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ARMY RECYCLING LESSONS LEARNED

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ARMY RECYCLING LESSONS LEARNED

1. Purpose. The purpose of this report is to provide lessons learned from Army recycling efforts.

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.

3. References.

a. AR 420-49-02, Facilities Engineering Utility Services, 28 May 1997.

b. PWTB 420-49-07, Solid Waste Options, 19 November 1996.

c. PWTB 420-46-13, Installation Recycling Guide, 15 July 2000.

d. PWTB 420-46-14, Installation Composting Guide, 1 March 1999.

e. *Office Waste Reduction Methods at Army Installations*, SFIM-AEC-TR-94063 (U.S. Army Environmental Center [USAEC], August 1994).

f. Waste Reduction Methods for Food Service Personnel at Army Installations, SFIM-AEC-TR-94064 (U.S. Army Environmental Center [USAEC], August 1994).

g. Concepts for Reuse and Recycling of Construction and Demolition Waste, TR 99-58 (U.S. Army Construction Engineering Research Laboratory, June 1999).

4. Discussion.

a. AR 420-49 contains criteria for solid (nonhazardous) waste management including source reduction, re-use, recycling, composting, collection, transport, storage, and treatment of solid waste.

b. Recycling -- including composting -- is a solid waste management option that can save energy and natural resources, reduce the depletion of landfill space, provide useful products, and generate economic benefits. The first steps in recycling include the separation and collection of post-consumer materials. However, these are only the first steps. Post-consumer materials must also be reprocessed or remanufactured. More importantly, only when the materials are purchased and reused is the recycling loop complete.

c. Appendix A to this PWTB summarizes lessons learned in establishing successful recycling programs on Army installations. "Lessons learned" include:

i. A description of recycling concepts and the components of a good recycling program.

ii. A summary or resources available to installations seeking to establish or improve a recycling program.

iii. A review of achievements of currently operating, effective installation recycling programs.

5. Points of Contact. HQUSACE is the proponent for this document. The POC at USACE is Mr. Malcolm E. McLeod, CEMP-RI, 202-761-0206, or e-mail: malcolm.e.mcleod@usace.army.mil.

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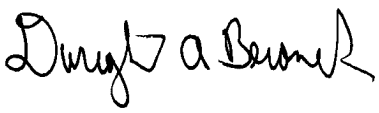
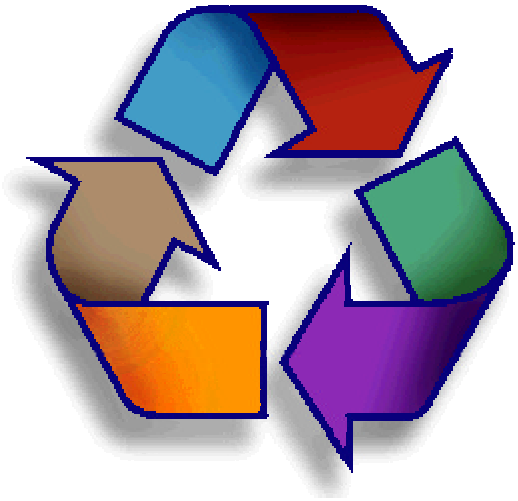


APPENDIX A

Army Recycling Lessons Learned

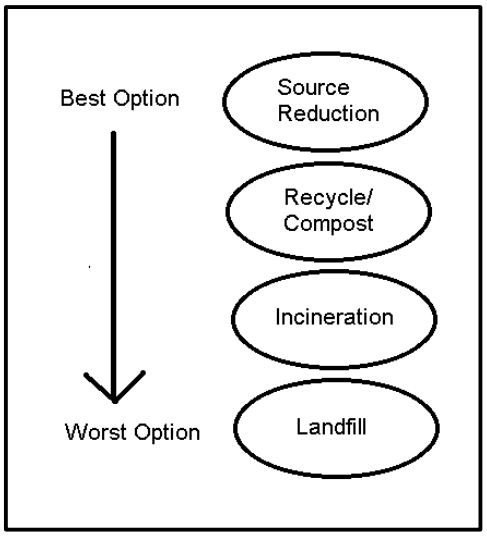


1. Background.

a. Recycling alone cannot solve an installation's municipal solid waste problem, but it can eliminate a significant portion of the waste stream, reducing disposal in landfills or incineration facilities. Because dozens of recycling options are available, recycling program development requires strategic planning. Recycling programs must be designed with the flexibility to handle market fluctuations and the unpredictability of demand.

b. Composting is an increasingly popular municipal waste management alternative as installations look for new ways to handle large amounts of organic waste that otherwise would be landfilled. Landscape waste, including leaves, grass clippings, and woody materials may comprise 15 to 25 percent of an installation's annual waste stream, depending on geography and season. Large quantities of compostable materials, along with their natural segregation from other solid waste, make composting a good objective for landfill diversion efforts.

