



Department of Environmental Protection

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David B. Struhs
Secretary

April 14, 2003

Ms. Nancy Forrester
FET Group
P.O. Box 3652
Vero Beach, Florida 32964
Phone: (407) 758-9033

Re: **IOS-500 Accelerated Composting**

Dear Ms. Forrester:

The Bureau of Petroleum Storage Systems hereby accepts IOS-500, a patented process for accelerated thermophilic composting of soil that is heavily contaminated by petroleum. The process is intended primarily for ex situ bioremediation of soil. As indicated by the information you submitted, the process can handle soil containing as much as 450,000 parts per million (ppm) petroleum hydrocarbons in 4 to 6 weeks. And as indicated for a case history, it reduced petroleum hydrocarbon contamination from 89,174 ppm to 13,000 ppm (an 85% reduction) in 3 weeks.

As indicated by IOS, the targeted application in Florida at this time is the onsite cleanup of petroleum-contaminated soil, in accordance with an approved site-specific Remedial Action Plan pursuant to Chapter 62-770, Florida Administrative Code (F.A.C.), which is the jurisdiction of this bureau. Other bureaus within the Department of Environmental Protection, or other state agencies may recognize this acceptance if it suits their needs and purposes. This bureau, however, is not responsible for applications beyond its jurisdiction.

A typical ex situ application of IOS is the composting of contaminated soil in windrows, approximately 9 feet high and 15 feet wide. This composting process involves the use of IOS-500 natural-occurring non-pathogenic bacteria with sterilized food-grade compost, and user-supplied amendments such as cattle manure, yard waste or fruit and vegetable residues, and a small amount of water. The process offers an opportunity to treat two types of wastes at the same time: the petroleum-contaminated soil and the amendments, since these amendments themselves are usually considered waste materials.

A copy of this letter in its entirety, and its accompanying enclosure, should be provided in the appendix of site-specific Remedial Action Plans proposing IOS-500. In this way, a Remedial Action Plan technical reviewer anywhere in the state will be informed that the bureau has evaluated the acceptability of the process from a regulatory standpoint. Enclosure 1 discusses some regulatory and other considerations that may need to be taken into account when using IOS-500 and amendments.

While the bureau does not endorse 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

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products and processes on their own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace. In no way, however, shall this regulatory acceptance letter be construed as certification of product performance. Additionally, the Department emphasizes a distinction between its regulatory "acceptance" and an approval. Products and processes are accepted but they are not approved.

The bureau reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, bureau 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 850/245-8911 if there are any questions.

Sincerely,

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

c: Bob Rawson, President
IWS
P.O. Box 157
Sebastopol, California 95473

Tom Conrardy, PCS3, Tallahassee

History:

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ENCLOSURE 1

REGULATORY AND OTHER CONSIDERATIONS FOR IOS-500 COMPOSTING

1. Availability of regulations: Chapters of the Florida Administrative Code that are cited below can currently be found at web page www.dep.state.fl.us, in a sidebar under the heading "Categories", under "Rules".
2. Biopile classification: For regulatory purposes, the Bureau of Petroleum Storage Systems classifies IOS-500 composting as a "biopile" for the treatment of contaminated soil, since its windrows can be as high as 9 feet. While it is similar in some ways to land farming, a distinction is made between the biopile and land farming. The bureau's classification of IOS-500 composting as a biopile is consistent with the United States Environmental Protection Agency publication titled How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-95-007, May 1995, Solid Waste and Emergency Response 5403W. Biopiles are also known as biocells, bioheaps, biomounds, and compost piles.
3. Source Removal: Although there may be some similarities between soil remediation via biopile and soil remediation via land farming, it should be noted that Rule 62-770.300(2), F.A.C., allows only land farming for petroleum Source Removal without prior approval by the Florida Department of Environmental Protection or its contracted local government programs. If IOS-500 composting can be adapted to meet the land farming requirements of Rule 62-770.300(2)(b), F.A.C., including the maximum soil thickness of twelve (12) inches, then it can be used as a method of Source Removal for petroleum-contaminated soil pursuant to Section 62-770.300, F.A.C., without prior approval.

