United States
Environmental Protection
Agency

Risk Reduction
Engineering Laboratory
Cincinnati, OH 45268

Research and Development

EPA/600/SR-92/096 June 1992

EPA

Project Summary

Potential Reuse of Petroleum-Contaminated Soil: A Directory of Permitted Recycling Facilities

James H. Nash, Seymour Rosenthal, George Wolf, and Marilyn Avery

Soil contaminated by virgin petroleum products leaking from underground storage tanks is a pervasive problem in the United States. Economically feasible disposal of such soil concerns the responsible party (RP), whether the RP is one individual small business owner, a group of owners, or a large multinational corporation. They may need a starting point in their search for an appropriate solution, such as recycling.

This summary describes a more comprehensive report that provides initial assistance in two important areas. First, it discusses four potential recycling technologies that manufacture marketable products from recycled petroleum-contaminated soil: the hot mix asphalt process, the cold mix asphalt system, cement production, and brick manufacturing. The report also presents the results of a project survey designed to identify recycling facilities. It lists recycling facilities alphabetically by location within each state, organized by U.S. Environmental Protection Agency (EPA) Region. The facilities shown have each reported that they are operating either under a permit or another required vehicle of formal state approval, at the time of the survey; that they have temporarily ceased previously approved operations; or that they are in the final stages of the permit/approval cycle and expect to begin operations shortly. The report also includes detailed addresses, recycling locations, telephone numbers, and contacts for these facilities. The scope of the project limits listings to fixed facilities or small mobile facility owners that recycle soil contaminated by virgin petroleum products into marketable commodities. It does not address site-specific or commercial hazardous waste remediation facilities.

The Project Summary was developed by EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Soil contaminated by virgin petroleum products leaking from underground storage tanks is a pervasive problem in the United States. Economically feasible disposal of such soil concerns the responsible party (RP), whether the RP is an individual small business owner, a group of owners, or a large multinational corporation. Disposal of such soil is costly, both in terms of money and landfill resources.

Federal legislation makes the generator responsible for soil contaminated by chemical materials, even if the contaminants are virgin products rather than processed waste [40 CFR 261.3(a)(92)]. In the case of a large corporate site, the responsible party may need a starting point for a competent technical team that can explore the appropriate remedies and implement them. At the other extreme, however, for a small business, finding an economically feasible remedy may be more difficult. A typical example is the gasoline station owner who has arranged to have an old tank removed/

replaced, but is then left with a substantial pile of excavated, contaminated soil, covered by a tarpaulin pending cleanup.

Public Law 98:616 (the reauthorization of the Resource Conservation and Recovery Act, called RCRA, published in 1984) mandates the development and implementation of an extensive regulatory plan for underground storage tanks (USTs). The U.S. Environmental Protection Agency (EPA) must promulgate the agency regulations that protect human health and the environment. Therefore, EPA must define long-term corrective actions for the treatment of petroleum-contaminated soils at UST sites regulated under RCRA Subtitle I.

Under RCRA, soil contaminated by virgin petroleum product is not considered a hazardous waste. However, the individual states, and even individual communities, have the right to legislate standards that are more restrictive than federal statutes. Such regulations, peculiar to a particular state or community, can and do change rapidly. Past trends indicate that the future may bring even more restrictive statutes on a state-by-state basis or even on the federal level [42 USC 6901 *et seq.*, RCRA Section 3006(a)]. Therefore, the persons or companies responsible for the disposal or recycling of petroleum-contaminated soil must periodically familiarize themselves with any applicable legislation, and any changes to such legislation, on the national, state, county, and municipal level.

Due to differing statutes and random changes, the concept of a permitted facility cannot be uniform. For the purposes of this summary, "permitted" will mean that the facility operates with formal governmental authorization. This may take the form of an air permit, a RCRA permit, certification, or some other vehicle from the appropriate governing body that formally authorizes the facility's operation. In some cases the permitting is required for the manufacturing process, regardless of whether petroleum-contaminated soil is part of the raw material.

This summary concentrates the information contained in a more comprehensive report of the same title. The full report focuses on fixed recycling facilities that are authorized to accept soils contaminated by virgin petroleum products. It discusses four technologies that transform such material into marketable products: the hot mix asphalt process, the cold mix asphalt system, cement production, and brick manufacturing. The report also includes a user-friendly, quick-reference table listing the names and locations of recycling companies in each state that allows such services, supplemented by a detailed directory of specific contacts for further information. It does not address facilities that handle hazardous wastes or address recycling at commercial hazardous waste facilities. Since most states consider petroleum-contaminated soil only a solid waste, these recyclers neither require RCRA Part B permitting nor listing RCRA data bases as transportation/storage/disposal (TSD) facilities.

