



Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

November 7, 2000

Mr. Larry D. Madrid, P.E.
Madrid Engineering Group, Inc.
175 East Summerlin Street
Bartow, Florida 33831

Re: **Liquefied Activated Carbon (LAC)**

Dear Mr. Madrid:

The Bureau of Petroleum Storage Systems hereby accepts Liquefied Activated Carbon (LAC), as an innovative product, for the in situ bioremediation of petroleum-contaminated groundwater and soil via stimulation of indigenous microorganisms. We note that this product, manufactured by SHAC Environmental Products of Alberta, Canada, has been certified by the National Sanitary Foundation (NSF) International to conform to the requirements of NSF Standard 61 for water treatment plant applications. We also note your indication that -- unlike the conventional use of granular activated carbon for the adsorption of contaminants -- this micro-fine carbon (liquefied lignite) is consumed during the bioremediation process, with the ultimate degradation products being carbon dioxide and water. A chemical analysis of LAC is provided as enclosure 1.

There are no objections to the use of LAC provided: (a) the considerations of this letter are taken into account; (b) a Remedial Action Plan is approved by the Department; and (c) the terms of a November 1, 2000 variance granted by the Department to the Madrid Engineering Group are observed. The terms of the variance -- which temporarily allows a zone of discharge where the secondary drinking water standards for aluminum, iron, manganese, thallium and total dissolved solids may be exceeded -- are summarized in enclosure 2. The enclosure also includes a list of environmental and regulatory considerations.

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from an environmental standpoint with respect to applicable rules and regulations, and the interests of public health, safety, and welfare. Vendors must then market the products and processes on their own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace.

Preparers of Remedial Action Plans are advised to include a copy of this letter in the appendix of plans they submit, and call attention to it in the text of their document. In this way, technical reviewers throughout the state will be informed that the Department of Environmental Protection has

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determined the environmental acceptability of this product. To aid those reviewers, supplemental information is provided in enclosure 3.

The Department reserves the right to revoke its acceptance of a product or process if the nature or composition of its ingredients, or its performance, has been falsely represented. Additionally, Department acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case.

A site specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site specific design details must be provided in Remedial Action Plans prescribing the product or process.

Questions regarding petroleum applications of LAC may be directed to Rick Ruscito in the Bureau of Petroleum Storage Systems at (850) 487-3299.

Sincerely,

Rick Ruscito, P.E.
Bureau of Petroleum Storage Systems

enclosures (4)

c: George Heuler - UIC, FDEP/Tallahassee
Cynthia Christen - OGC, FDEP/Tallahassee
Tom Conrardy - BPSS, FDEP/Tallahassee

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ENCLOSURE 1

FULL-STRENGTH LIQUEFIED ACTIVATED CARBON (LAC) CHEMICAL ANALYSIS *

<u>CHEMICAL SPECIES OR PARAMETER</u>	<u>AMOUNT</u>	<u>UNITS</u>
<u>Primary Drinking Water</u>		
<u>Contaminants</u>		
Antimony	< 0.2	mg/L ‡
Arsenic	0.099	mg/L
Barium	17	mg/L
Beryllium	0.06	mg/L
Cadmium	< 0.01	mg/L
Chromium	0.21	mg/L
Lead	0.74	mg/L
Nickel	0.1	mg/L
Selenium	0.22	mg/L
Sodium §	190	mg/L
Thallium *	< 0.5	mg/L
<u>Secondary Drinking Water</u>		
<u>Contaminants</u>		
Aluminum *	640	mg/L
Copper	0.13	mg/L
Iron *	300	mg/L
Manganese *	16.68	mg/L
Silver	< 0.02	mg/L
Total Dissolved Solids *	>500	mg/L
Zinc	1.4	mg/L
<u>Minimum Groundwater Criteria of</u>		
<u>Chapter 62-777, Florida Administrative Code</u>		
Boron	13	mg/L
Cobalt	< 0.1	mg/L
Molybdenum	< 0.1	mg/L
Vanadium	0.63	mg/L
<u>Non-regulated Drinking Water</u>		
<u>Parameters</u>		
Calcium	860	mg/L
Magnesium	270	mg/L
Potassium	32	mg/L
Silica (as SiO ₂ soluble)	170	mg/L
Strontium	11	mg/L

‡ mg/L denotes milligrams per liter.

