



Department of Environmental Protection

Jeb Bush
Governor

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

David B. Struhs
Secretary

March 5, 2002

Mr. Steve Perry
ConSeal International, Inc.
728 Industry Road
Longwood, Florida 32750

Re: Bio-Zyme 1000-HC

Dear Mr. Perry:

The Bureau of Petroleum Storage Systems hereby [reaffirms](#) its acceptance of Bio-Zyme 1000-HC as an innovative product for the remediation of petroleum contamination in groundwater and soil, both in situ and ex situ. Per chemical analysis shown in enclosure 1 and your indication, the product contains only de-ionized water and [natural-occurring non-pathogenic bacteria](#). [This reaffirmation supersedes the original October 21, 1997 acceptance letter, which is hereby updated, including the removal of all references to the American Type Culture Collection \(ATCC\) at the request of the ATCC.](#)

For soil remediation, in situations where groundwater will not be affected by the use of the 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, where an aboveground treatment system produces effluent meeting the petroleum cleanup criteria of Chapter 62-770, F.A.C., and the drinking water standards of Chapter 62-550, F.A.C., for disposal via a recharge gallery or NPDES permit, there are no special concerns. But for in situ groundwater remediation, via direct injection of Bio-Zyme 1000-HC 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 a common application of this product, the bulk of the regulatory requirements discussed herein will be directed to that topic.

The Bureau recognizes Bio-Zyme 1000-HC as a viable bioaugmentation product for the remediation 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) applicable and appropriate underground injection control regulations are observed when the product is used for in situ aquifer remediation via injection.

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

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alternatives in the marketplace. In no way, however, shall this regulatory acceptance letter be construed as Department certification of product or process performance. Additionally, the Department emphasizes a distinction between a regulatory "acceptance" and an approval. Products and processes are accepted; they are not approved. For Bio-Zyme 1000-HC, the major environmental and regulatory considerations are set forth in enclosure 2.

Those who prepare Remedial Action Plans may 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 to inquire about the environmental acceptability of this product or process. To aid those reviewers, the Bureau of Petroleum Storage Systems provides supplemental information in enclosure 3.

The Department reserves the right to revoke its acceptance of a product or process if its nature 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: T. Conrardy - FDEP/Tallahassee

History:

Inn_008.doc
10/21/97

Inn_008a.doc
3/5/02

ENCLOSURE 1

CHEMICAL ANALYSIS OF BIO-ZYME 1000-HC

PARAMETER	RESULT	UNITS
Total phosphorus (as P)	9.4	mg/L
Ammonia Nitrogen	38	mg/L
Nitrite Nitrogen	ND	mg/L
Nitrate Nitrogen	0.38	mg/L
pH	6.87	SU
Total Dissolved Solids (Filt. Residue)*	770	mg/L
Total Suspended Solids (Non-filt. Residue)	240	mg/L
Potassium [K] (total)	13	mg/L
Sodium [Na] (total)	22	mg/L
Calcium [Ca] (total)	46	mg/L
Magnesium [Mg] (total)	7.3	mg/L
Iron [Fe] (total)	0.34	mg/L
Carbon (As Received Basis)	0.01	%
Hydrogen, H	10.80	%
Sulfur (As Received Basis)	<0.01	%
Oxygen (As Received Basis)	89.11	%

* Per the drinking water standards of Chapter 62-550, Florida Administrative Code, a total dissolved solids content greater than 500 mg/L is allowable if no other maximum contaminant level is exceeded.

Notes:

1. All results are on an as received basis for a liquid sample of Bio-Zyme 1000-HC delivered to a third party laboratory, exactly as it is sold by ConSeal International Incorporated: a mixture of de-ionized water and bacteria.
2. Chemical analysis was conducted September 1997.
3. Abbreviations: mg/L denotes milligrams per liter; ND denotes "not detected" at a concentration greater than 0.05 mg/L.

ENCLOSURE 2

BIO-ZYME 1000-HC: ENVIRONMENTAL AND REGULATORY INFORMATION

For Bio-Zyme 1000-HC, the major environmental and regulatory concerns are listed below.

- a. Groundwater cleanup standards: The onus shall be on users of Bio-Zyme 1000-HC to ensure that all applicable groundwater contaminant standards will be met at the time of project completion, for petroleum and any residuals associated with the ingredients of Bio-Zyme 1000-HC, and any byproducts produced as a result of chemical or biochemical 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; Chapter 62-770, F.A.C., for petroleum cleanup criteria; and Chapter 62-777, F.A.C., for cleanup target levels.
- 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. Enclosure 1 shows the complete chemical analysis of the Bio-Zyme 1000-HC blend of bacteria and water, as sold by ConSeal International Incorporated, as determined by a third party laboratory.
- c. Nutrients option: If the groundwater at an in situ aquifer remediation site is found to be deficient in nutrients essential to bioremediation, and the injection of Bio-Zyme 1000-HC is to be augmented by the addition of such nutrients or any other substances, then the Remedial Action Plan for the project must provide a complete chemical analysis of the Bio-Zyme 1000-HC/nutrient mixture. [If the composition of the injected mixture exceeds the drinking water standards set forth in Chapter 62-550, F.A.C., then the Remedial Action Plan, pursuant to Rule 62-522.300\(2\)\(c\), F.A.C., must address the size and duration of a zone of discharge, and groundwater monitoring of parameters that do not meet those drinking water standards.](#) Additionally, if the injected mixture contains substances not regulated as primary or secondary drinking water contaminants by Chapter 62-550, F.A.C., then none of them shall [exceed the minimum groundwater criteria of Chapters 62-520 and 62-777, F.A.C., without first obtaining a zone of discharge variance.](#)
- d. 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 Bio-Zyme 1000-HC. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply Bio-Zyme 1000-HC. 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 injection well.

