FIELD STUDY BRIEFING

Solid Waste Technology Systems in Germany

Inert sorting at Herhof Rennerod

In October, 2001 representatives from Santa Barbara County joined officials from El Dorado County, the City of South Lake Tahoe and the South Lake Tahoe Waste Management Authority to visit and study solid waste technology systems in Germany. The visit was organized and hosted by George Eowan of Integrated Recycling, Inc. (and former executive director of the California Integrated Waste Management Board), Herhof-Umwelttechnik GmbH of Solms-Niederbiel, Germany, and Sekundärrohstoff-Verwertungszentrum (SVZ) Schwarze Pumpe GmbH of Spreetal/Spreewitz, Germany. The field study ran from Sunday, 7 October 2001 to Wednesday 10 October, 2001.

The purpose of the field study was to examine state-of-the-art technology in recovery and recycling of 100% of the waste stream that may have potential application in Santa Barbara County. Herhof is considered one of the world's most advanced in the design, application, and operation of technology in recycling of waste. The field study included investigations of a cross-section of waste recovery technology from sorting and composting to fuel, methanol, and energy production. Throughout the three-day study, discussions were led by Herhof and SVZ designers, engineers, plant operators, and corporate executives. Participants were able to view components of the entire waste management system from design and manufacture of the technology to its complete application and operation.

Participants from Santa Barbara County

Supervisor Gail Marshall
Phil Demery, Public Works Director
Bill Chiat, Director of Organizational Effectiveness

Facilities Visited

Herhof Office, Design, and Manufacturing Facility	Niederbiel
Composting Plant	Beselich
Stabilate Plant	Rennerod
Stabilate and Energy Plant	Aßlar
SVZ Methanol and Energy Plant	Spreewitz
Stabilate Plant	Dresden

Incoming waste at Herhof Rennerod

Background

The Integrated Waste Management Act (AB939) mandated that by the year 2000, California cities and counties reduce their waste streams by 50%. Many communities—including Santa Barbara County—have reached or exceeded that requirement. There remains in the waste stream, however, additional materials which may be recovered and recycled. Technologies now exist and are being further refined to extract recoverable materials from the waste stream. Through facilities such as Materials Recovery Facilities (MRFs), composting, and energy production facilities, significantly higher recovery rates can be achieved.

Sorted products from Stabilate plant

Germany and other European counties are among those in the forefront of this technology development. Germany in particular, has had a long history of recycling and recovery; the green dot program for packaging is just one example. Today, Germany is again in the spotlight with recycling and resource recovery. Under German law, by 2005 no direct landfilling of any unprocessed waste will be allowed in the county. Therefore many jurisdictions and manufacturers are developing approaches to recycle 100% of the waste stream. Some facilities are already built and operating. Those designed and operated by Herhof and SVZ are now able to eliminate *all landfilling* through a combination of technologies that can remove all recoverable materials (glass, metal, inerts) and produce a product that can be converted into electricity and methanol; or can take green and other organic wastes and compost them into a valuable product.

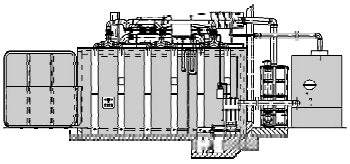
This briefing summarizes the observations and questions which emerged from studying these facilities.

Herhof Compost

Compost boxes at Beselich

The main subject of the field study was to examine the compost and Stabilate plants designed, built, and operated by Herhof. Herhof entered the waste business in 1986 through design and construction of compost facilities. German law enacted in the mid ‘80’s required source separation of kitchen waste from the wastestream. Thus was created a market for composting facilities. Currently Herhof operates some 45 plants in Germany (and numerous other around the world—including two in Canada). Herhof uses a box system which can be sized to meet the particular wastestream. Because it is a completely enclosed system, the technology allows care control of temperature, moisture, dust and odors. It also results in a higher quality product which the company is able to market. Herhof operates facilities that use both source-separated organic waste, as well as facilities which use mixed waste for composting. Currently inclusion of biosolids in the composting process is very limited due—as in the United States—to

both perception and laws severely limiting land application of compost with biosolids as a feedstock.