Users of IOS for Source Removal are instructed to read the land farming requirements of Rule 62-770.300(2)(b), F.A.C., in detail. For the sake of convenience, they are summarized here: (a) a 200-foot minimum distance from any residence, park, or school; (b) ample area to spread soil to a thickness of 12 inches; (c) control of access to the land farm; (d) use of sturdy, weather-resistant materials; (e) an impermeable liner supported by berms; (f) biweekly tilling; (g) a cover; (h) monitoring, including monitoring of additives; (i) 180-day maximum; and (j) soil cleanup target levels of Chapter 62-777, F.A.C., apply. The bureau would like to discourage the use of cattle manure as an amendment if IOS-500 composting is adapted to a relatively thin 6 to 12 inch layer for land farming, for Source Removal, pursuant to Section 62-770.300, F.A.C. The reason is that sufficient bulk may not be present to maintain temperatures high enough to destroy pathogens that could be present.

If a windrow biopile of height greater than 12 inches is contemplated for Source Removal, then it would be more appropriate to employ the method as an approved Remedial Action Plan, pursuant to Section 62-770.700, F.A.C., as indicated in Rule 62-770.300(2)(c), F.A.C. And if the Source Removal will be performed as neither land farming nor as work authorized by an approved Remedial Action Plan, then approval of an Alternate Procedure and Requirement pursuant to Section 62-770.890, F.A.C., is necessary.

4. Permits: As indicated by IOS, the targeted application for IOS-500 composting in Florida at this time is the onsite cleanup of petroleum-

contaminated soil, in accordance with an approved site-specific Remedial Action Plan pursuant to Chapter 62-770, Florida Administrative Code (F.A.C.). No permit is needed for this type of application, but the remedial action requirements of Section 62-770.700 apply. As for the operation of IOS-500 composting as either a commercial, stationary soil treatment facility, or as a commercial, mobile soil treatment facility, a permit is required pursuant to Chapter 62-713, F.A.C.

5. An appropriate regulation: Even though the Source Removal Task requirements of Rule 62-770.300(2)(b), F.A.C., were written for land farming, some those same requirements may be helpful or appropriate for Remedial Action Task work pursuant to Section 62-770.700, F.A.C., when IOS-500 composting in a biopile is involved. Those who prepare Remedial Action Plans, and technical reviewers of those plans, are encouraged to use judgment in determining which land farming regulatory requirements may also be appropriate for composting. For example, it may be appropriate to keep the IOS windrows a safe distance from residences, parks and schools; there must still be ample room to perform the operation at the site; access to the public should be restricted, etc.
6. Design and operating parameters: The design features and engineering controls of an IOS-500 composting project should be such that groundwater and nearby surface waters will not be adversely affected by petroleum contaminants and nutrient leachates from the fertilizer-like compost, should any leaching occur.

Information about operating conditions for thermophilic composting is readily available in textbooks, and in US EPA publications such as that which is mentioned in paragraph 2 above, EPA 510-B-95-007. The "RAP Checklist", currently available from the Bureau of Petroleum Storage Systems at web page www.dep.state.fl.us/waste/categories/pcp/pages/active.htm, does not contain information specific to composting, but it does contain a list of topics for "Land Farming of Soil". Most of the land farming topics in the checklist are applicable to the closely related topic of composting. Those who prepare Remedial Action Plans, and technical reviewers of those plans, are encouraged to use judgment on a site-specific basis in determining which land farming topics in the RAP Checklist are also appropriate for IOS-500 composting.

The table below is a summary of the most important biopile physical conditions listed in EPA publication 510-B-95-007 for the biodegradation of petroleum-contaminated soil. These conditions are not to be construed as absolute, and they are not to be construed as specific to the IOS-500 composting process. They are, instead, presented for the sake of conveying some general information to readers unfamiliar with biopiles, in need of a broad overview of the most important physical conditions. For operating conditions specific to the IOS process, readers are instructed to contact IOS.

