

Department of Environmental Protection

Jeb Bush
Governor

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

Colleen M. Castille
Secretary

February 4, 2005

Mr. Peter Kalleres
Regenesis
1707 Forest Avenue
Neptune Beach, Florida 32266

Re: **ORC Advanced™ Oxygen Release Compound**

Dear Mr. Kalleres:

The Bureau of Petroleum Storage Systems hereby accepts ORC Advanced Oxygen Release Compound as a stimulant for in situ bioremediation of petroleum and other suitable contaminants in groundwater and soil. As Regenesis has indicated, ORC Advanced contains calcium oxyhydroxide, and is formulated in such a way that it slowly releases its full 17 percent (by weight) oxygen when wetted, for the purpose of accelerating the growth of microorganisms that biodegrade contaminants. The chemical composition of ORC Advanced is shown in enclosure 1.

This acceptance applies only to the jurisdiction of this Bureau, which is the cleanup of petroleum pursuant to Chapter 62-770, Florida Administrative Code (F.A.C.). Other bureaus within the Florida Department of Environmental Protection, or other state agencies and local governments may choose to recognize this acceptance if their needs and requirements are similar, but this Bureau is not responsible for applications beyond its jurisdiction.

For vadose remediation, if the underlying groundwater will not be affected by leaching of this product, there are no special concerns beyond those that 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, F.A.C. But for in situ groundwater remediation, via direct injection of ORC Advanced into an aquifer, there are underground injection control (UIC) regulations that must be observed. Since in situ aquifer remediation 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 ORC Advanced 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) applicable and appropriate underground injection control regulations are observed when the product is used for injection-type in situ aquifer remediation. For ORC Advanced, the major environmental and regulatory considerations are set forth in enclosure 2.

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it

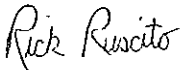
does recognize the need to determine their acceptability from an environmental standpoint with respect to applicable rules and regulations, and the interests of public health and safety. Vendors must then market the products and processes on their own merits regarding performance, cost and safety against competing alternatives in the marketplace. In no way, however, shall this regulatory letter of acceptance be construed as certification of product performance. Additionally, the Department emphasizes a distinction between regulatory "acceptance" and approval. Products and processes are accepted; they are not approved.

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 will be informed that you have contacted the Department of Environmental Protection to inquire about ORC Advanced's environmental acceptability. To aid those reviewers, the Bureau of Petroleum Storage Systems provides supplemental information as enclosure 3.

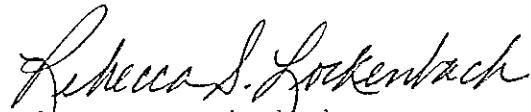
Even though it may be convenient to have an acceptance letter for inclusion in the appendix of a plan, as suggested above, the Bureau would like to emphasize that it is not a requirement for a particular remediation product or process have an official acceptance letter in order to be proposed in a site-specific Remedial Action Plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable and appropriate rules and regulations, especially those of the Florida Administrative Code pertaining to groundwater and underground injection control.

The Department reserves the right to revoke its acceptance of a product or process if 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) 877-1133, extension 29 if there are any questions.

Sincerely,



Rick Ruscito, P.E.
Ecology and Environment, Inc.
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6



Rebecca S. Lockenbach
FDEP Section Leader
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6

c: T. Conrardy - FDEP/Tallahassee

Regenesis
1011 Calle Sombra
San Clemente, California 92673

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ENCLOSURE 1

ORC ADVANCED TM* CHEMICAL COMPOSITION [†]

(Hydrated) Calcium OxyHydroxide [†] [CaO(OH) ₂] also known as (Hydrated) Calcium Oxide Peroxide (CAS no. 666235-17-2)	>60% by weight [§]
Other inorganic calcium compounds (Calcium Hydroxide [Ca(OH) ₂], and Calcium Carbonate [CaCO ₃])	>35% by weight [§]
Phosphates (to control oxygen release over approx. 12 months)	~3% by weight

[†] Information from Material Safety Data Sheet dated November 22, 2004 by Regenesys, San Clemente, California.

[‡] Active ingredient.

[§] Percent by weight for product as shipped by the manufacturer: dry, powder with a bulk density of 0.5 to 0.65 g/ml.