2. Army Recycling Program Overview.



Army recycling programs are improving each year. Efforts to divert components of the MSW stream are becoming more successful; however, there is always room for improvement and new ideas.

3. Summary of Lessons Learned.

Each Army recycling program has its unique set of problems. However, common problems appear at many installations. Some of the major improvements recommended within Army recycling programs include the following:

a. Integrate recycling with other waste management options.

b. Standardize accounting procedures.

c. Improve collection and recovery of recyclable materials.

d. Close the loop: buy recycled products, and encourage others to buy recycled products.

e. Increase use of source reduction concepts: use your buying power (and encourage others) to demand products that create less waste.

f. Reap your potential profits through effective marketing of recyclables.

g. Collection contracting. Maximize system efficiency and cost effectiveness.

h. Find alternative uses for Construction and Demolition (C&D) materials.

4. Lessons Learned.

a. Integrate recycling with other waste management options.

i. Installation personnel and environmental managers are responsible for the planning and management of recycling programs. These responsibilities include: integrated solid waste management; market analysis for recyclables; designing site layouts; determining equipment and processing needs, tracking progress, and looking ahead for areas of improvement. In many cases, resource and labor constraints exist, making it even more difficult to fulfill these responsibilities.

ii. Installations are encouraged to take an integrated approach to solid waste management, and to consider the potential effects each management option will have on another.

For instance, if recycling programs are not integrated with other solid waste management options, time, resources, and dollars can be wasted.

iii. One method for conducting preliminary integrated solid waste management planning is with the use of Solid Waste Options (PWTB 420-49-07, 19 November 1996), a computerized planning tool for solid waste planners. SW-Options is an interactive management plan optimization system developed by the U.S. Environmental Protection Agency (USEPA) with the assistance of the U.S. Army Construction Engineering Research Laboratory (CERL). This software tool provides military installations with a method for developing preliminary integrated solid waste management planning that minimize cost and maximize landfill diversion. The user of SW-Options needs little prior waste management experience or computer experience. User-friendly menus and data screens prompt the user at each step (for additional information, see Public Works Technical Bulletin 420-49-07, Solid Waste Options).

iv. Recycling programs vary greatly, as can the amount of materials removed from the waste stream. In the more comprehensive recycling programs, significant quantities of waste can be diverted from ultimate disposal. Recycling is, therefore, one of the first options selected by Army installations faced with an impending landfill capacity shortfall.

v. Waste combustion is an end-of-pipe solution to waste management via the reduction of waste volumes disposed of in landfills. The reduction, reuse, or recycling of waste is the preferred front-end solution to the waste management problem. Despite historical tension between supporters of the two options, recycling can have a beneficial impact on waste-to-energy facilities. Recycling programs can reduce the overall waste stream, which means a smaller capacity waste combustion facility and lower capital and operating costs. In addition, recycling can have a direct effect on the environmental impact of municipal waste combustion. Air emissions and waste combustion ash are the main environmental concerns at these facilities. Many of these potential problem materials (e.g., automotive batteries, steel cans, electronics equipment, and

white goods) can be removed from the municipal waste combustion feedstock through recycling programs.

vi. Recycling can also have a positive impact on composting operations. Like combustion facilities, recycling can remove harmful constituents (e.g., metals) from the material to be composted. In fact, even with the use of high-end compost systems, tests have shown that many common recyclable materials are non-compostable and are actually contaminants in the compost product.

vii. Fort Riley, KS, for example, has developed a comprehensive recycling program that is not only cost effective, but has also been recognized as one of the premier recycling programs in the State. The recycling program at Fort Riley, incorporates traditional recyclables, composting, hazardous materials collection, education, and a partnership with the host community.

b. Standardize accounting procedures. Accounting procedures vary between Army installation, making it nearly impossible to compare program successes across installations. For MACOMs, this poses a significant problem when attempting to track installation recycling progress. For installation personnel, the lack of standard accounting procedures, even at the installation level, makes it very difficult to track progress and impact. There is a significant need for standardized accounting procedures for the tracking of recyclables revenues generated through direct sales and sales via the Defense Reutilization and Management Services (DRMO). The use of the Defense Environmental Security Corporate Information Management (DESCIM) Solid Waste Annual Reporting Software (SWARS) will assist in standardizing how installations account for their recycling efforts. An updated version of SWARS for Department of Defense (DOD) was developed from the original Navy model, and is being implemented by the Army.