* Prior to aquifer injection applications, full-strength LAC will be diluted by combining 100 parts clean water with 1 part LAC (by volume). At such a dilution ratio, the following maximum contaminant level (MCL) of 0.002 mg/L for the primary drinking water contaminant thallium, as set forth in Chapter 62-550, F.A.C., will be exceeded. Additionally, at that same dilution ratio, the MCLs shown for the following secondary drinking water parameters will be exceeded: aluminum, 0.2 mg/L; iron, 0.3 mg/L; manganese, 0.05 mg/L; and total dissolved solids, 500 mg/L. As a result of these expected exceedances, the Madrid Engineering Group petitioned for, and was granted on November 1, 2000, a variance for exemption from Rule 62-522.300(2)(a), F.A.C., in order to create a 50-foot zone of discharge around each injection point, where a temporary departure from the drinking water standards set forth in Chapter 62-550, F.A.C., will be tolerated for a period of time not to exceed one (1) year for aluminum, iron, manganese, thallium, and total dissolved solids.

§ Sodium is a State of Florida primary drinking water contaminant with an MCL of 160 mg/L set forth in Chapter 62-550, F.A.C., but not a federal primary drinking water contaminant.

PHYSICAL PROPERTIES DATA FOR FULL-STRENGTH LAC

<u>PARAMETER</u>	<u>VALUE</u>	<u>UNITS</u>
Moisture, loss to 100 °C	95.30	% by weight
<u>Total Solids</u>	<u>4.70</u>	<u>% by weight</u>
Total	100.00	% by weight
Fixed Solids	64.37	% by weight
<u>Volatile Solids</u>	<u>35.63</u>	<u>% by weight</u>
Total	100.00	% by weight
Appearance/Odor	Blackish / brown liquid, clean coal odor	

ENCLOSURE 2

LIQUEFIED ACTIVATED CARBON (LAC): ENVIRONMENTAL AND REGULATORY INFORMATION

For LAC, the major environmental and regulatory concerns are listed below.

- a. Groundwater cleanup standards: The onus shall be on users of LAC to ensure that all applicable groundwater contaminant standards will be met at the time of project completion. This includes the contaminants of concern, any residuals associated with the injected LAC, and any by-products produced as a result of chemical reactions. The following chapters of the Florida Administrative Code are cited: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C. for groundwater classes and standards; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation projects.
- b. Groundwater injection standards: For in situ aquifer remediation, the composition of the injected fluid must meet the drinking water standards set forth in Chapter 62-550, F.A.C., pursuant to underground injection control Rule 62-528.600(2)(d), F.A.C. Additionally, any non-regulated substances injected must meet the minimum criteria for groundwater as defined in Rule 62-520.400(1), F.A.C.

Since the LAC fluid to be injected does not completely meet the drinking water standards of Chapter 62-550, F.A.C, a variance has been granted. It is the intention of the Bureau of Petroleum Storage Systems to make a copy of the variance available at web page www.dep.state.fl.us/dwm/programs/pcp/innovative.htm as soon as possible. In the meantime, the parameters of the variance are summarized in paragraph c below, and the monitoring requirements of the variance are summarized in paragraph f.3.