Procedure

A two-stage survey methodology provided the framework for preparing the full report and this project summary. During Stage I, surveyors contacted authorities and private companies in each state to identify its facilities for recycling petroleum-contaminated soil. This stage contained four segments: a brief review of some extant listings of treatment facilities; telephone interviews of selected permit personnel in EPA regional offices to identify region-specific facilities and knowledgeable state contacts; requests to each state UST and LUST office for information on facilities; and a telephone survey of recyclers to gather basic information about their operations.

Stage II refined the scope of the survey, supplemented the listings, and reviewed some of the earlier information. This stage designed a revised, more user-friendly report that would provide a more streamlined table, divided not only by EPA Region, but also by state, which would pinpoint recycling facilities for ready access according to the primary user's first concerns: location and identity. The report would then tabulate the capacity, cost, product, and contaminant issues that would help the RP make a "first cut" of potential resources. A detailed directory would follow the table, enabling the user to easily find all the necessary information for follow-up inquiries after initial identification.

In addition to the revised Directory, Stage II produced a more thorough discussion of the targeted marketable products (hot mix asphalt, cold mix asphalt, cement, and brick) that when supplemented with additional illustrations would aid the RP in better understanding the potential of recycling technologies. The concept of a marketable product received added attention because it lowers the recycling cost and increases the environmental value of the selection. Also, the targeted application (i.e., universal assistance to RPs with widely varying volumes of contaminated soil) eliminated irrelevant site-specific remediation facilities incorporating these technologies. To clarify the scope of the report, the governing definition of "recycling" in the report was limited to the reuse of petroleum-contaminated soil for another purpose. Therefore, it also precluded the listing of onsite "treat and dispose" operations.

Discussion of Technologies

Each technology section contains the same components: a process summary, process theory, required equipment, desired product mix, and applications for recycling. Simplified process flow diagrams and sketches further illuminate the specific technology.

Under the scope of this report, four technologies recycle petroleum-contaminated soil into marketable products: hot mix asphalt processes, cold mix asphalt systems, cement production, and brick manufacturing techniques.

Hot Mix Asphalt

The hot mix process employs both mixing and heating to make paving material. It blends and dries mineral aggregates like sand, gravel, and crushed stone (with a diameter as large as 3/4-in.), heating them to 300 to 350 °F. Mixing hot asphalt (5-10% by weight) with the hot aggregate produces paving material.

A hot mix temperature of 300 to 350 °F does not destroy the hydrocarbons vaporizing from the soil. Secondary combustion chambers have modified the process in some hot asphalt plants used for recycling. The recycling of petroleum-contaminated soil takes place in the aggregate preparation process. Exhaust treatment by cloth filters (baghouses) provides a means of controlling particulate emissions.

Cold Mix Asphalt

The cold process mixes aggregate and liquid asphalt in small open pugmills or revolving drums to form the paving material. It uses surfactant to emulsify asphalt cement in water. Anionic, cationic, and nonpolar asphalt emulsions are available. These materials may contain polynuclear aromatic hydrocarbons, depending on the grade of asphalt cement from which they are derived. The resulting emulsions are relatively nonvolatile. The asphalt particles are suspended in the liquid and separated from each other (and the aggregate) by a

film of water. During paving, pressure expels the film of water, bringing the asphalt particles together in contact with the aggregate.

Cement

The cement manufacturing process employs raw materials such as limestone, clay, and sand which are usually fed to a rotary kiln. The raw materials enter the raised end of the kiln and travel down the incline to the lower end, which is heated by coal, oil, or gas. Petroleum-contaminated soils may enter the process as part of the raw material or drop into the hot part of the kiln. As the raw materials move through the inclined, rotating kiln, they heat to extremely high temperatures — up to 2,700 °F. These temperatures cause physical and chemical reactions such as evaporation of free water, evolution of combined water, evolution of carbon dioxide from carbonates, and combination of lime with silica, alumina, and iron to form the desired compounds in the clinker. The petroleum-contaminated soil also breaks apart chemically. At extremely high temperatures, the organic compounds burn — producing heat, carbon dioxide, and water vapor. The inorganic components recombine with the raw materials and the clinker incorporates them. The clinker leaves the kiln in golf-ball-sized lumps. The rapidly cooled clinker, mixed with gypsum and ground to a fine powder, produces Portland cement.

