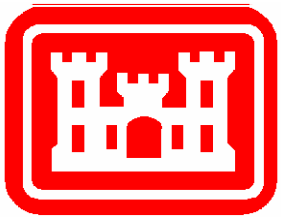
PUBLIC WORKS TECHNICAL BULLETIN 200-1-51
1 APRIL 2008

SOLID WASTE GENERATION RATES AT ARMY BASE CAMPS



Public Works Technical Bulletins are published by the U.S. Army Corps of Engineers, 441 G Street NW, Washington, DC 20314-1000. They are intended to provide information on specific topics in areas of Facilities Engineering and Public Works. They are not intended to establish new DA policy.

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
441 G Street, NW
Washington, DC 20314-1000

CECW-CE

Public Works Technical Bulletin 1 April 2008
No. 200-1-51

Facilities Engineering
Environmental

SOLID WASTE GENERATION RATES AT ARMY BASE CAMPS

1. Purpose.

a. This Public Works Technical Bulletin (PWTB) transmits the results of two studies conducted to characterize the generation rates of nonhazardous solid wastes at Army base camps. It is intended for use by base camp planners and by organizations conducting studies to develop solid waste management and sustainability technologies for Army base camps.

b. All PWTBs are available electronically (in Adobe® Acrobat® portable document format [PDF]) through the World Wide Web (WWW) at the National Institute of Building Sciences' Whole Building Design Guide web page, which is accessible through URL:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability. This PWTB applies to all U.S. Army organizations managing or supporting base camp sustainment and sustainability.

3. References.

a. Army Regulation (AR) 420-1, "Army Facilities Management," 12 February 2008.

b. AR 200-1, "Environmental Protection and Enhancement," 21 February 1997.

c. Gerdes, G.L., and A.L. Jantzer. 2006. “Base Camp Solid Waste Characterization Study,” ERDC/CERL TR-06-24, Champaign, IL: U.S. Army Engineer Research and Development Center.

d. Jantzer, A.L., and G.L. Gerdes. 2005. “Base Camp Utility Technology Matrix,” ERDC/CERL TR-05-34, Champaign, IL: U.S. Army Engineer Research and Development Center.

4. Discussion.

a. AR 420-1, Chapter 23, Section III addresses solid waste management at Army garrisons. AR 200-1 contains general pollution prevention policies. Gerdes and Jantzer (2006) is a solid waste characterization study. Chapter 5 of the Base Camp Utility Technology Matrix (Jantzer and Gerdes 2005) describes alternative technologies that are available for managing nonhazardous solid waste at Army base camps.

b. Two studies have been conducted in the Balkans to characterize the generation rates of nonhazardous solid wastes at Army base camps. The first study was conducted in 2004 and summarized several characterization efforts over the previous few years, but it was largely based on one 2003 sorting study. The second study was conducted at a single base camp in 2006. The 2003 and 2006 studies were not conducted at the same camp. The results from the two studies represent two marginally different ages of base camps. The first study characterized wastes generated by a camp that had recently transitioned from combat operations to stability operations. The second study characterized wastes generated by a camp that had matured to the extent that the infrastructure was largely semi-permanent and was capable of sustaining long-term missions. Gerdes and Jantzer (2006) contains further information on the 2003 study and can be requested from DTIC. Further information on the 2006 study may be available from USAREUR ODCSENGR.

c. A comparison of the results of the two studies showed that the solid waste generation rates were very similar. However, the reported generation rates of specific waste stream components showed dramatic differences. The generation of scrap wood and plastic bottles was significantly greater in the 2003 survey, while the generation of other plastic, paper and cardboard, food waste, sewage sludge, and ashes was much greater in the 2006 survey. Possible explanations for these differences are discussed in Appendix A.

d. In order to make this PWTB available to the public, all references to specific installations and troop strengths have been eliminated.

5. Points of Contact (POCs). Headquarters, U.S. Army Corps of Engineers (HQUSACE) is the proponent for this document. The POC at HQUSACE is Malcolm E. McLeod, CEMP-II, 202-761-0632, or e-mail: Malcolm.E.Mcleod@hq02.usace.army.mil.