- c. Variance summary: A November 1, 2000 variance granted to the Madrid Engineering Group is for an exemption from Rule 62-522.300(2)(a), F.A.C., in order to create a 50 foot zone of discharge in the aquifer around each injection point. Within this zone of discharge, a temporary departure from the drinking water standards set forth in Chapter 62-550, F.A.C., will be tolerated for a period of time not to exceed one (1) year for aluminum, iron, manganese, thallium and total dissolved solids. By the end of the 1-year period, the groundwater must meet the required values for these parameters, or the natural-occurring background value for each of them at a given remediation site, whichever is less stringent. The current drinking water standards for these parameters are as follows: aluminum, 0.2 milligrams per liter (mg/L), maximum; iron, 0.3 mg/L, maximum; manganese, 0.05 mg/L, maximum; thallium, 0.002 mg/L, maximum; and total dissolved solids, 500 mg/L, maximum. No other chemical species in LAC are expected to exceed a drinking water standard. However, as a prudent measure, the terms of the variance include monitoring of antimony and lead, for the reason described in paragraph f.3 of this enclosure.

The variance granted by the Department is a general variance, which may be applied to each site-specific LAC Remedial Action Plan submitted hereafter. The Madrid Engineering Group does not have to petition for a new variance each time LAC is proposed for the remediation of a site, provided there is no deviation from the terms of the variance.

- d. Permits for injection wells: Rule 62-528.630(2)(c), F.A.C., allows the authorization of aquifer remediation projects by way of a Remedial Action Plan (RAP) Approval Order (or other enforceable Department approval mechanism) provided the construction, operation, monitoring, and injection well inventory requirements of Chapter 62-528, F.A.C., are met. This simply means that a RAP (or RAP Modification) approval order issued by the Bureau of Petroleum Storage Systems for the use of LAC also serves as the permit for the construction and operation of a Class V injection well.
- e. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Department has no objection to the use of some wells for the injection of LAC. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used for injection. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not also used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each designated tracking well.
- f. Groundwater monitoring: As in any remediation effort, the actual petroleum contaminants of concern are to be monitored in accordance with applicable rules and regulations. Several aspects of monitoring are discussed below.
 - 1. Active remediation monitoring: During the period of active remediation, groundwater shall be monitored for petroleum contaminants of concern in accordance with the requirements set forth in Section 62-770.700, F.A.C., for petroleum contaminated sites. The selection of designated monitoring wells shall be of sufficient quantity to demonstrate remediation of the aquifer.
 - 2. Post active remediation monitoring: At least one (1) year of quarterly post active remediation groundwater monitoring for contaminants of concern shall be conducted at a minimum of two (2) wells, one located in the area of maximum contamination, the other downgradient of the area of maximum contamination. (For specific information about post active remediation monitoring at petroleum contaminated sites, please refer to Section 62-770.750, F.A.C.)
 - 3. Underground injection control monitoring: The Department, for underground injection control purposes, has determined that groundwater sampling, before and after injection, shall be conducted when LAC is injected into an aquifer. The variance granted November 1, 2000 requires that aluminum, iron, manganese, thallium and total dissolved solids, be measured before and after injection, for comparison to their secondary drinking water standards set forth

in Chapter 62-550, F.A.C., or a cleanup site's natural-occurring background values, whichever is less stringent. Additionally, because the natural-occurring lignite from which LAC is manufactured may contain contaminants of varying concentrations, the Department has determined that sampling should include two metals found to be present in concentrations that are appreciable in comparison to their drinking water maximum contaminant levels (MCL). They are antimony (50% of MCL) and lead (33% of MCL).

For the measurement of pre-injection background values, the Bureau of Petroleum Storage Systems suggests at least one (1) monitoring well located upgradient of the contamination plume, or at least one (1) non-upgradient monitoring well, located beyond the edge of the plume, be sampled and analyzed. If more than one well is sampled, then the average value can be used as the background value for the site.

For the post injection sampling of aluminum, iron, manganese, thallium and total dissolved solids, the terms of the variance require that groundwater downgradient of the injection points be sampled. Additionally, the Bureau of Petroleum Storage Systems recommends sampling one or more wells located in the central region of the injection points, where the deviation of variance parameters from their respective standards are likely to be highest.

