



Department of Environmental Protection

Jeb Bush
Governor

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

David B. Struhs
Secretary

January 11, 2000

Mr. Steve Kraynak
e*cor
2130 East Oranewood Avenue
Anaheim, California 92806

Re: **soilKLEAN**
(formerly HC-Zyme)

Dear Mr. Kraynak:

The Bureau of Petroleum Storage Systems hereby accepts soilKLEAN (formerly known as HC-Zyme) as a product for both in situ and ex situ bioremediation of soil and groundwater at petroleum contaminated sites in Florida. The results of a chemical analysis performed on the full-strength product, prior to dilution for use, are presented in enclosure 1.

This letter supersedes the original October 7, 1999 acceptance letter issued for HC-Zyme. As indicated in your January 4, 2000 correspondence, the name of the product has been changed, as well as the contracted manufacturer, but not the formulation. With the exception of the name change for the product, and deletion of reference to a contracted manufacturer's name, the text of this superseding letter is unchanged.

For 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 products 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 soilKLEAN 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) the terms of a September 8, 1999 variance granted by the Department are observed. The terms of the variance, which creates a zone of discharge, in which a temporary exceedance of four specific secondary drinking water parameters is

tolerated, 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. Vendor's 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 soilKLEAN. To aid those reviewers, the Bureau of Petroleum Storage Systems provides supplemental information as enclosure 3.

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

Sincerely,

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

c: Terry Adair
Perix Industries
100 Canterbury Circle
Niceville, Florida 32578-4412
Phone: (850) 897-8095
Fax: (850) 897-4546
e-mail: adair@cwix.com

Ed Furu, Vice President
Park Environmental Corporation
2130 East Orangewood Avenue
Anaheim, California 92806

G. Heuler - FDEP/UIC/Tallahassee

T. Conrardy - FDEP/Tallahassee

History:

INN_035.doc/pp1 #043 (10/7/1999)
INN_035a.doc/pp1 #066 (1/11/2000)

ENCLOSURE 1

FULL-STRENGTH SOILKLEAN CHEMICAL ANALYSIS *

CHEMICAL SPECIES OR PARAMETER	AMOUNT	UNITS
<u>Primary Drinking Water Contaminants</u>		
Antimony	ND <	mg/L >
Arsenic	ND	mg/L
Barium	0.295	mg/L
Beryllium	ND	mg/L
Cadmium	0.005	mg/L
Chromium	0.23	mg/L
Lead	0.007	mg/L
Mercury	0.002	mg/L
Nickel	0.22	mg/L
Selenium	ND	mg/L
Sodium S	2,400	mg/L
Thallium	ND	mg/L
<u>Non-regulated Drinking Water Parameters</u>		
Bicarbonate	<0.4	mg/L
Calcium	299	mg/L
Carbonate	<0.4	mg/L
Hydroxide	<0.4	mg/L
Magnesium	141	mg/L
Potassium	1,736	mg/L
Total Hardness	1,326	mg/L
Specific Conductance	17,300	umhos/cm %
<u>Secondary Drinking Water Contaminants</u>		
Aluminum	2.58	mg/L
Copper	0.333	mg/L
Iron *	15.4	mg/L
Manganese *	2.89	mg/L
pH *	3.4	standard units
Silver	ND	mg/L
Total Dissolved Solids *	12,000	mg/L
Zinc	0.368	mg/L

* Prior to aquifer injection applications, full-strength soilKLEAN will be diluted by combining at least 16 parts water with 1 part soilKLEAN (by volume). At such a dilution ratio, only four secondary drinking water parameters (iron, manganese, pH, and total dissolved solids) will exceed their respective maximum contaminant levels (MCL) set forth in the June 24, 1997 issue of Chapter 62-550, F.A.C. A September 8, 1999 variance granted by the Department allows a temporary exceedance of the MCLs for iron, manganese, pH, and total dissolved solids in a zone of discharge for a period not to exceed 365 days. The zone of discharge is

defined as a distance of 35 feet, radially, from each point of injection.

◀ ND denotes not detected.

▶ mg/L denotes milligrams per liter.

§ 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.

% umhos/cm denotes micromhos per centimeter.

PHYSICAL PROPERTIES DATA FOR FULL-STRENGTH soilKLEAN

<u>PARAMETER</u>	<u>VALUE</u>	<u>UNITS</u>
Boiling Point	212	°F
Solubility in Water	100	%
Specific Gravity	1.05	
Freezing Point	32	°F
Appearance/Odor	Brown liquid with slight sweet odor	

ENCLOSURE 2

SOILKLEAN: ENVIRONMENTAL AND REGULATORY INFORMATION

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

- a. Applicable rules and regulations: The onus shall be on e*cor and users of soilKLEAN 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 soilKLEAN, 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. For soilKLEAN, it is possible that the secondary drinking water standards for iron, manganese, pH, and total dissolved solids may be exceeded. A summary of the variance granted in regard to these potential exceedances is summarized in paragraph *d* below.
- d. Variance summary: The September 8, 1999 variance granted by the Department is for an exemption from Rule 62-522.300(2)(a), F.A.C., in order to create a 35 foot zone of discharge in the aquifer around each injection point. Within this zone of discharge, a temporary exceedance of the standards for four (4) secondary drinking water parameters will be tolerated for a period of time not to exceed one (1) year. The secondary drinking water standards

set forth by Chapter 62-550, F.A.C., for the four parameters are: iron, 0.3 milligrams per liter (mg/l) maximum; manganese, .05 mg/l, maximum; pH, range 6.5-8.5; and total dissolved solids (TDS), 500 mg/l maximum. By the end of the 1-year period, the groundwater must meet these values, or their naturally-occurring background values at a given remediation site, whichever is less stringent.