Microbial Population	Greater than 1,000 Colony Forming Units (CFU)/gram
Soil pH	Range 6 - 8
Soil Moisture Content	12% - 30% by weight (roughly 40% - 85% of field capacity)
Soil Temperature	10 °C - 40 °C (50 °F - 104 °F) during treatment. See note 1.
Nutrient Concentrations	Carbon:Nitrogen:Phosphorus (C:N:P) ratio between 100:10:1 and 100:1:0.5
Soil Texture	Free of clays that could cause clumping and poor aeration.
Total Petroleum Hydrocarbons (TPH)	Less than 50,000 parts per million (ppm). See note 2 for IOS capabilities.
Heavy Metals	Less than 2,500 ppm, otherwise may be toxic to the microbes.
Oxygen	Essential for aerobic microbial activity. Turn the compost pile periodically to replenish oxygen levels.

Note 1: Temperature during treatment is for biodegradation of petroleum contaminants. If cattle manure is used as an amendment, as is possible during the IOS-500 composting process, and destruction of pathogens is an objective as a result, then the windrow may have to be held at the high end of this temperature range, or higher, for a period of time sufficient for the destruction of pathogens that could be present.

Note 2. For the patented IOS process, soil with petroleum contamination as high as 450,000 ppm can be treated in 4 to 6 weeks. One particular IOS case history reports that soil contaminated with 89,174 ppm petroleum hydrocarbons was reduced to 13,000 ppm in 3 weeks.

7. Destruction of pathogens: It is neither the role nor the intent of the Bureau of Petroleum Storage Systems to serve as the omniscient technical authority on every conceivable aspect and detail of every remediation product and process that is marketed. Rather, the bureau evaluates products and processes from a regulatory standpoint, placing emphasis on the identification of applicable and appropriate rules and regulations, and safety of the public. The destruction of pathogens is one of these aspects that may be a concern when cattle manure is used as an amendment during the IOS-500 composting process. The onus is on users and developers, who have intimate knowledge of their process, to ensure that operating conditions are such that pathogens will not be a problem in the soil upon completion of the treatment.

Readers interested in learning more about pathogen destruction as it applies to composting are advised to consult textbooks, articles, and government publications on the subject. Technical information about the related subject of sewage plant sludge treatment "Processes to Significantly Reduce Pathogens (PSRP)", and "Processes to Further Reduce Pathogens (PFRP)" appears to be directly applicable to concerns about pathogens that may arise during IOS composting.

One source cites PSRP conditions for the composting of sludge, which is generally considered to be an approximate 90 percent reduction in pathogens. For windrows, it is necessary to maintain a minimum temperature of 40 °C (104 °F) for at least 5 days, of which 4 hours must be greater than 55 °C (131 °F). For PFRP, which is described as capable of reducing pathogens to negligible numbers, the conditions are as follows for windrow composting: a minimum temperature of 55 °C (131 °F) for at least 15 days, with 5 turnings of the windrow during the high temperature period. Users of IOS-500 composting, and technical reviewers with questions about time and temperature requirements for the IOS composting process, as they apply to pathogen destruction, are advised to contact IOS directly.

In the course of its literature search on the subject of pathogen reduction, the Bureau of Petroleum Storage Systems found that "liming" (the use of lime to create a high pH) can be kept in mind as a backup, in the event that pathogens are not satisfactorily reduced. Irradiation could also be a backup to keep in mind, should there ever be a need to further reduce the number of residual pathogens in soil treated by the IOS process when cattle manure is used as an amendment.

The bureau instructs users of the IOS process to take samples, for analysis, to verify that unacceptable levels of pathogens are not present in the treated soil when cattle manure is used as an amendment. The analysis should cover E. Coli, Salmonella, and any other pathogens that could have been present initially, to verify their absence after treatment. For comparison purposes, it may also be a good idea to sample the mixture of soil and amendments for pathogens at the start of the treatment.

8. In situ applications: As IOS has indicated, the IOS-500 composting process can also be used for onsite in situ treatment of contaminated soil. For such applications, the bureau believes that site-specific hydrogeologic conditions should be considered in order to evaluate the suitability of the site, and design features and engineering controls incorporated as necessary to ensure that leachate, if any, does not adversely affect the underlying groundwater. While it may be feasible to perform IOS-500 composting in situ, the bureau, from a prudent standpoint, prefers onsite ex situ treatment, since controls can be more easily implemented to completely encircle the compost mass, to prevent the escape of nutrient and petroleum contamination leachates.
9. Disposal: If petroleum-contaminated soil treated by the IOS-500 composting process meets the Direct Residential Exposure and Groundwater Leachability Soil Cleanup Target Levels of Chapter 62-777, F.A.C., (and no pathogens are present if cattle manure was the amendment) thereby qualifying for an unconditional declaration of No Further Action, then there are no restrictions on the use of the soil. A related regulation that the bureau believes is worth citing regarding disposal, albeit for land farming rather than biopile composting, is Rule 62-770.300(2)(b)10, F.A.C., from the August 5, 1999 issue of Chapter 62-770, F.A.C.