c. Improve collection and recovery for recyclable materials.

i. For most Army installations, collecting municipal solid waste (MSW) is not a new activity. Like the other areas of MSW management, however, it is an area undergoing rapid

changes. Reevaluation and even redesign of the collection system or collection contracts may be necessary.

ii. Collection programs are often the most costly component of the installation waste management system; proper collection system design and management can result in significant cost savings. One of the major planning decisions is whether the collection system, or portions of the system, should be operated in-house or contracted to private collection services.

iii. The standardization of collection procedures can provide substantial benefits to the entire MSW management system. A standardized collection system can offer several advantages: flexibility; economies of scale (i.e., financing, equipment purchases, market development); and the ability to try new technologies and/or programs in a system where all other factors can be held constant.

iv. At Fort Campbell, KY, for example, two SW convenience centers were established on post for the collection of SW and segregation of recyclables from the waste streams. The convenience centers were established for two principal reasons: to provide managed SW disposal for military units during and returning from field training exercises, and to provide military family housing units with an outlet for recyclables. Since the program's inception in 1990, the convenience centers have diverted 660 tons of SW into recyclables.

v. At Fort Carson, CO, the recycle center purchased eight, 30-cu yd roll-off containers for use in the motorpool areas. This initiative enabled units to collect consumer recyclable materials (cardboard, cans, etc.) within their areas. The total cost of $40K has a projected payback of less than 1 year.

d. Close the loop: buy and encourage the use of recycled products.

i. On 20 April 1994, the USEPA proposed a Comprehensive Procurement Guideline that, when finalized, would

designate items that are or can be made with recovered materials (cf. http://ww/epa.gov/cpg/) The items arranged into product categories are:

(1) Vehicular Products

(2) Reclaimed engine coolants

(3) Construction Products

(4) Structural fiberboard

(5) Laminated paperboard

(6) Plastic pipe and fittings

(7) Geotextiles

(8) Cement/concrete containing ground granulated blast furnace slag Carpet

(9) Floor tiles

(10) Patio blocks

(11) Transportation Products

(12) Traffic barricades

(13) Traffic cones

(14) Park and Recreation Products

(15) Playground Surfaces

(16) Running Tracks

(17) Landscaping Products

(18) Hydraulic Mulch

(19) Yard Trimmings Compost

(20) Non-Paper Office Products

(21) Office recycling containers

(22) Office waste receptacles

(23) Plastic desktop accessories

(24) Remanufactured toner cartridges

(25) Binders

(26) Plastic Trash Bags.

ii. Tobyhanna Army Depot, PA, for example, helps improve its demand for recyclable materials by purchasing letterhead, copy paper, tablet paper, adding machine tape, and corrugated cardboard that is manufactured with 50 percent total recycled content, of which 20 percent is post consumer. The custodial contractor also participates by purchasing all hand towels and tissues manufactured of 100 percent recycled content, of which 50 percent is post consumer. The depot also recycles coal fly ash generated at its Main Boiler Plant by using the alkaline fly ash to neutralize coal mine refuse, thereby preventing acid mine drainage. The depot realizes disposal cost avoidance of $25,000 per year for the 998 lb of fly ash generated each year.

e. Increase use of source reduction concepts: use your installation buying power.

i. Source reduction, the highest goal in the solid waste management hierarchy -- reduce, reuse, recycle -- should be the focal point of every government procurement program. However, the concept of buying for source reduction is still far less developed than the concept of buying recycled products. Although recycling rightly questions and changes how products are manufactured, it is not designed to question why they are produced. Source reduction asks these questions: Do we need this? If we do, can it be produced with fewer resources, take up less space, make a lighter environmental impact? U.S. Army Environmental Center pamphlets SFIM-AEC-TR-94063 and SFIM-AEC-TR-94064 outline a number of ways Army installations can reduce office and food service waste.

ii. A "source reduction product" can be defined as "a product that results in a net reduction in the generation of waste compared to the previous or alternate version and included durable, reusable, and manufactured products; products with no, or reduced, toxic constituents; and products marketed with no, or reduced, packaging." For example, to ELIMINATE (the overuse of paper):

(1) Use computers more to reduce paper use.

