

Composting: Solve a Problem And Create a Useful Product

By J.C. Patterson and J.R. Short

The Chesapeake and Ohio Canal NHP parallels the Potomac River for approximately 185 miles, from Washington, D.C., to Cumberland, MD. Built between 1828 and 1850, the canal ceased operation in 1924 and has since become one of the nation's most unusual historic parks. In 1975-76, the C & O Canal encountered a unique problem with waste disposal.

Pit toilets had been used in the more frequently used areas along the canal. Concern developed that pit toilets might be contaminating the ground water, and in 1972 the C & O substituted portable toilets, to comply with environmental quality standards. Waste from the portable toilets was trucked to local municipal treatment plants. After three years, operators of the local plants informed park officials they would no longer accept the waste. Allegedly, the toilet chemicals were interfering with the biological processes of the waste treatment plants.

Alternatives suggested included closing the tow-path, transporting the waste to municipalities outside the district, building a sophisticated treatment facility, and constructing an experimental composting system. The last option was selected, since NPS felt it could modify the USDA-Beltsville composting technology for use with these high liquid content wastes. A cooperative effort was begun between the maintenance staff of the Piedmont District of the C & O Canal and scientists of the Ecological Services Laboratory (ESL) in Washington, D.C.

Composting is a naturally occurring phenomenon that man has enhanced. Scientists at the Science and Education Administration, USDA, in Beltsville, MD, had developed an aerated static pile composting system, described in Vol. 48, No. 4, *Journal of Water Pollution Control Federation*, "A Force Aeration System for Composting Wastewater Sludge," by Epstein, Willson, Burge, Mullen and Enkiri. These techniques were developed and refined to treat filter cake sludge from sewage treatment plants. The filter cake is approximately 20 percent solid, 80 percent liquid, differing significantly from raw waste, which is only 2 to 3 percent solids.

In the Beltsville technology, one volume of filter cake sludge is thoroughly mixed with two volumes bulking material, generally wood chips. A static pile is built over corrugated polyethylene tubing and the air is drawn through the pile during composting. The "static pile" is monitored periodically to assure proper oxygen balance and adequate temperature buildup. After 21 days, the pile is dismantled and allowed to cure. The organic material produced is excellent soil conditioner and has value as a low analysis fertilizer.

The static pile technique was modified to include several additional bulking organic materials to absorb the excess liquid fraction. The technique has been perfected and has received favorable response from the C & O Canal staff and the NPS. By June 1976, waste material was being treated effectively by composting on a routine basis.

Waste generation and need for waste treatment has the same seasonal variation as visitation along the Canal. In general, the last static pile setup is in October or early November. This pile usually is allowed to stand until early spring. It is then disassembled

and a new static pile is built in April or May to compost the first wastes collected for the season. During heaviest visitation in the summer months, compost piles may be built every four to six weeks. Waste is pumped from the toilets as necessary during the season, then transferred to an on-site storage tank. When the tank nears its 2,000 gallon capacity, a compost pile can be built. The tank, though not essential, provides for more efficient use of both manpower and site activities.

To initiate composting, a bed of absorbent organic materials is prepared for receipt of the liquid waste from the holding tank. At the C & O, the absorbent organic mixture is comprised of shredded office waste paper, sawdust, wood chips, leaves, and previously composted material. These are thoroughly blended on a concrete mixing pad, then formed into a saucer-like configuration. Waste from the tank above the pad is gravity-fed into the saucer. Absorption (about 30 minutes) is followed with thorough mixing of waste and absorbent materials by a front-end loader.

Adjacent to the mixing pad is a mattress of previously composted materials, to receive the mixture of waste and absorbent materials. Details on how air is supplied and odors mitigated can be had from the ESL Lab.

The absorbent mixture of bulking materials and waste is transferred onto the mattress from the mixing pad, the completed pile resembling an inverted cone. A blanket of compost or wood chips insulates the pile to maintain necessary composting temperatures and suppresses odors produced during early stages of biologic action. An electrically operated

blower draws air through the pile at intervals pre-selected on a timer.

Careful monitoring of the pile is essential. A range of 5 to 15 percent oxygen is optimum for microbial activity. Microbial activity generates heat to reach temperatures of 55° C (131° F) and above. The heat is produced as the microorganisms digest the nitrogen and carbon of the waste during aerobic metabolism. Temperatures should range between 60 and 70° C for a period of three weeks; this temperature usually is reached within the first 3 to 5 days of composting.

