



# Department of Environmental Protection

Jeb Bush  
Governor

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

David B. Struhs  
Secretary

December 18, 2000

Mr. Joseph E. Gaudet, President  
Bio-Tech 2000  
420 Clematis Street  
West Palm Beach, Florida 33401

**Re: Hydrocarbon Degradation Formula**

Dear Mr. Gaudet:

The Bureau of Petroleum Storage Systems hereby accepts Hydrocarbon Degradation Formula (HDF) as a product for both in situ and ex situ bioremediation of petroleum hydrocarbon contaminants in soil and groundwater at contaminated sites in Florida. The product is a mixture of non-pathogenic, naturally occurring aerobic microorganisms and nutrients. Enclosure 1 is a chemical analysis of the product.

For in situ vadose remediation, when the underlying groundwater will not be affected by the leaching of this product, there are no special concerns beyond those which would normally need to be addressed in preparing a Remedial Action Plan and conducting a cleanup in accordance with the petroleum cleanup requirements of Chapter 62-770, Florida Administrative Code (F.A.C.). For ex situ groundwater treatment, when an aboveground treatment system produces effluent meeting the petroleum cleanup criteria of Chapter 62-777, F.A.C., as referenced by Chapter 62-770, F.A.C., and the drinking water standards of Chapter 62-550, F.A.C., for disposal via recharge gallery or NPDES permit, there are no special concerns. But for in situ groundwater remediation via injection of the product into an aquifer, there are underground injection control (UIC) regulations that must be observed. Since in situ aquifer remediation via injection is likely to be the most common application of this product, the bulk of the regulatory requirements discussed herein will be directed to that topic.

The bureau recognizes HDF as a viable product for the bioremediation of petroleum contaminated sites in Florida. There are no objections to its use provided: (a) the considerations of this letter are taken into account; (b) a Remedial Action Plan is approved by the Department; and (c) all applicable and appropriate regulations are observed. Additionally, for in situ aquifer remediation projects, either the overall concentration of HDF injected shall be such that the 0.3 milligrams per liter (mg/L) secondary drinking water standard for iron is not exceeded, or a variance for a temporary zone of discharge shall be obtained to permit the injection of more than 0.3 mg/L of iron.

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Enclosure 2 includes a list and a discussion of the regulations that apply.

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 you have contacted the Department of Environmental Protection in regard to HDF. To aid those reviewers, the Bureau of Petroleum Storage Systems provides supplemental information as enclosure 3.

The Department reserves the right to revoke acceptance of any product or process if the nature or composition of either its ingredients or 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. You may contact me at 850/487-3299 if there are any questions.

Sincerely,

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

c: G. Heuler - FDEP/UIC/Tallahassee  
T. Conrardy - FDEP/Tallahassee

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ENCLOSURE 1

HDF CHEMICAL ANALYSIS \*

<u>CHEMICAL SPECIES OR PARAMETER</u>	<u>AMOUNT</u>	<u>DETECTION LEVEL</u>	<u>UNITS</u>
<u>Primary Drinking Water Contaminants</u>			
Nitrate (as nitrogen)	ND †	0.050	mg/L ‡
Nitrite (as nitrogen)	ND †	0.050	mg/L
Sodium §	ND †	1.0	mg/L
<u>Secondary Drinking Water Contaminants</u>			
Iron	0.55	0.010	mg/L
pH	6.3	n.a.	pH units
Total Dissolved Solids	15	4	mg/L
<u>Minimum Groundwater Criteria Contaminants of Chapter 62-777, F.A.C.</u>			
Ammonia (as nitrogen)	ND	0.040	mg/L
<u>Non-regulated Drinking Water Parameters</u>			
Calcium	2.7	1.0	mg/L
Magnesium	ND †	1.0	mg/L
Potassium	ND †	1.0	mg/L
Total Nitrogen	ND †	0.10	mg/L
Total Kjeldahl Nitrogen ☞	ND †	0.10	mg/L
Total Phosphate (as phosphorus in water)	0.13	0.010	mg/L

\* Analysis of HDF at an overall concentration of 5 grams per gallon of water (equivalent to 1.32 milligrams per liter)

† ND denotes not detected at the indicated detection level.

‡ mg/L denotes milligrams per liter.

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

☞ Total Kjeldahl Nitrogen (TKN) is the sum of free ammonia and organic

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nitrogen compounds, expressed as elemental nitrogen.

ENCLOSURE 2

HDF: ENVIRONMENTAL AND REGULATORY INFORMATION

For HDF, the major environmental and regulatory concerns are discussed below.