(2) Use bulletin boards and routing slips, share frequently used products, maintain central filing systems and libraries to discourage duplicate files and publications..

(3) Do without when it makes sense: eliminate fax cover sheets or use fax labels.

(4) Update mailing and distribution lists and eliminate outdated information.

iii. To REDUCE, think "minimum impact" when ordering equipment or designing processes:

(1) Use rechargeable batteries.

(2) Use fluorescent or sodium lights.

(3) Use copiers that can easily and efficiently duplex.

(4) Use plain paper faxes.

(5) Use interoffice envelopes.

(6) Use bulk containers of commonly purchased supplies to minimize discard of unneeded packaging.

(7) Use permanent plantings for landscaping.

(8) Use mulching-type lawn mowers.

iv. To REUSE:

(1) Use labels to extend product life (e.g., on binders, file boxes, interoffice envelopes).

(2) Return excess or reusable supplies to a central supply cabinet for use by others.

(3) Focus on equipment maintenance and repair to extend machine life and to avoid premature catastrophic failure and replacement.

(4) Use salvage operations. Shop warehouses first before ordering new items and send your own usable discards to reuse centers.

(5) Sell what you can (e.g., steel drums) to reconditioners.

(6) Use waste exchanges, particularly if you have excess or unusual products.

(7) Investigate direct donation programs that give what you cannot sell to charitable organizations and schools.

(8) Consolidate and use products completely.

(9) Use paper wisely.

(10) Use trashcan liners until dirty rather than disposing every time trashcans are emptied.

(11) Combine leftover amounts of oil and lubricants rather than disposing; use a dispenser with a spigot if an opened product needs to be protected.

(12) Save blank labels from pre-printed sets for other uses. Print directly onto envelopes.

(13) Buy recycled products.

(14) Use binders with refillable label pockets or reusable labels.

(15) Install cloth roll towels in restroom dispenser systems. (They can be reused more than 100 times before being made into rags.)

(16) Use reusable air filters in heating, ventilation, and air-conditioning (HVAC) systems and for automotive use.

(17) Use refillable pens, pencils, and erasable wall calendars.

(18) Use refillable ink-jet print cartridges.

f. Reap your potential profits: use resale options.

i. The majority of Army installations currently use the services of a DRMO for the sale of recyclables. In the last few years, the DOD has recognized and encouraged the growth of recycling at all installations and supports practices increasing recycling rates. DOD concurs that greater profitability, true market value, and more immediate proceeds may be obtained from recycling when installations have the authority to directly sell their recyclable commodities.

ii. Under the Combined Services Interim Guidance for Direct Sales of Recyclables, MACOM Commanders are authorized to directly sell qualified recyclable materials and may further delegate this authority to installation commanders. Personnel designated to conduct direct sales shall have experience, knowledge, and/or training in Federal contracting procedures and in the disposal of government property. Installations may continue to use the local DRMO to market their recyclables. The decision to use the DRMO or sell directly shall be documented and include a comparison of alternative sources.

g. Collection Contracting.

i. Many Army installations contract waste and recyclable material collection. Two out of three installations pay for services that exceed their needs. For example, most collection contracts are written for peak mission capacity. In some cases, the installations are additionally constrained to a 5+ year collection contract.

ii. It is in every installation's interest to make its system more efficient and cost effective. In most cases, collection contractual agreements can be improved to significantly impact effectiveness, efficiency, and cost. Modifications and improvements to existing contracts can be negotiated. Specifically, where the installation mission has decreased significantly (and where the amount of waste generated has been reduced), the collection contract should be reviewed annually and (if necessary) modified to reflect current conditions.

iii. In drawing up new contracts, flexibility should be a first priority. Installations need to ensure that mission readiness is not compromised, while at the same time, that they pay only for the services they receive.

h. Find alternative uses for C&D materials.

i. The Army engages in a great number of construction, renovation, and demolition projects across the nation. A significant amount of debris resulting from these activities, including concrete, wood, and metals is currently disposed of in landfills. Landfilling this debris results in a large loss of natural resources and an increasingly expensive problem for solid waste managers. The problem is widespread in landfills throughout the United States. C&D waste accounts for an estimated 15 to 30 percent of the municipal solid waste (MSW) stream.

ii. A few installations have been successful in diverting a portion of their C&D waste stream through innovative strategies. The U.S. Army has documented successful efforts at building salvage at Fort McCoy, WI, and Fort Ord, CA (USACERL, June 1999). Such strategies include: donation of buildings to local community groups and organizations; or sale of buildings to private parties with the stipulation that the buyer is responsible for removing the building within a set period of time. Noting these resourceful efforts to reduce the C&D waste stream from landfills, more installations need to explore alternatives for use, reuse, and recycling of C&D waste.

iii. Wastes typically generated by demolition activities include:

(1) Aluminum.