A minimum of 55° C for three days is necessary to kill pathogens. Temperatures as high as 80° C (176° F) sometimes are reached within the first 10 days. The compost pile will maintain very high temperatures for only a few days and will slowly decrease to about 60° C (150° F) for several weeks. High temperatures for prolonged periods result in a nearly sterile composted product.

The C & O composting site is less than one acre. This includes a pad (approximately 150' x 75'), a diversion ditch which surrounds the pad, and an organic storage area. The C & O Canal composts between 8,000 and 35,000 gal/year (33-145 tons/year). Designed to handle 105,000 gal/year, the site has not approached capacity. So far the operation has required no more than 0.2 work year for complete operation of all activities.

Success of the operation within the Piedmont District has sparked a similar operation in the Allegheny District of the C & O Canal. The design and site were prepared and implemented in 1979 and ac-



A complete view of the Piedmont District composting site at C & O Canal. Left to right are: shed housing the blower, a compost pile being constructed, a blanket of compost being added to the wet mixture to insulate against excessive heat loss, protect from rainfall and reduce odor. Behind the tractor is a working static compost pile. The storage tank with concrete mixing apron in front of it is at the extreme right. The slope around the site diverts runoff to a holding basin in the photo foreground.

tive composting has taken place ever since.

Compost contains nominal amounts of essential soil nutrients, however these levels are generally low. Since compost has a nearly neutral pH, (about 6.6 to 6.8), it is an effective soil liming agent. The ESL has used compost to neutralize highly acidic spoil from Prince William Forest Park's pyrite mine, where the pH was as low as 2.0 to 2.4. It was felt that compost would be the principal soil amendment in restoring a favorable soil chemistry and provide a soil medium to support native vegetation.

Compost has proven a desirable amendment for soil renovation. Large quantities have been used in rebuilding soils and turf areas of the National Capital Region. The C & O Canal has used it in areas where culverts have been restored and vegetation reestablished around park facilities. A similar system is to be set up in Redwood NP, California, where it is proposed to treat wastes from sanitary toilets and septic systems and use the composted product to restore badly eroded slopes.

The methodology has received considerable attention from international organizations as a useful, cost effective, efficient way to treat wastes and at the same time produce a valuable, safe soil amendment. Demonstrations have been staged for representatives of the World Bank, AID, Appropriate Technology International, Inter-American Development Bank, Pan American Health Organization, EPA, USDA, USFS, USDI, and many other federal and state groups.

Composting has broad applicability throughout the entire National Park System. Small batch, raw waste composting is possible at back country campsites, using power from photovoltaic solar panels. Each location requires some modification of the system, depending on the kind, amount and availability of bulking materials. Proper ration of bulk to waste must be empirically established, as must the time required for adequate breakdown (treatment) of the mixture, the cycling frequency and size of the blower system, and the utilization of the compost product. Since absorbent materials could be limiting at some locations, it could be necessary to recycle cured compost to achieve desired consistency in static pile construction. Thickness and composition of the blanket, frequency of setup-teardown schedules, and availability of manpower and equipment to handle the waste materials also require site-specific solutions.

Additional references are Leonard and Fay's 1978 Forest Service Research Note (NE-254), "A Compost Bin for Handling Privy Wastes: Its Fabrication and Use," and Patterson and Short's 1980 paper on "Static Pile Composting of Sanitary Toilet Waste and Septage Within a National Park," from the *Proceedings of the National Conference of Municipal and Industrial Sludge Composting-Materials Handling*, sponsored by Information Transfer, Inc., Hazardous Materials Control Institution, the Sludge Magazine, and SEA-USDA, Nov. 14-16.

Patterson and Short are agronomists with the Ecological Services Laboratory, National Capital Region, NPS.



Gravity flow from an elevated storage tank allows for efficient emptying of the tank. The absorptive organic mixture of shredded waste paper, compost, wood chips, leaves and sawdust effectively absorbs the liquid waste. Absorption will proceed for about 30 minutes.



Perforated piping and the mattress are in place at the right, while the solid (non-perforated) piping connects perforated piping of the pile.