- g. Underground injection control inventory: Remedial Action Plans prescribing in situ aquifer injection-type remediation shall include information pursuant to Rule 62-528.630(2)(c)1 through 6, F.A.C., for the inventory purposes of underground injection control. Per Rule 62-528.630(2)(c), F.A.C., aquifer remediation projects involving injection wells may be authorized under the provisions of a Remedial Action Plan, provided the construction, operation, and monitoring requirements of Chapter 62-528, F.A.C., are met. A memorandum outlining the inventory information about injection-type aquifer remediation plans to be transmitted by Department reviewers to the Underground Injection Control Section is provided as enclosure 4.
- h. Operation:
 - 1. Avoidance of migration: Injection of LAC shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the LAC or the contaminants already in the aquifer occurs, pursuant to Rule 62-528.630(3), F.A.C.
 - 2. Underground injection control operating permit: Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the contamination plume is expected to accompany LAC injection, the Department requests that the information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction details.

Additionally, each Remedial Action Plan should clearly indicate the total amount of LAC that will be injected.

- i. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order, or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from the inventory list.

ENCLOSURE 3

LIQUEFIED ACTIVATED CARBON (LAC): SUPPLEMENTAL INFORMATION

The information below may be helpful to reviewers of Remedial Action Plans prescribing LAC. It is provided as information only and should not be construed as absolute, nor should it be used as a substitute for technical judgments that should be made on a site-specific basis.

- a. UIC Notification: Department of Environmental Protection reviewers of in situ injection-type aquifer remediation plans, regardless of whether in Tallahassee or district offices, must fill in the blanks on the enclosure 4 memorandum, whose subject is "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Contaminated Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

Local governments contracted by the Department to conduct technical reviews of petroleum Remedial Action Plans and Remedial Action Plan Modification proposals are instructed to follow the March 16, 2000 instructions for approval of such documents, and for submittal of the above memorandum. The March 16, 2000 instructions are included in the Bureau of Petroleum Storage Systems guidance package BPSS-10, titled "In Situ Chemical Additives for Petroleum Remediation", at web page address [/www.dep.state.fl.us/dwm/programs/pcp/geninfo/active.htm](http://www.dep.state.fl.us/dwm/programs/pcp/geninfo/active.htm).

- b. Pilot tests: Pursuant to Rule 62-770.700(2), F.A.C., a pilot study shall be performed when a bioremediation or innovative technology is proposed for the cleanup of a petroleum-contaminated site, prior to designing a treatment system. If conditions or the situation at a site do not warrant a pilot study, then a proposal explaining the rationale for the decision not to perform a pilot study shall be submitted for review, pursuant to a provision of that same rule.
- c. Application, dosage, and injection spacing: Madrid Engineering Group has provided information regarding the usage of LAC. For the remediation of high permeability soils and the underlying groundwater, LAC can be sprayed topically and allowed to percolate downward. For the remediation of low permeability soils and the underlying groundwater, LAC can be poured into 6-inch diameter boreholes that are installed to the soil/water table interface, spaced approximately 4 feet on center. The boreholes are initially filled with a LAC solution prepared by mixing 1 quart of LAC to 25 gallons of water. The boreholes are then "topped", as necessary, for up to 30 days with a LAC solution prepared by mixing 1 quart of LAC to 50 gallons of water.

The Bureau of Petroleum Storage Systems is willing to consider Remedial Action Plans that propose other methods of application that may be suitable for LAC, such as pressure injection into a direct-push borehole. Additionally, the use of site-specific information is preferable, although not necessarily required, when proposing the depth and spacing of injection points, and the volume and concentration of LAC to be applied, when preparing a Remedial Action Plan.

- d. Site conditions: The manufacturer indicates that LAC will function in both aerobic and anaerobic environments.
- e. Surface water applications: If a petroleum-contaminated site that falls under the jurisdiction of the Bureau of Petroleum Storage Systems has impacted a surface water body, and the site is being cleaned up pursuant to Chapter 62-770, F.A.C., then the surface water criteria of Chapter 62-302, F.A.C., may have to be taken into account. However, surface water applications of LAC not associated with the cleanup of petroleum contaminated sites pursuant to Chapter 62-770, F.A.C., are not within the jurisdiction of the Bureau of Petroleum Storage Systems. The bureau neither approves nor disapproves the use of LAC for these applications that are not within its jurisdiction.