Questions and/or comments regarding this subject should be directed to the technical POC:

U.S. Army Engineer Research and Development Center
Construction Engineering Research Laboratory
ATTN: CEERD-CN-E (Gary L. Gerdes)
2902 Newmark Drive
Champaign, IL 61822-1072
Tel. (217) 373-5831
FAX: (217) 373-3430
e-mail: gary.l.gerdes@erdc.usace.army.mil

FOR THE COMMANDER:

JAMES C. DALTON, P.E.
Chief, Engineering and Construction
Directorate of Civil Works

APPENDIX A:
SOLID WASTE GENERATION RATES AT ARMY BASE CAMPS

Introduction

Background

As contingency operations (CONOPS) transition from combat operations to stability operations, the method of sustainment evolves from complete dependence on Army supply and distribution to obtaining goods and services from the local economy. This transition has a significant impact on how nonhazardous solid wastes are managed, and on the generation and character of that waste.

When base camps are established in combat conditions, solid waste management has a very low priority. Field-expedient measures of open dumping, burying, and limited burning of solid waste are the standard practice of Army units on the move, and these practices continue in the initial base camp phases until the local threat level is low enough to allow units to address solid waste management as a general health and sanitation requirement.

Other factors besides threat level impact solid waste management at immature base camps. The environmental awareness and expectations of host-nations and combatants in times of war are very low compared with expectations after stability has been achieved. In some nations, solid waste management has a very low priority among host nationals due to the culture, even in times of peace. Further, in many wartime situations, a military unit has no idea whether they will occupy a given base camp for 1 week, 1 month, or 6 months. This sense of nonpermanence impacts priorities and actions relating to solid waste management.

An important impact on Army base camp solid waste management is the Dining Facility (DFAC). Shortly after the base camp and supply route security issues are resolved to the point that service contractors can serve the base camp, the Army rapidly directs a service contractor to establish DFACs that serve three A Rations (hot meals) per day and provide troop access to 24-hour meal and beverage service. The establishment of DFACs has numerous impacts on solid waste volume and characteristics. The most immediate impact of DFACs on immature base camps is the minimization of MRE-related wastes from the waste stream. Meal, Ready-to-Eat (MRE) wastes can continue to be significant,

however, where a large percentage of the base camp population is involved in frequent patrol or Listening Post/Observation Post (LP/OP) duty. Unless a base camp is established in a region of prolonged local hostility or frequent patrol and LP/OP duty, the MRE-related waste generated at an Army base camp generally diminishes over time.

As the base camp matures, the management of drinking water can change dramatically. Throughout most of the Balkan occupation, the U.S. military has relied on imported bottled water to supply 100 percent of the drinking water demand. The polyethylene terephtalate (PET) plastic bottles resulting from this consumption constitutes a “problem” waste due to the sheer volume of PET bottles and to the noxious fumes that they create when burned in an air curtain destructor. In the Balkans, Office of the Deputy Chief of Staff, Engineer (ODCSENGR) has minimized the water-bottle waste stream by establishing bulk water coolers to distribute water into troop canteens, and severely curtailing bottled water distribution.

A mature base camp includes a substantial complement of Army/Air Force Exchange Service (AAFES) facilities, including a large post exchange (PX) and multiple cafes and fast food restaurants. These facilities result in a large amount of plastic packaging and consumable waste. The high plastic content of the AAFES waste stream is especially problematic because it is not readily recyclable or disposable under a sustainable base camp solid waste program that is based on composting and recycling.

Another unique characteristic of base camp solid waste management is the increased loadings associated with transfers of authority. When a replacement command is transitioned into a base camp, the incoming and outgoing troops overlap by approximately 2 weeks to facilitate transfer of institutional knowledge. Tours of duty at a given base camp will vary, but they tend to occur in 6-month cycles. From a solid waste management perspective, this means that base camp troop populations will double for approximately 1 month of every year.

The population of a base camp also changes constantly due to transients temporarily using facilities at the camp. U.S. Army, other U.S. services personnel, and personnel from allied and partner nations add to the effective population of a base camp. Further, every base camp has a population subset of host-nation employees working for various contractors who provide services to the camp. This base camp population subset will vary from camp to camp. The unpredictable nature of a base camp population makes it difficult for planners and engineers to

provide appropriate facilities for basic services, including solid waste disposal.

Purpose

This appendix presents the results of two studies characterizing the nonhazardous solid wastes generated at Army base camps in the Balkans. The differences between the studies demonstrate how the characteristics of solid waste can change as base camps mature in a theater of operations. The purpose of this PWTB is to make the results of these reports available to Army organizations involved in the planning and support of base camps. In order to make this PWTB available to the public, all references to specific installations and troop strengths have been eliminated.