There may also be disposal considerations specific to soil treated by the IOS-500 composting process. For example: the disposal location and conditions should be such that ammonia, nitrate, phosphorus and potassium from the fertilizer-like compost do not adversely affect the groundwater and nearby surface waters, should any leaching of these nutrients occur after treatment.

10. Soil Cleanup Target Levels (SCTL): The soil cleanup target levels for petroleum and other contaminants for an unconditional declaration of No Further Action are the Direct Residential Exposure and Leachability levels of Table II in Chapter 62-777, F.A.C. The lower of the two levels shall be met. For example, the current direct residential exposure soil cleanup level for benzene is 1.1 milligrams per kilogram (mg/Kg), and its soil cleanup level for leachability based on groundwater cleanup criteria is .007 mg/Kg. Therefore, the lower of the two goals to be met is the leachability goal of .007 mg/Kg.

SCTLs for pathogens. When cattle manure is used as an amendment, consideration should be given to the potential for pathogens to be present, and the destruction of them during the treatment process. The bureau is aware that thermophilic composting is widely used as a process to reduce pathogens in sludge from sewage treatment plants. When cattle manure will be used as an amendment during IOS-500 composting of petroleum-contaminated soil, it may be helpful for users to review, beforehand, for guidance, some related federal and state regulations about pathogens and the composting of sewage treatment sludge.

Of particular interest may be Title 40 of the Code of Federal Regulations (CFR), currently available from the National Archives and Records Administration, on the internet, at web page www.access.gpo.gov/ecfr. The sewage sludge regulations are located in 40 CFR, Part 503, Section 503.32, titled "Pathogens". Maximum pathogen levels are given for Class A sewer sludge, for which the State of Florida does not restrict use, as indicated in Rule 62-640.400, F.A.C. There are currently six (6) ways set forth in 40 CFR to meet the pathogen requirements of a Class A sludge, but they all have a common overall requirement: either a fecal coliform density of less than 1000 Most Probable Number per gram of total solids (dry weight basis), or a density of *Salmonella* sp. bacteria less than three Most Probable Number per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed, or at the time it is prepared for sale or give away in a bag or other container for application to the land. Users of IOS-500 are advised to read 40 CFR for further information and details. There is also a Class B sewage sludge specification listed in 40 CFR, with less stringent pathogen requirements, for disposal with restrictions.

As a regulatory body, the Bureau of Petroleum Storage Systems would like to convey its opinion regarding Soil Cleanup Target Levels to users of IOS-500 when cattle manure is an amendment. Since the soil cleanup target levels for petroleum contaminants must meet those set forth in Chapter 62-777, F.A.C., for direct residential exposure and leachability for groundwater, for a declaration of No Further Action without conditions, pursuant to petroleum cleanup Chapter 62-770, F.A.C., for unrestricted use, then it should follow that the level of pathogens present in IOS-treated soil be required to meet those of a Class A sewage sludge, in order to remain qualified for unrestricted use.

Similarly, just as a conditional declaration of No Further Action, restricting use, is necessary when remediated soil does not meet the unconditional petroleum cleanup target levels of Chapter 62-777, F.A.C., it follows that the use of IOS-treated soil should be restricted when it meets only the less stringent pathogen requirements of a Class B sewage sludge. The appropriate institutional and engineering controls imposed as restrictions should be addressed in a conditional declaration of No Further Action, pursuant to petroleum cleanup Rule 62-770.680(2), F.A.C., August 5, 1999

The State of Florida regulation that appears most appropriate as guidance when pathogens may be present in petroleum-contaminated soil treated by the IOS-500 composting process, when cattle manure is an amendment, is Chapter 62-640, F.A.C., "Domestic Wastewater Residuals". It incorporates by reference the pathogen requirements of Title 40 CFR, Part 503, Subpart D, Section 503.32.