- a. Applicable rules and regulations: The onus shall be on Bio-Tech 2000 Incorporated and users of HDF to comply with all applicable regulations, particularly those regarding underground injection control and groundwater quality. All applicable groundwater contaminant standards shall be met at the time of project completion for the contaminants of concern, any residuals associated with the ingredients of HDF, and any byproducts produced as a result of chemical or biochemical reactions involving those ingredients. The following chapters of the Florida Administrative Code are cited as applicable but should not be construed as an exhaustive list: 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 wells; Chapter 62-770, F.A.C., for petroleum cleanup criteria; and Chapter 62-777, F.A.C., for contaminant cleanup target levels.

A noteworthy aspect of the minimum criteria set forth in Chapter 62-520, F.A.C., is that it requires groundwater to be free from substances which are harmful to plants, animals, and organisms, and free from substances that are carcinogenic, mutagenic, teratogenic or toxic to human beings. In effect, these "free from" requirements form a catchall. They close what would otherwise be a loophole in the regulations by preventing injection of a potentially harmful product in the event that any of its ingredients is not regulated as a specific primary or secondary drinking water contaminant.

- b. Injection well permit: The issuance of a site-specific Remedial Action Plan Approval Order, by either the Bureau of Petroleum Storage Systems or the Bureau of Waste Cleanup, for injection-type aquifer remediation constitutes the granting of a Class V injection well permit.
- c. Groundwater injection standards: For in situ aquifer remediation, the composition of an 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., and the minimum groundwater criteria set forth in Chapter 62-520, F.A.C. If the Bio-Tech 2000 makes any changes to its formulation of HDF in the future, then the bureau should be notified and provided with a complete chemical analysis of the reformulated product.

- d. Additional nutrients: In the event that a user of HDF decides to augment the injection of it into an aquifer with nutrients or other substances, then that user must provide a complete chemical analysis of the augmenting injection fluid in a Remedial Action Plan. The augmenting fluid must meet the groundwater injection standards described in paragraph c above. An exception to the need for a chemical analysis would be a case in which the augmenting nutrients or substances are on the list of injection-type aquifer remediation products already accepted by the department, for which a chemical analysis has already been provided.
- 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 application of HDF. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling), shall be used to apply HDF. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not 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 injection well.
- f. Groundwater monitoring:
  1. Active remediation petroleum 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. Two noteworthy rules within that section are 62-770.700(3)(i), F.A.C., for frequency of sampling, and 62-770.700(5)(f), F.A.C., which requires a sampling schedule for bioremediation.
  2. Post remediation petroleum monitoring: At least one (1) year of quarterly post remediation groundwater monitoring for petroleum contaminants of concern shall be conducted at a minimum of two (2) wells, one located in the area of maximum petroleum contamination, the other downgradient of the area of maximum petroleum contamination, pursuant to Section 62-770.750, F.A.C.
  3. Underground injection control monitoring: For situations in which the concentration of iron in the injected HDF fluid does not exceed 0.3 mg/L, the department, pursuant to Rules 62-528.615(1)(b)1 and (2), F.A.C., has determined that the tracking of any particular ingredient of HDF shall not be mandatory for underground injection monitoring purposes. For situations where a variance has been issued to cover the injection of HDF containing more than 0.3 mg/L iron, the monitoring requirements of the order granting a variance shall be observed.
- g. Operation:

1. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of HDF shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the product's ingredients or the contaminants of concern in the aquifer results, 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 petroleum contamination plume is expected to accompany the HDF treatment process, 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 volume of fluid and the overall concentration of HDF that will be injected.
  3. Operating parameter measurements: Petroleum cleanup Rule 62-770.700(9)(h), F.A.C., sets forth frequency requirements for the measurement of bioremediation operating parameters such as dissolved oxygen levels, rates of nutrient addition, temperature, etc. It also includes an option for reduction in the frequency or discontinuation of some measurements in situations when appropriate.
- h. Abandonment of wells: Upon issuance of a petroleum 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 tracking list.

ENCLOSURE 3

HDF: SUPPLEMENTAL INFORMATION

The information below, compiled from several sources, may be helpful to reviewers of Remedial Action Plans prescribing bioremediation.

- a. Nature of the product: HDF is a mixture of non-pathogenic, naturally occurring aerobic microorganisms and nutrients. The microorganisms are contained in an inert natural clay and cornstarch and re-hydrated prior to use.