e. Groundwater monitoring:

1. Active remediation petroleum monitoring: During the period of active remediation, groundwater shall be monitored 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 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: The Department, for the sake of prudence, in its original October 21, 1997 acceptance of Bio-Zyme 1000-HC, required underground injection control monitoring of some primary and secondary groundwater parameters pursuant to Rule 62-528.615(2), F.A.C., even though none of these parameters were exceeded by the composition of the injected Bio-Zyme 1000-HC. It will no longer require monitoring of those parameters for underground injection control purposes for Bio-Zyme 1000-HC.

However, Chapter 62-777, F.A.C., effective August 5, 1999, established a minimum groundwater criterion of 2.8 mg/L for ammonia, which is exceeded by the 38 mg/L concentration of ammonia nitrogen in Bio-Zyme 1000-HC, as shown in enclosure 1. It is therefore now necessary for Bio-Zyme 1000-HC to obtain a zone of discharge variance to inject such a concentration of ammonia nitrogen, and conduct groundwater monitoring of it before and after the use of Bio-Zyme 1000-HC at a site.

- f. Background samples. Prior to commencement of in situ injection type aquifer remediation projects, at least one (1) monitoring well located upgradient of the petroleum contamination plume, or at least one (1) non-upgradient monitoring well, safely located beyond the edge of the plume, shall be sampled and analyzed for the background concentration of these regulated parameters of concern: nitrates, nitrites, and pH. If more than one well is sampled, then the average value of each parameter can be used as the background value for the site.
- 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: For in situ injection type aquifer remediation projects, injection of Bio-Zyme 1000-HC 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 petroleum contaminants 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 Bio-Zyme 1000-HC 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 amount of Bio-Zyme 1000-HC that will be injected.
3. Operating parameter measurements: 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.
- i. 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

BIO-ZYME 1000-HC: SUPPLEMENTAL INFORMATION

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

- a. 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.

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 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.

- b. 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. For state funded projects, reviewers are encouraged to use judgement in balancing cost and the need for technical information to be obtained from a pilot study.
- c. Bacteria: Conseal indicates that on a total weight basis, 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. The Department notes, from other sources, that naturally occurring organic carbon at a site can also serve as a carbon source for bacteria. Depending on 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 the bacteria to grow.
- d. Byproducts: Carbon dioxide and water are the byproducts of aerobic and most anaerobic biodegradations of petroleum hydrocarbons. Aerobic processes use oxygen as an electron acceptor. In the case of methanogenesis, an anaerobic process, carbon dioxide and methane are produced. For some of the other major anaerobic hydrocarbon degradation processes, the byproducts (fate of chemical species involved) also include: the generation of nitrogen (N_2) when nitrate serves as the electron acceptor in nitrate reduction processes; the formation of ferrous (Fe^{+2}) forms of iron in ferric iron (Fe^{+3}) reduction processes; the formation of (S^{-2}) forms of

sulfur when sulfate serves as the electron acceptor in sulfate reduction processes; and the formation of Mn^{-2} forms of manganese when manganese dioxide is reduced.

- e. 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.
- f. Dosage: For in situ hydrocarbon remediations, the manufacturer of Bio-Zyme 1000-HC indicates that one (1) gallon of liquid bacterial blend per cubic yard of contaminated soil may be used as a rough rule of thumb dosage. The precise dose to be used will depend on a site specific evaluation of the type of contaminants present, the concentration of the contaminants, and the nutritional sources available at the site for the bacteria. (The Department assumes that the one gallon per cubic yard of soil rule of thumb may also be used to roughly estimate the quantity and cost of Bio-Zyme 1000-HC required to remediate one cubic yard of aquifer for sites where only the groundwater needs to be remediated.)
- g. Operating parameters: The bioremediation parameters listed below, compiled from product bulletins, are provided as guidance only, and should not be construed as absolute, or used as the sole criteria for approval or disapproval of proposed Remedial Action Plans or remediation status reports.

Total nitrogen:	50-100 mg/L
Total phosphorus:	50-100 mg/L
Temperature:	10-40 deg. C
	30 deg. C, optimum
Moisture content (for soil):	15-20%
pH:	4.5-9.0
	7.0, optimum
Dissolved oxygen:	2 ppm minimum
	> 3 ppm, optimum
Carbon/nitrogen ratio:	20 to 1, maximum
	10 to 1, optimum

**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
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): _____

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Date: _____

Site name: _____
FDEP facility no.: _____

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.