Herhof composting box

Average facilities handle 20-40,000 tons per year. A new facility in Venice handles 60,000 tons of compost a year. The Herhof system is described in detail in both their literature and on their website (www.herhof.de). Essentially the process entails a prescreen to remove contaminates (plastics, metals) prior to shredding. Material is then loaded into a composting box where it decomposes for 7-10 days under highly controlled temperature, moisture, and air quality conditions. The resulting product has been reduced in mass by an average of 55% due primarily to removal of water. The product may then be marketed as mulch, or can go through several stages of post treatment to produce higher quality products for agriculture, landscaping, and home gardening use.

Final compost at Beselich

Herhof reports they are able to market 100% of the compost products, however the sales do not cover the full cost of producing the products. Therefore there is both tipping fees and sales revenues required to run the operation. Average tipping fees in Germany appear to be in the range of $40-$80US/ton.

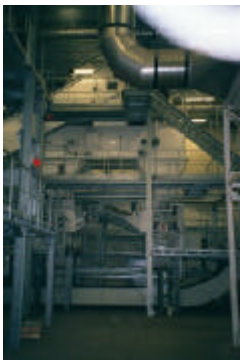
Herhof Recovery and Stabilate Systems

In recent years Herhof has taken its composting box technology and greatly enhanced it into a highly technical system to separate and process municipal wastes. The Herhof Trockenstabilat® (Stabilate) method is based on the principle that dry municipal waste can be more effectively separated and processed than wet waste, and can therefore produce a variety of marketable products. Through these facilities Herhof is currently demonstrating that nearly 100% of the wastestream can be recycled. Through either their own facilities or in partnership with SVZ all end products from municipal wastes are being recycled either as raw materials (metals, glass, etc.) or as a source for energy generation. With the exception of batteries and similar materials (which are hand removed at the end of the process) there were no end products which required landfilling.

Herhof Aßlar Stabilate and Energy Plant

The heart of the system is the highly technologized processing plant. During the field study three of the Herhof plants were examined. They ranged in capacity from 85,000 to 200,000 tons/year. As a comparison, Tajiguas currently landfills approximately 200,000 tons/year. The system consist of four major components: 1) Receiving and grinding of incoming municipal waste; 2) Box drying of ground waste; 3) Separation and recovery of materials for recycling (glass, metals, inerts); and 4) Processing of final Stabilate for energy recovery (pellet or bale).

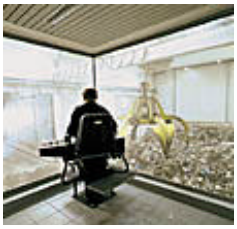
The Herhof process is component driven. Components can be added which increase the quality of the recovered material; and which increase the cost per ton processed. For example, the Herhof Aßlar plant has a glass separation component which uses sophisticated optical scanner technology to separate glass by colors. In California, it is unlikely that component would be needed as there is a market here for mixed-color glass.



Separation system at Dresden

The drying of the waste typically removes approximately 30% of the volume from the municipal waste. That water is treated in a Herhof technology process and is reused in the system (as a coolant) and evaporated. The system works without producing wastewater. Of the remaining 70% of the waste, typically 17% is removed by the separation technology for production of other material besides Stabilite (metals, glass, inerts).

The separation system is simply amazing and technologically complex. Conveyors move all the waste through a series of screens, shakers, optical scanners, blowers and other technology to sort out recyclable materials, as well as contaminates (such as batteries). Typically the 17% recovered consists of color-separated glass (4%), ferrous metals (5%), nonferrous metals (2%), minerals and inerts (4%), batteries (>1%), and fine dust and grains.



Operator at Aßlar

The remaining 53% of the municipal solid waste is prepared as Stabilate. It consists primarily of very dry organics, paper, plastics and textiles. Herhof reports the calorific value of Stabilate to be comparable to lignite (a low grade form of coal still burned extensively in eastern Germany, Poland, and other countries for electricity).