For maximum effectiveness, the Bureau of Petroleum Storage Systems believes that designers of remediation systems should make sure HDF is applied in such a way that adequate vertical and horizontal coverage throughout the volume of soil and/or groundwater to be remediated is achieved. If sufficient oxygen is not present for the microorganisms to be effective, then it may be added artificially. In the case of soil remediation, if ample moisture is not present for the microorganisms to be effective, then it too may be introduced artificially.

- b. 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 Petroleum Remedial Action Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. A similar form is available through the Bureau of Waste Cleanup for notification of injection at a non-petroleum remediation site.

Only reviewers within the Department and its district offices may approve in situ injection-type remediation plans in which the approval constitutes the issuance of a Class V injection permit; local programs are not authorized to grant such approvals.

Reason: Although an arrangement between the US Environmental Protection Agency and the Department delegates underground injection control authority to the Department, it does not allow the Department to delegate that authority any further. This includes delegation to the Department's contracted remediation review agencies such as those operated by the counties and other local governments. Injection approval instructions to the local programs can be found in the Bureau of Petroleum Storage Systems guidance document BPSS-10 titled "In Situ Chemical Additives" at web page /www.dep.state.fl.us/dwm/programs/pcp/active.htm.

- c. Pilot study: For bioremediation, per rule 62-770.700(2), F.A.C., a pilot study proposal shall be submitted for review, and a pilot test shall be performed 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. The state's technical reviewers are encouraged to use judgment in balancing cost and the need for technical information to be obtained from a pilot study. In some cases, only a biotreatability test may suffice. In other cases, perhaps only a sampling of the site for parameters indicative of bioremediation could serve in lieu of a pilot test, to show that some bioremediation is already occurring naturally and that the site may be conducive to enhancements.

- d. Bioremediation indicator samples: Prior to preparation of a remedial action plan for full-scale in situ injection-type aquifer remediation of a site, the bureau recommends the sampling of monitoring wells that are upgradient, within, and downgradient of the groundwater contamination plume for bioremediation parameters, and then comparing the results in order to determine whether intrinsic bioremediation is already occurring across the plume. Paragraph *h* below lists some of the bioremediation parameters that may be sampled. This sampling suggestion is for technical, not regulatory purposes. It is not mandatory but is recommended as a matter of good practice.
- e. Underground injection control inventory: Remedial Action Plans prescribing in situ injection-type aquifer 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.
- f. Bacteria: It is generally reported (on a total weight basis) that bacteria are approximately 70 to 80 percent water. On a dry weight basis, approximately 95 percent of the composition is represented by 5 elements: carbon, oxygen, nitrogen, hydrogen, and phosphorus. At a petroleum remediation site, it is intended that the source of carbon for the growth of bacteria will come from the petroleum hydrocarbons themselves. Naturally occurring organic carbon at a site may also compete with the petroleum or other contaminants being remediated as a carbon source for bacteria. Depending on a site's specific conditions, the remaining four elements must either be available naturally, or added as macronutrients in order to stimulate bioremediation. Micronutrients must also be present for bacteria to grow.
- g. Degradation products: Carbon dioxide and water are the ultimate products of aerobic and most anaerobic biodegradations of hydrocarbons. In the case of methanogenesis, an anaerobic process,

carbon dioxide and methane are produced. The intermediate products of aerobic degradation may include simple acids, alcohols, and fatty acids. Aerobic processes use oxygen as an electron acceptor to produce carbon dioxide and water. When chlorinated organic compounds are biodegraded, the degradation products will include chloride.

- h. Parameters: The following parameters may be useful in determining the potential for bioremediation at a site, or whether bioremediation is already occurring. They were selected from a list that appears in the publication "In Situ Treatment Technology" by E. Nyer et al., Lewis Publishers, 1996. The parameters are: dissolved oxygen; redox potential; pH; temperature; specific conductance; volatile organic compounds; nitrate; nitrite; ammonia nitrogen; manganese (total and dissolved); iron (total, dissolved, and ferrous); sulfate; sulfide; and total organic carbon. Gaseous parameters include carbon dioxide, oxygen, nitrogen, and methane. Other parameters that may be helpful are chemical oxygen demand, biochemical oxygen demand, and total organic carbon. Preparers of bioremediation plans and their reviewers should determine which parameters, if any, should be investigated on a site specific basis.
- i. Dosage: For rule-of-thumb purposes, per information about HDF submitted to the bureau, one (1) pound of HDF can be used to remediate 5 cubic yards of contaminated soil. For groundwater, the dosage will be site-specific.

**Memorandum**

**Florida Department of  
Environmental Protection**

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 events): \_\_\_\_\_

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Site name: \_\_\_\_\_

FDEP facility no.: \_\_\_\_\_

Date: \_\_\_\_\_

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.

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- 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.