* For in situ injection-type remediation projects, generally, ORC Advanced will be applied as a 20%-40% aqueous slurry. For the pH and total dissolved solids content of the fluid to be injected, Rule 62-522.300(2)(c), Florida Administrative Code, allows an injection zone of discharge.

To comply with the rule, a Department-approved Remedial Action Plan proposing the use of ORC Advanced must: (a) indicate that the fluid to be injected will not meet the secondary drinking water standard of 6.5-8.5 for pH, and that it will not meet the 500 milligrams per liter secondary drinking water standard for total dissolved solids; (b) indicate a zone of discharge size (i.e. a radius of influence for each injection point); (c) indicate the period of time during which the injected fluid could temporarily exceed the secondary drinking water standards for pH and total dissolved solids; and (d) propose adequate groundwater monitoring of pH and total dissolved solids.

ENCLOSURE 2

ENVIRONMENTAL AND REGULATORY INFORMATION

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

- a. Groundwater cleanup standards: The onus shall be on users of ORC Advanced to ensure that all applicable groundwater contaminant standards will be met at the time of project completion, for the contaminants of concern, any residuals associated with the ingredients of ORC Advanced, 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: 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.

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 that 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 remediation via injection of ORC Advanced into an aquifer, constitutes the granting of a Class V injection well permit. [62-528.630(2)(c) and 62-528.640(1)(c), F.A.C.]
- c. Groundwater injection standards: For in situ aquifer remediation, pursuant to Chapter 62-528, F.A.C., the composition of an injected fluid must meet the drinking water standards set forth in Chapter 62-550, F.A.C., and the minimum groundwater criteria described in Chapter 62-520, F.A.C. The minimum groundwater criteria set forth in Chapter 62-777, F.A.C., also apply. The Bureau of Petroleum Storage Systems is aware that the chemical analysis of enclosure 1 for ORC Advanced will not meet the secondary drinking water standards of 500 mg/L for total dissolved solids and the 6.5 to 8.5 range for pH. Therefore, in order to use ORC Advanced for injection-type in situ aquifer remediation, rule 62-522.300(2)(c), F.A.C., must be applied to these secondary drinking water parameters that do not meet injection requirements.

Rule 62-522.300(2)(c), F.A.C., effective August 27, 2001, allows a temporary zone of discharge for aquifer remediation purposes, within which a temporary exceedance of the primary and secondary drinking water parameters is tolerated when ORC Advanced is injected. In order to comply with the rule, a Department-approved site-specific remediation plan proposing ORC Advanced must: (a) identify the secondary parameters pH and total dissolved solids, whose standards are exceeded by the composition of the fluid to be injected; (b) indicate the size and duration of the temporary zone of discharge; and (c) propose groundwater

monitoring of the secondary parameters in the fluid that do not meet injection requirements.

The manufacturer indicates, as a rule of thumb, that a one (1)-year zone of discharge period should suffice in most cases, and that a zone size of not much more than 1 foot, radially from the point of injection is sufficient for pH, since it decreases rapidly with distance. The Bureau of Petroleum Storage Systems does not dispute the claim in regard to the pH, but instead would like to encourage those who prepare Remedial Action Plans to use a site-specific zone duration time and size whenever possible. Historically, for Florida applications, most injection-type aquifer remediation products have used a zone size in the range of 10 to 50 feet radially from each injection point, which the Bureau believes is reasonable, since this is neither too small nor too large, yet leaving enough room for some variation to occur at a site without causing a violation of the zone size that was permitted as part of the Remedial Action Plan approval process, pursuant to Rule 62-522.300(2)(c), F.A.C.

- 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 ORC Advanced. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply ORC Advanced. 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 monitoring of petroleum: 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 non-petroleum cleanups, the monitoring should be conducted in accordance with the provisions of an approved Remedial Action Plan.
 2. Post remediation monitoring of petroleum: During the period of post active remediation, groundwater monitoring for petroleum contaminants of concern shall be conducted in accordance with the requirements set forth in 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. Monitoring for underground injection control purposes: Pursuant to rule 62-522.300(2)(c), F.A.C., groundwater monitoring of the primary and secondary drinking parameters set forth in Chapter 62-550, F.A.C., that are not met by a fluid injected for aquifer remediation must be addressed in a Department-approved Remedial Action Plan. Additionally, if an injected fluid does not meet the minimum groundwater criteria of Chapters 62-520 and 62-777, F.A.C., then groundwater monitoring must be conducted for the specific parameters associated with the necessary temporary zone of discharge variance for the injection of such a fluid. In the case of ORC Advanced, only the secondary drinking water parameters for pH and total dissolved solids are not met by the fluid to be injected, so the groundwater monitoring of those two parameters must be addressed in a Department-approved Remedial Action Plan.