Brick

The brick manufacturing process blends the petroleum-contaminated soil with the clay and shale. It molds this raw material into a green brick. Once the green brick is dried and preheated, the kiln fires it at 1,700 to 2,000 °F for approximately 12 hours. The temperature and residence time in the kiln destroy the organics, incorporating the inorganics in a vitrified brick product.

Directory of Permitted Recycling Facilities

The key portion of the comprehensive report is its two-part DIRECTORY OF PERMITTED RECYCLING FACILITIES. The initial part of the Directory is a tabular List of Permitted Facilities. This List identifies permitted (or otherwise formally state-approved) recycling facilities, organized geographically by EPA Region. Within the region, the List arranges the locations of the facilities alphabetically within each state. The facilities shown have each reported their approval status (which is shown on the List): they are operating either under a permit or another required vehicle of formal state approval at the time of the survey; they have temporarily ceased previously approved operations; or they are in the final stages of the permit/approval cycle and expect to begin operations shortly.

[Information provided by the permitted facilities was not verified by site inspection, copy of permit, or performance testing. Any RP must require proof of permit/approval before engaging in a contract.]

An RP can easily find potential recyclers by looking at the appropriate state on the List and selecting those facilities in the most convenient locations. All the details needed to obtain further information appear in the subsequent, alphabetical (by company name) section of the Directory of Recycling Facilities. It provides specific addresses, other recycling locations, telephone numbers, and contact data for the RP who may wish to follow up with individual queries.

Each facility in the Directory has its own analytical requirements. Because these requirements (total hydrocarbons, flashpoint, pH, etc.) respond to the local state regulations as well as an individual permit, they are subject to change. During the follow-up query, the RP should request, from the selected facility, a written list of requirements that apply at that time.

Conclusions and Recommendations

The following conclusions have emerged from this survey project to identify permitted facilities that manufacture marketable products from recycled petroleum-contaminated soil:

- This study identified 77 facilities in the U.S. that recycle petroleum-contaminated soil into marketable products. They are not, however, evenly distributed among the 10 EPA regions or the 50 states.
- More than half of the recycling facilities (41) are located in Region 1 and Region 4 (22 and 19, respectively). Region 5 has 13 approved facilities; Region 3 has 11; and Region 10 has 5. The remaining facilities are spread among the other five EPA regions.
- Most facilities in this study accepted soil with all six typical contaminants (gasoline, kerosene, diesel, fuel oil #2, fuel oil #4, and fuel oil #6).
- Hot mix asphalt appears to be the most commonly manufactured product at these facilities. Other common products consist of cold mix asphalt, aggregate, hydraulic cement, and brick.
- Regulations and requirements pertinent to recycling of petroleum-contaminated soil lie almost entirely within the jurisdiction of individual states. They vary significantly among the various states.
- The cost per ton for recycling petroleum-contaminated soil ranged from a low of $25/ton to a high of $100/ton. The majority of the plants surveyed reported a high of $50/ton.
- The constant changes in applicable regulations and the rapid emergence of new recyclers mandate the need for scheduled updating of this technical resource document.

The full report was submitted in fulfillment of Contract Number 68-C9-0033 by Foster Wheeler Enviresponse, Inc., under the sponsorship of the U.S. Environmental Protection Agency's Risk Reduction Engineering Laboratory.

*U.S. Government Printing Office: 1992 — 648-080/60026

James H. Nash is with Chapman, Inc., Atlantic Highlands, NJ 07716; and Seymour Rosenthal, George Wolf, and Marilyn Avery are with Foster Wheeler Enviresponse, Inc., Edison, NJ 08837.
Chien T. Chen is the EPA Project Officer (see below).
The complete report, entitled "Potential Reuse of Petroleum-Contaminated Soil: A Directory of Permitted Recycling Facilities," (Order No. PB92-173 780/AS; Cost: $17.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Risk Reduction Engineering Laboratory
U.S. Environmental Protection Agency
Edison, NJ 08837

United States
Environmental Protection
Agency

Center for Environmental
Research Information
Cincinnati, OH 45268

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT No. G-35

Official Business
Penalty for Private Use $300

EPA/600/SR-92/096