**Florida Department of
Environmental Protection**

Memorandum

TO: Richard Deuerling, Mail Station 3530
Division of Water Facilities
Underground Injection Control Section
Florida Department of Environmental Protection
2600 Blair Stone Road, Tallahassee, FL 32399-2400

FROM: _____ (Note 1.)

DATE: _____

SUBJ: **Proposed Injection Well(s) for In Situ Aquifer
Remediation at a Petroleum Remedial Action Site**

Pursuant to Rule 62-528.630(2)(c), F.A.C, inventory information is hereby provided regarding the proposed construction of temporary injection well(s) for the purpose of in situ aquifer remediation at a petroleum-contaminated site.

Site name: _____
Site address: _____
City/County: _____
Latitude/Longitude: _____
FDEP Facility Number: _____

Site owner's name: _____
Site owner's address: _____

Well contractor's name: _____ (Note 2.)
Well contractor's address: _____

Brief description of the in situ injection-type aquifer remediation project:

Summary of major design considerations and features of the project:

Areal extent of contamination (square feet): _____
Number of injection wells: _____
Composition of injected fluid (Note 3)
(ingredient, wt. %): _____

Injection volume per well (gallons): _____
Single or multiple injection events: _____
Injection volume total (all wells, all

Richard Deuerling
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Date: _____

Site name: _____
FDEP facility no.: _____

events): _____

A site map showing the areal extent of the groundwater contamination plume, and the location and spacing of injection wells and associated monitoring wells is attached.

The following is a summary description of the affected aquifer:

Name of aquifer: _____
Depth to groundwater (feet): _____
Aquifer thickness (feet): _____

The injection well(s) features are summarized below, and/or a schematic of the injection well(s) is attached.

Direct-push or Conventional (*circle the appropriate well type*)

Diameter of well(s) (i.e., riser pipe & screen)(inches): _____
Total depth of well(s) (feet): _____
Screened interval: _____ to _____ feet below surface
Grouted interval: _____ to _____ feet below surface
Casing diameter, if applicable (inches): _____
Cased depth, if applic.: _____ to _____ feet below surface
Casing material, if applic.: _____

The in situ injection-type aquifer remediation plan for this petroleum contaminated site is intended to meet the groundwater petroleum cleanup criteria set forth in Chapter 62-770, F.A.C. Additionally, all other groundwater standards will be met at the time of project completion for any residuals associated with the ingredients of the injected remediation products, and any by-products or intermediates produced as a result of the chemical or biochemical transformation of those ingredients or the contaminating petroleum during their use. Applicable primary and secondary drinking water standards are set forth in Chapter 62-550, F.A.C., and additional groundwater quality criteria are set forth in Chapter 62-520, F.A.C.

The remediation plan estimates that site remediation will take _____ months. We will notify you if there are any modifications to the remediation strategy which will affect the injection well design or the chemical composition and volume of the injected remediation product(s).

The proposed remediation plan was approved on _____ by an enforceable approval order. A copy is attached. The remediation system installation is expected to commence within 60 days. Please call me at _____ if you require additional information.

Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: Per agreement with EPA, the FDEP cannot delegate this authority. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should follow the instructions in a March 16, 2000 memorandum to arrange for Department headquarters' execution of an approval order, and then complete this form. This form is primarily for use by state and local program technical reviewers, but petroleum remediation contractors may fill in all blanks except those labeled "FROM", "DATE", and "approval date", and "telephone number" blanks in the last paragraph. Those blanks should be completed only by a state or local program reviewer.

Note 2. If an injection well installation contractor has not yet been selected, then indicate the name and address of the project's general remediation contractor/consultant.

Note 3. Complete chemical analysis of injected fluid is required by Chapter 62-528, Florida Administrative Code. Proprietary formulations shall make confidential disclosure. Injected fluids must meet drinking water standards of Chapter 62-550, F.A.C., unless an exemption or variance has been granted.