Characterization Studies

2004 Report

The 2004 characterization report summarized the results of characterization efforts that had occurred in the previous few years. The most significant effort was a sorting study performed in 2003 at one Army camp (referred to as Camp A in this study). The data from that sorting study were collected during three randomly selected days in June 2003. The results shown in the 2004 report are largely based on the 2003 sorting data.

At the time of the 2003 sorting study, the base was already becoming a mature camp — infrastructure upgrades were ongoing. The base camp population at the time of the survey included resident troops, Department of Defense (DOD) civilians, and contractors. An additional daytime population included walk-on host-nation employees of Kellogg, Brown, & Root Services, Inc., which provided construction, operation, and maintenance labor for the Logistics Civil Augmentation Program base camp support services, and guest soldiers and civilians from other units who used camp facilities. Supplied drinking water was entirely PET bottled water.

At the time of the survey, the solid waste program consisted of:

- daily mixed solid waste collection;
- burning the wastes using an air curtain destructor; and

- direct burial of the residual ash from the air curtain destructor.

The following solid wastes were not included in the survey because they were separated and disposed of independently:

- Medical waste
- Materials managed by Defense Reutilization and Marketing Office
  - Hazardous waste
  - Salvaged construction material and equipment
  - Recycled scrap metal
- Material contaminated with petroleum, oils, and lubricants.

The technical report for this study (Gerdes and Jantzer 2006) is not available for download, but can be requested from the Defense Technical Information Center. Distribution is limited to DOD and DOD contractors. Table 1 summarizes results (2003 data) from that report. (Annual generation rates were calculated by multiplying the average daily generation weights measured during the surveys by 365.)

Table 1. Results of two characterization studies.

	2006 Data (Camp B)		2003 Data (Camp A)	
Component	**lb/person/yr**	**Percent**	**lb/person/yr**	**Percent**
Plastic bottles	196	3.0	295	5.1
Other plastic	502	7.6	143	2.5
Aluminum	46	0.7	10	0.2
Light metal	202	3.0	11	0.2
Cardboard (and paper)	529	8.0	349	6.1
Other paper	974	14.7	179	3.1
Food and vegetation waste	609	9.2	418	7.3
Textiles	95	1.4	25	0.4
Glass	37	0.6	40	0.7
Rubber	4	0.1	4	0.1
Polystyrene	21	0.3	9	0.2
Scrap wood	1076	16.2	4151	72.1
Sewage sludge	688	10.4	70	1.2
Ashes	811	12.2		0.0
Miscellaneous	838	12.6	52	0.9
Total	6627	100.0	5756	100.0

2007 Report

A second characterization study was recently completed for U.S. Army Europe (USAREUR) in the Balkans at a camp this report will refer to as Camp B. The results presented in the report from that study are based on data from 14 days of manually sorting the mixed wastes generated at a base camp in 2006. The site of the 2006 sorting study was not the same camp as where the sorting study was conducted in 2003. The report for this study is in draft form and currently is not available for distribution. Table 1 also summarizes results from the 2007 report (2006 data).

Study Results

It was noted in the 2007 draft report that some components in the waste had high moisture content. The following moisture contents should be considered by agencies that are developing solid waste processing systems.

- Plastics had 31% moisture. Normally in domestic solid waste it is less than 20%.

- Paper had 44% moisture, much higher than the normal 5-20%.

- The food fraction had 63% moisture, which might be expected.

- The miscellaneous fraction had 51% moisture. “Miscellaneous” consisted of what was left of the piles of waste after sorting. It was too mashed together or unrecognizable to be sorted.

Moisture content was not measured during the 2003 sorting study. However, moisture levels in that waste were probably similar to that measured during the 2006 sorting study.

Comparison of 2003 and 2006 Data

An assessment of the differences in the generation rates of the various components is as follows:

1. Plastic. The amount of plastic bottles significantly decreased from 2003 to 2006. This is likely due to the efforts in the Balkan camps to provide bulk drinking water supplies for filling canteens as a replacement for bottled water. However, the generation of “Other Plastic” significantly increased, which may be due to the increased function of the PX services on the

base camps. PX services created an increase in disposal of plastic packaging.