The terms of the September 8, 1999 variance, with respect to underground injection control, indicate that monitoring should be site-specific and addressed in a Department-approved remediation plan, and at a minimum such monitoring must include groundwater sampling before and after injection. As an aid to preparers of remedial action plans, the Bureau of Petroleum Storage Systems would like to offer some suggestions on how to comply with the pre-injection and post injection monitoring requirements of the variance, as well as underground injection control Rule 62-528.615(2), F.A.C. It is advised that pre-injection sampling be conducted in at least one (1) monitoring well located beyond the upgradient edge of the groundwater contamination plume, in order to establish background values. It is also advised that post injection sampling be conducted in at least two (2) monitoring wells, quarterly, for a period of one (1) year, with one of the wells located in the central region of the injection points, where the temporary exceedances of the secondary drinking water parameters are likely to be greatest, and the other well located downgradient of the injection points, to determine if unwanted migration has occurred. During post injection monitoring, if a parameter meets its respective secondary drinking water standard or its naturally-occurring background value sooner than one year, then sampling of that parameter may be reduced in frequency or discontinued.

- 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 soilKLEAN. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling), shall be used to apply soilKLEAN. 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.
- 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. For non-petroleum cleanups, the monitoring should be conducted in accordance with the provisions of an approved Remedial Action Plan.
 - 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. For non-petroleum cleanups, the monitoring should be conducted in accordance with the provisions of an approved Remedial Action Plan.

3. Underground injection control monitoring: The September 8, 1999 variance sets forth terms for the underground injection control monitoring of secondary drinking water parameters associated with soilKLEAN. These terms are summarized in paragraph *d* above, where suggestions by the Bureau of Petroleum Storage Systems on how to comply with the terms of the variance are also provided.

g. Operation:

1. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of soilKLEAN 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 soilKLEAN 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 concentration of products 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

SOILKLEAN: 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: soilKLEAN does not contain bacteria. Instead, it is a formulation of non-toxic, biodegradable enzymes, emulsifiers, nutrients, simple sugars, amino acids and other growth agents that stimulate the indigenous bacteria at a petroleum or hydrocarbon contaminated site. If sufficient oxygen is not present in the aquifer at a site, for aerobic biodegradation stimulated by this product, then it may be added artificially, either by air sparging, magnesium peroxide, or other suitable means. In the case of soil remediation, ample soil moisture must be present, and it too, if necessary, 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.

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.

The 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 for 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 suggested sampling is for technical purposes, and should not be confused with the sampling required by the injection variance or the monitoring requirements of Chapter 62-770, F.A.C.

- 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 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 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.
- 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 and application rate: Information submitted by e*cor indicates that, prior to use, one (1) volume of soilKLEAN, shipped as a concentrate, is typically diluted with sixteen (16) volumes of water, which is approximately a 6% solution by volume. Approximately 1 gallon of the concentrate will remediate 8 cubic yards of contaminated soil. Based on this dosage, the bureau assumes that the same amount will remediate at least 8 cubic yards of contaminated aquifer. This dosage information is provided only as a rule-of-thumb; the actual dosage will depend on site-specific conditions.

It is suggested that soilKLEAN be applied in a pulsed fashion over a five (5) week period, with one-fifth (1/5) of the required dose being applied at weekly intervals as a 6% solution.

For soil remediation, the ideal moisture content of the soil is 60% to 80% of the field soil holding capacity. As indicated in paragraph a above, moisture may have to be added artificially, if necessary. And for either soil or groundwater remediation, ample oxygen must be available, or added artificially if necessary.

**Florida Department of
Environmental Protection**

Memorandum

TO: Richard Deuerling, Mail Station 3530
Division of Water Facilities
Bureau of Resource Protection
Underground Injection Control Section

FROM: _____ (Local programs
_____ see Note 1.)

DATE: _____

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

This is to notify you of proposed injection well(s) construction for the in situ remediation of groundwater at a petroleum contaminated site. The following is a description of the site location.

Name: _____
Address: _____
City/County: _____
Latitude/Longitude: _____
FDEP Facility Number: _____

The design of the injection-type aquifer remediation system consists of the following:

Areal extent of contamination (square feet): _____
Number of injection wells: _____
Composition of injected fluid (See note 2)
(ingredient, wt. %): _____

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

Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: The Department, per agreement with EPA, has been delegated this authority but is not allowed to delegate it any further. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should follow instructions in a September 29, 1998 memorandum to arrange for Department headquarters' execution of an approval order.

Note 2. Complete chemical analysis of injected fluid is required by Chapter 62-528, Florida Administrative Code (no exceptions). 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.

Richard Deuerling
Page Two
Date:_____

Site name:_____
FDEP facility no.:_____

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

Excerpts from the remediation plan which describe the site lithology are attached. The following is a summary description of the affected aquifer:

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

A schematic of the injection well(s) is attached. The following is a summary:

Depth of well (feet):_____
Screened interval:_____ to _____ feet below surface
Well casing diameter (inches):_____
Bore hole diameter:_____
If direct-push type well(s), indicate
diameter (inches):_____ and depth (feet):_____

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.