Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
DEC 2005		**00-00-2005 to 00-00-2005**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Composting Solid Waste in Military Contingency Operations	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Engineer School,14010 MSCoE Loop BLDG 3201, Suite 2661,Fort Leonard Wood,MO,65473-8702**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**2**	

Composting Solid Waste in Military Contingency Operations

By Mr. Joseph Bost, Mr. Stephen Stouter, and Mr. James F. Lee

Armies around the globe have always had to deal with the problem of solid waste. Today, a large percentage of solid waste is packaging materials (cardboard, paper, and plastic), in addition to waste food and sewage sludge. While much of the solid waste generated at base camps is biologically degradable, the solid waste problem presents significant waste management challenges for the U.S. Army. This is a particular concern when we operate in countries where there are few—if any—modern waste disposal facilities.

More than 1,000 boxes of sewage sludge are stockpiled at this base camp. It was composted during the beginning of a pilot study in 2004.

During the past 2 years, the United States Army Europe (USAREUR) Engineer Support Operations (ESO) has tested a composting system that converts up to 85 percent of the putrescible waste (waste that decomposes) generated at base camps into a usable product. Additionally, this composting system greatly reduces pathogens, as well as minimizes odor and bioaerosol emissions. The compost produced by the system can be used in a variety of ways, including erosion control, soil amendment, or land application in agricultural, forestry, or mine reclamation use.

When contingency operations (CONOPS) base camps are initially established, solid waste landfills are normally not available. Solid waste is usually taken to a burn box to be incinerated. This process requires approximately 1 gallon of fuel per cubic meter of waste and reduces the volume of waste by approximately 80 to 90 percent. The residuals (for example, ash and incompletely burned solid waste) must then be transported for disposal. However, many local waste disposal sites are burial pits or excavation sites, and most of them lack liners, daily covers, run-off controls, or other modern techniques used for managing sanitary landfills. These disposal site conditions present another set of significant environmental problems, such as toxic leachate, vector attraction, and even greenhouse gas creation. The process of burning solid waste, including low British thermal unit (BTU) value wastes (for example, dining facility [DFAC] and other organic or wet waste), is to soak it with diesel fuel and incinerate it in a burn box. The burning waste emits toxic, acrid smoke that has led to health complaints from military personnel due to eye and lung irritation. At a base camp in Kosovo, there have been numerous Soldier and chain-of-command complaints regarding smoke from incinerator use.

With troop safety a vital concern, it is critical to effectively treat solid waste and sewage sludge. Soldiers' safety and quality of life are enhanced by reducing pathogens associated with sewage sludge and reducing the amount of solid waste burned. It is also essential to minimize the volume and toxicity of solid waste disposed at disposal sites that lack modern environmental controls. USAREUR ESO has tested various methods to improve CONOPS solid waste management and reduce long-term environmental liabilities and risks.

At a base camp in Kosovo, the practice of burning solid waste ended in October 2005. USAREUR ESO—along with COMP-ANY GmbH and Kellogg, Brown, and Root (KBR)—will use composting combined with recycling and landfill disposal. After successful pilot testing during 2004 and 2005, a full-production mobile aerated static heap composting system was deployed to the base camp in September 2005. The new AGILE™ flex system incorporates semipermeable membrane technology that—

- Mitigates the effects of extreme weather on composting.
- Accelerates the natural composting process.
- Minimizes manpower costs.
- Allows composting to occur within the confines of a small base camp due to the more than 90 percent reduction in odor and vector attraction.

The odor is reduced due to the scrubbing effect of the semipermeable GORE-TEX® membrane cover that also blocks vectors. The AGILE flex system has shown excellent results by minimizing pathogens and other problems created by solid waste in CONOPS. The AGILE flex system increases composting efficiency by using cardboard and paper waste generated by the base population to balance the carbon-to-nitrogen ratio. This is critical to the successful composting of high nitrogen content waste, such as sewage sludge and food or catering waste.

Currently, the Directorate of Public Works at the base camp in Kosovo and KBR manage and compost solid waste consisting of sewage sludge, DFAC waste, wood chips, shredded cardboard, paper, and hay. These ingredients are mixed and placed in a heap over air feeder aeration tubes that extend from a standard International Standards Organization (ISO) shipping container. A GORE-TEX fabric cover is placed over the heap and held to the ground with a water-filled fire hose. Temperature- and oxygen-monitoring probes are inserted through the cover into the heap to record heap temperature and oxygen data. Blower fans, controlled by a computer located in the ISO container, force air into the heap based on real-time feedback from the probes. During the initial 3-week processing period, bacterial activity is controlled as the computer automatically adjusts the air flow to maintain optimum temperature and oxygen levels. Internal compost temperatures easily achieve 150 to165 degrees Fahrenheit. After the initial 3-week period, the compost heap is uncovered and moved to the opposite side of the ISO container. The compost heap is treated with the same procedure for an additional 3 weeks. After the total 6-week period, the compost is ready to be tested and used for soil amendment.

Composting will reduce fuel costs associated with burning solid waste. In the past, the U.S. Army paid $65,000 for a year's worth of JP-8 (jet propulsion fuel, type 8) used as an accelerant to burn waste. That expense will no longer be necessary. Additionally, USAREUR ESO estimates that composting will require fewer man-hours. After successfully treating 100 percent of the sewage sludge and DFAC waste generated by two base camps in Kosovo during 2004 and 2005, the USAREUR ESO firmly believes this composting process will lead the Army into the next generation of solid waste management systems for contingency operations.

The AGILE flex system has proved to be a powerful solid waste management tool through its simplicity, reduced operating costs, reliability in all weather conditions, and the short processing time for the treatment protocol. Also, this system enhances force protection by reducing Soldier transport or escort to off-site waste disposal areas. Because of its compact (ISO container), mobile, and self-contained characteristics, this innovative system is especially beneficial in CONOPS. The ability of this system to successfully treat large amounts of solid waste on-site within a short time period increases its value to the U.S. Army mission.

The waste heap is placed on top of the aeration tubes, and the cover is placed over the heap. The temperature and oxygen-monitoring probes are placed through the cover into the heap.

Mr. Joseph Bost is the chief of Engineer Support Operations, Office of the Deputy Chief of Staff, Engineer (ODCSENG), and is responsible for the military and civil construction, engineer operations, and environmental programs occurring in the Balkan area of operations. He holds a master's from the University of Southern California.

Mr. Stouter is the program manager for the Corps of Engineers, Afghan Engineer District, Kabul, Afghanistan, and worked with the ODCSENG staff on critical environmental and facilities functions in Kosovo and Bosnia. He holds a degree in biology from Middle Tennessee State University in Murfreesboro.

Mr. Lee is an environmental management officer for ODCSENG, USAREUR, and is responsible for environmental policy and problem solving associated with contingency operations. He holds a degree in energy and environmental management from City University in Bellevue, Washington.