2. Light metal. The light metal increased in 2006, possibly because of an increase in metal cans disposed by the dining facility (fewer MRE's issued), and more canned drinks were available at the PX.

3. Paper and cardboard. The amount of paper and cardboard generated per person almost tripled from the 2003 sorting event to the 2006 sorting event. The greatest gains were in paper. This may be due in part to an increased function of the PX and disposal of packaging. The high moisture content discussed in the 2007 report undoubtedly contributed to the high generation rate as well.

4. Scrap wood. The amount of scrap wood showed a decrease of 75% in 2006 compared to 2003, which might be attributed to two factors: (a) The camp in 2003 may have had more construction activities, creating a large amount of construction debris, and (b) The camp in 2003 may have been more dependent on goods shipped from the United States, as opposed to depending on the local economy where goods are not palletized and arrive in smaller trucks.

5. Sewage sludge. The huge increase in sludge generation cannot be attributed. The sewage sludge reported in the 2003 survey was reported as dried solids. The moisture content of the sludge reported in the 2006 survey was not known, but was probably somewhat dry according to pictures in the report. Possibly at the 2006 survey site, sewage sludge was collected from other base camps for disposal at the composting facility, thus raising the apparent generation rate.

6. Ashes. The results of the 2003 survey were based on the waste prior to incineration, because all wastes were incinerated. The camp where the 2006 survey was done used an incinerator to dispose of only items that had to be burned, such as uniforms and documents. Since these items would not be disposed of by another method or recycled, the ash was considered to be generated waste and not the items incinerated.

7. Miscellaneous. This category was significantly higher in the 2006 survey. Descriptions of the waste being sorted indicated that the waste sorted in 2006 was much wetter than the waste sorted in 2003, making it more difficult to sort. It is also possible the workers in 2003 were much more diligent at pulling apart compressed waste.

Conclusion

The total waste generated increased from 5756 lb/person/year in 2003 to 6627 lb/person/year in 2006, or from 15.8 lb/person/day to 18.2 lb/person/day. Had the waste components sorted in the 2006 survey had normal moisture contents, the 2006 generation rate might have been somewhat lower. An important observation is that scrap wood was reported as 72% of the waste stream during the first study, and only 16% during the second study. Of concern is that the amount of the other components in the 2006 survey increased enough to compensate for the difference. While current recycling and composting efforts significantly decrease the amount of waste that must go to landfills, clearly the potential is great for making Army base camps more sustainable.

References

(DRAFT) Final Evaluation Report, Solid Waste Survey ... . 2007. Prepared by COMPANY GmbH, Bockhorn, Germany, for Headquarters USAREUR, ODCSENGR, Engineer Support Operations.

Gerdes, G.L., and A.L. Jantzer. 2006. Base Camp Solid Waste Characterization Study. ERDC/CERL TR-06-24. Champaign, IL: U.S. Army Engineer Research and Development Center.

Hüttmeier/Wayss & Freytag JV. 2004. Composting/Bioremediation Design Review, Camp Bondsteel, Kosovo; Draft Design Report to U.S. Army Corps of Engineers (USACE) Europe District under Contract DACA90-03-D-0031, DO 0004.

Jantzer, A.L., and G.L. Gerdes. 2005. Base Camp Utility Technology Matrix, ERDC/CERL TR-05-34. Champaign, IL: U.S. Army Engineer Research and Development Center.

Jantzer, A.L. 2003a. Laundry Relocation Assessment, Task Force Falcon, Kosovo; Buchart-Horn GmbH Preliminary Engineering Report to USAREUR ODCSENGR and USACE under Contract DACA90-00-D-0017, DO 0017.

Jantzer, A.L. 2003b. TFF Contaminated Soil and WWTP Sludge, Treatment Disposal Assessments, Task Force Falcon, Kosovo; Buchart-Horn GmbH Final Engineering Report to USAREUR ODCSENGR and USACE under Contract DACA90-00-D-0017, DO 0018.

Jantzer, A.L. 2000. Sludge Management Survey, Task Force Eagle, Bosnia-Herzegovina; Buchart-Horn GmbH Final Engineering Report to USAREUR ODCSENGR and USACE under Contract DACA90-97-D-0015, DO 0009.

Tucker, R.E., J.F. Lee, and W.R. Gatewood. 2004. Waste Management in the Balkans; File Report at Headquarters, USAREUR ODCSENGR.