- f. 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.
- g. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of ORC *Advanced* 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.
- h. Operating parameters: Section 62-770.700, 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.
- j. Surface waters: The Bureau anticipates that most applications of ORC *Advanced* Oxygen Release Compound will be at petroleum cleanup sites where groundwater is in need of remediation, but surface waters will not be nearby, or at least not affected by the groundwater or remediation activities to clean up the groundwater. Therefore, the small amount of phosphate present in the ORC *Advanced* Oxygen Release Compound should not be of great concern in these cases.

If surface waters, however, happen to be present, and could be affected by the chemicals used to clean up the groundwater, then sufficient consideration should be given to the phosphate and its potential to affect the surface water. Given that the amount of phosphate in ORC *Advanced* is relatively small, and not likely to be highly mobile, the potential threat to surface waters should be very small, if any at all. And if for some reason a question or a concern should arise, then background or upstream surface water samples could be taken for analysis of phosphate prior to the use of the ORC, in order to establish a baseline phosphate concentration. The Bureau suggests that judgment and common sense be used when surface waters are nearby, and that phosphate be handled as an issue when necessary, but not necessarily as a routine matter that always requires surface water sampling.

- k. Open pit applications: The application of ORC *Advanced* to an open excavation pit prior to backfilling, for the purpose of remediating groundwater, is not an injection. In such cases, it is not necessary to notify the Underground Injection Control Section by using the notification memorandum in enclosure 4. However, this does not release the user from the responsibility of making sure that no long-term negative groundwater impacts occur as a result of the chemicals added to the pit. In the case of ORC *Advanced*, it may be prudent to measure the

pH and total dissolved solids concentration of the groundwater in the pit area prior to application, and to measure them again some time after the application, in order to demonstrate that the groundwater meets the 6.5 to 8.5 standard for pH and the 500 mg/L maximum standard for total dissolved solids, or their natural-occurring background levels, whichever is less stringent. Additionally, it may be helpful to know that drinking water regulations will tolerate a total dissolved solids concentration greater than 500 mg/L, but only if no other parameter's standard is exceeded.

ENCLOSURE 3

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 injection-type in situ 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 the appropriate bureau chiefs and division directors within the Department and its district offices may sign in situ injection-type remediation plan approval orders that constitute the granting of a Class V injection permit. Local program staff may review such plans but are not authorized to sign the approval orders. 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 Section 62-770.700, 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.
- c. 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. Natural-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.
- d. 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.
- 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 inorganic carbon. Those who prepare bioremediation plans and their reviewers should determine which parameters, if any, should be investigated on a site-specific basis.

- f. Vendor information: Below is some of the information included in the submittal by Regenesys for ORC *Advanced* that the Bureau of Petroleum Storage Systems would like to pass along to readers of this letter.

(Hydrated) Calcium Oxide Peroxide [CaO(OH) ₂] (white powder)	60% by weight, minimum
Other inorganic calcium compounds Calcium Hydroxide [Ca(OH) ₂] Calcium Carbonate [CaCO ₃]	35% by weight, minimum
Active Oxygen	17%
Solubility	1.65 g/l at 68 °F (for calcium hydroxide) [Ca(OH) ₂]
pH	11 to 13 (saturated solution)
Loose Bulk Density	0.5 to 0.65 g/ml
Theoretical weight ratio of oxygen to BTX for aerobic degradation	3:1
Application Rate (typical, examples) (tailor to site-specific conditions)	Sands: 15 lbs per vertical ft. (max.) Silts & clays: 10 lbs per ft. Minimum: 4 lbs per ft.
Application strength	20% to 40% aqueous slurry

- g. Limitations: Not recommended for free product.

Florida Department of
Memorandum 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): _____

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 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 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', '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 injection zone of discharge has been permitted by Rule 62-522.300(2)(c), F.A.C., or by variance.