Several other components were characteristic of the Stabilate plants. First, they are virtually fully automated. Over the last few years the technology has improved so that the newest plant visited (in Dresden) is fully automated and operated essentially by one person. Support staff are required to service the equipment, sort out batteries, conduct quality control, and other support functions, but one operator with several computers controls the entire operation. Second, the plants integrate an extensive air quality management system. All conveyors, processing equipment, and systems are enclosed to control dust, odors, and air contaminates. Herhof has developed LARA®--an air treatment and cleaning system—for all of its plants. The system uses a combustion chamber process to remove dust, organic substances and odorous substances. A question which will require further research is whether the Herfhof system will meet U.S. and California air emission

LARA system at Rennerod

standards. The methodologies used in Germany differ from the U.S. so comparisons of data need additional study.

Conversion of Stabilate to Energy

Stabilate pellets

Two facilities were visited which convert Stabilate into energy. At Herhof's Aßlar plant, the company has designed and operates a technology it calls EVA which converts Stabilate into electricity. Stabilate serves as the fuel which is combusted for power. Currently the plant produces enough energy to operate the entire waste processing plant. The plant processes Stabilate from both Aßlar and Rennerod. Ash from the plant is considered inert and typically used in road base material.

EVA energy plant at Aßlar

The Stabilate from Dresden and other plants is trucked to a facility built and operate by SVZ on the massive site of a former lignite and gas processing facility operated by East Germany. Since 1995 SVZ has been developing technologies to convert waste into methanol, electricity, and other products which can be reused. The SVZ facility accepts Stabilate as well as biosolids, plastics, unprocessed municipal wastes, tar and sludge, and other liquid wastes into its process. After an initial processing, the materials are gasified, purified, and processed into marketable products. The primary product is methanol which is used in the production of antifreeze, cooling agents, solvents, paints, pharmaceuticals, as well as fuel cells for automobiles. A secondary product from the plant is electricity (75MW). The SVZ plant is capable of processing 100,000 tons of waste material per year, including Stabilite.

SVG methanol and electricity plant

Costs to Recycle

Any discussion or comparison of costs is difficult at this stage of a study, especially since there are no U.S. facilities in operation. Germany has significantly different economics for capital, operational, and marketing costs and revenues than here. For example, in Germany there is an energy glut, so there is little if any revenue earned from the sale of electricity. The energy market is very different in California which could contribute to a significantly lower cost than Germany.

Still, a look at the costs of the German facilities is instructive. As with the composting facility, in the cases of both the Herhof Stabilate plants and the SVZ methanol plant, the facilities do not pay for themselves. Despite the revenues generated from products and electricity, all facilities charge significant tipping fees to offset costs. The SVZ plant, for example, charges Herhof approximately $60US/ton to process Stabilate. The Stabilate plants have tipping fees themselves in the $60-80US/ton. The ultimate cost to recycle 100% of the waste stream therefore is in the $120-140US/ton range. It is important to remember

that the Herhof costs include a number of components which may not be needed in Santa Barbara. Glass separation, Stabilite pelletizing, and methanol production are examples of components that may not be needed here. Pelletizing alone adds approximately $15US/ton to the cost whereas methanol production adds approximately $60US/ton.

Facility Ownership and Operation

Herhof Rennerod Stabilate plant

Both the Herhof and SVZ facilities visited were designed, built and operated by the manufacturer. In the case of Herhof, the Aßlar, Beselich, and Rennerod plants are operated by Herhof on behalf of the local jurisdiction under 15 year operating contracts, which consisted essentially of put-or-pay agreements. In the case of Dresden a special operating company was established to operate the plant, with 58% of the ownership held by the City of Dresden and 42% ownership by Herhof. SVZ is a completely private operation.

Questions to Consider

This particular field study examined the facilities and technologies of only two specific manufacturers. However the key questions to consider apply to most any technology being considered in Santa Barbara County to manage solid wastes. While it is acknowledged that Herhof is at the more extreme end of technology and costs, these questions should be considered for any system being evaluated.

