon drum located under the treatment bin and microbes and nutrients were added to the drum. SSWM began recirculating the water on Monday, October 29. A schematic of the process is shown in Figure 1.

SSWM personnel returned on Tuesday, October 30, and found that the pH of the water had increased to more than 12 standard units, killing the microbes used to regenerate the carbon. For the next several days, the pH was adjusted using citric, sulfuric, and finally muriatic acid to break the buffering capacity of the carbon. On Monday, November 5, the pH had remained stable over the weekend and microbes and nutrients were added to start the regeneration.

The pH remained stable over the next four days (at approximately 8 s.u.) and a sample of the carbon was collected on Thursday, November 8, for laboratory analysis. The carbon sample was analyzed for Apparent Density and Carbon Tetrachloride activity to determine to what extent the regenerated carbon had been restored to virgin conditions.

### Analytical Results

The samples were submitted to Professional Analytical and Consulting Services (PACS) laboratory in Corapolis, PA for testing. SSWM has worked with PACS and Dr. Henry G. Nowicki during the development of the BAC™ process. Dr. Nowicki is nationally recognized for his expertise in the analysis of activated carbon.

The results of the laboratory analysis are summarized in Table 1.

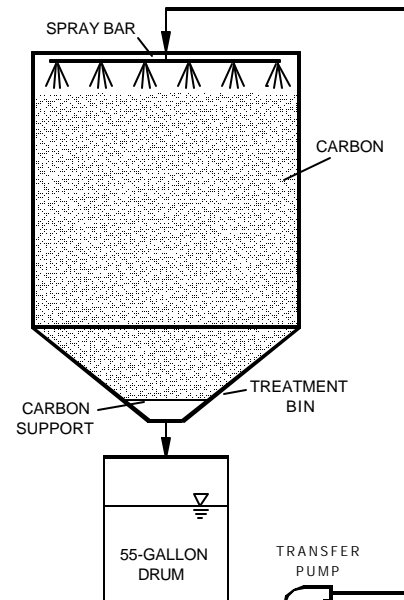


Figure 1 – Process Flow Diagram

**Table 1**  
**Analytical Results**

Test	Result for Bio-regenerated Carbon	Typical Thermally Regenerated Carbon	Typical Virgin Carbon
Apparent Density	0.50 g/cc	0.45-0.55 g/cc	0.45-0.55 g/cc
CCl4 Activity	50 g/100g	50 - 60 g/100g	60 - 70 g/100g

As shown in Table 1, the apparent density of the carbon fell in the middle of the typical ranges for activated carbon indicating that chemicals and inorganic material (silt, bio-mass, etc.) are not infiltrating the pore spaces of the carbon. Additionally, the CCl4 activity has been restored to the low end of the typical range for regenerated carbon. Since the carbon was only processed for 4 days, SSWM believes that the CCl4 activity can be further increased with additional processing time in the bioreactor.

It should be noted that the carbon provided by the facility appeared to be a mixture of pelletized and granular carbon, and it is not known what percentage of the carbon was virgin or regenerated. If the carbon was a mixture of virgin and regenerated carbon, the CCl4 activity of the carbon prior to being placed in service was likely in the range of 55 to 65 g/100g.

Typically, SSWM using BAC™ to reactivate carbon costs approximately \$.45 per pound subject to specific facility requirements for both vapor and liquid phase activated carbons.

For further information contact either:

Jason Nesseth, Senior Project Engineer at (303) 347-6388, extension 3#, email [jnesseth@bugsatwork.com](mailto:jnesseth@bugsatwork.com)

Peter Schmidt, Project Superintendent at (760) 918-1860, extension 112, email [peters@bugsatwork.com](mailto:peters@bugsatwork.com)