1. ***How much to recover and recycle?***
   The higher the goal to recycle, the more expensive. In the case of Herhof, to eliminate all landfilling the costs in Germany are in the $120-140/ton range, if not significantly more (due to very different regulatory requirements, waste composition, operational costs). To remove the recoverable materials and dry the remaining waste (thus reducing the waste mass by some 47%) costs in the range of $60-80/ton (with the same caveat as before) plus the cost of landfilling the residual dried material.

2. ***Can the facility be fiscally viable?***
   Neither Herhof nor SVG have built any facilities in the U.S., and the experience in California with waste processing facilities beyond a standard MRF is limited. Therefore understanding the fiscal implications (capital, operational, and markets) is a challenge. The facilities examined are big and capital intensive. The life of the equipment is expected to be 15 years, though most are new and there is little information developed on the operational costs over those 15 years. Some of the capital costs are made up in operational costs, since most of the facilities are highly automated and require far less staffing than a traditional landfill, transfer station or MRF. In addition, capital and operational costs will in

part be driven by the components and capabilities of the selected processing system.

3. ***What kind of final product will be acceptable?***
A key decision is what kind(s) of final product(s) can be marketable in the region and will be acceptable to the community. Potential products include: organic compost, mixed waste compost, dried refuse for landfilling or shipping to a generation plant, recyclables, electricity, methanol. These decisions will drive the type and size of plant(s) which will have to be constructed.

Herhof Dresden Stabilate plant

4. ***Can the products be marketed?***
Unknown is the market value of various products (such as compost or electricity) or conversely the cost of further processing of products (such as sending material to a power plant for conversion to electricity). Research on markets and the cost of getting products to market must be conducted prior to selecting a technology. One of the lessons learned is to be sure a secure market exists before investing in a technology.

5. ***Will the community be willing to accept a facility?***
As alluded to earlier these are large, industrial facilities. The MRF in Oxnard may be a good comparison, but a facility along the Herhof design is likely to be larger and taller. In the facilities examined in Germany, most were 4-6 stories tall with tall smokestacks. The compost facilities were shorter (1-2 stories) but still take a significant amount of land for processing and post processing. Communities across California have developed similar waste management facilities. While a Stabilate-type facility would be among the larger industrial buildings on the south coast, its size, siting, and appearance would be key factors when determining an appropriate site. If production of energy is desired, the community will have to consider the addition of a power generation or methanol facility.

Herhof automated dry box system

6. ***Where will the facility be sited?***
Of course if the answer to the above question is yes, then a site is needed where an industrial-type facility can be built. All of the facilities visited were located at the edge of communities usually next to existing or former landfills. In the case of Dresden, the city has expanded around the facility which is built at the foot of the now closed Dresden City Landfill.

7. Can it meet environmental standards?

Environmental standards and even what components are measured is very different between Germany and California. There has been little research into whether the plants (compost, Stabilate, energy) in Germany would meet current or future U.S. and California air and water quality standards. All of this needs to be considered before settling on a particular technology or system. Likely the County would need to lobby for changes or exceptions to regulations in order to implement new technologies.

8. How will technology fit in the waste system?

Unless the community is willing to accept a system which recovers 100% of the wastestream, some landfilling of the processed material will still be required. Therefore a long-term disposal facility will be required.

Dry box water collection and recycling system

9. Has it been demonstrated to work with an equivalent wastestream?

Vendors of new technologies make broad claims regarding the capacity and performance of their systems. The question is whether they have demonstrated ability at existing facilities with a wastestream of similar scale and composition as Santa Barbara.

Currently the South Lake Tahoe Waste Management Authority (El Dorado County and South Lake Tahoe) are in the process of accepting and evaluating proposals for a waste management system. Herhof is one of the vendors. Many of the questions posed in this Briefing will be addressed through the proposals and the analysis performed by the Authority in evaluating the proposals. Staff will continue to monitor the progress of this process and report on the conclusions.