(2) Copper.

(3) Tile.

(4) Iron and steel.

(5) Wood.

(6) Plastic.

(7) Roofing materials.

(8) Concrete.

(9) Asphalt.

(10) Brick and block.

(11) Insulation.

(12) Glass.

(13) Lead pipes.

(14) Reuse of materials that normally would be considered rubble can not only reduce disposal costs at the demolition site, but also reduce material costs at the construction site where they are used. Inspect the site before demolition begins and list materials that should be saved. Then select demolition methods and procedures that will promote reuse. Demolition items that can be readily reused include: bricks and blocks, doors and windows, plumbing fixtures and pipes, and electric fixtures and wiring.

iv. Recycling is the use, reuse, or reclamation of a waste after it has been generated. Examples of opportunities for recycling demolition waste include:

(1) Creating mulch or chips from wood, or using wood as a fuel.

(2) Recycling all glass and plastic.

(3) Rejuvenating old asphalt. A new asphalt mixture can contain up to 30 percent of asphalt milled from road construction.

(4) Rejuvenating existing asphalt by heating pavement, injecting petroleum distillates, grinding, mixing, and rerolling in a single-step process.

(5) Crushing old concrete and using it as an aggregate or a base material.

(6) Separating reinforcement steel with magnets for sale as scrap metal.

(7) Removing and recycling all metal before demolition, including aluminum siding, steel pipes, copper pipes, and cast iron bathtubs.

v. Use available outside sources of information.

(1) Much useful information is available through the World Wide Web. Recycling information, fact sheets, case studies, and a list of C&D recyclers can be found at:
http://www.ciwmb.ca.gov/mrt/cnstdemo/default.htm

(2) USACERL Technical Report (TR) 97/58, Concepts for Reuse and Recycling of Construction and Demolition Waste documents and describes successful Army efforts at recycling recovered C&D materials. This report is available for viewing or free download from the Internet at URL:
http://www.cecer.army.mil/techreports

5. Examples of Successful Recycling Efforts

a. Fort Riley, KS.

i. Fort Riley generates over 11,000 tons of solid waste each year. (Figure A-1 shows the Fort's recycling building.) Due to this large quantity of waste (that would otherwise be landfilled), For Riley developed a comprehensive recycling program that is not only cost effective, but has also been recognized as one of the premier recycling programs in Kansas. The recycling program at Fort Riley, KS, is a success story that incorporates traditional recyclables, composting, hazardous materials collection, education, and a partnership with the host community.

(1) Troop Incentive. Fort Riley's Recycle Division gives an annual award to the top battalion in each category, small or large unit, that brings in the most total pounds of recyclables. Over 90 percent of the units stationed at Fort Riley have joined in the competition to be the Fort's top recycler.

(2) Direct Sales. In FY95, the Fort Riley Recycle Division received permission from the U.S. Army Forces Command and the Defense Logistics Agency to sell standard recyclables (glass, white paper, newspaper, plastics with recycle logo 1 &

2, aluminum cans, steel cans, and corrugated cardboard) directly to recycle dealers instead of going through the Defense Reutilization and Marketing Office. All proceeds go back into the recycling account to cover the costs and awards. Money remaining at the end of the year is used to support programs such as Safety; Morale, Welfare, and Recreation; as well as other environmental and educational programs.

Figure A-1. Recycling building at Fort Riley.

(3) Household Hazardous Waste Program. This program allows residents to turn in common hazardous household products that are no longer wanted, instead of disposing of them. In 1995, 93 percent of the products taken from the Household Hazardous Waste Program were reissued for reuse by Fort Riley personnel. This has prevented disposal of these materials in landfills at an expense to the installation and the environment.

(4) Composting Program. Leaves, grass clippings, and wood chips from both residential and nonresidential areas of Fort Riley, along with manure from the buffalo corral and horse stables are composted, creating from 33 to 53 tons of compost annually. The compost is distributed to post residents, used to augment soils, and also to enhance bioremediation of soil

contaminated with petroleum products. Fort Riley's compost Facility was the first such facility permitted in Kansas, and receive the best large Composting Program Award from the Kansas Department of Health and Environment in 1996.

(5) Bioremediation of Petroleum, Oil, and Lubricants (POL)-Contaminated Soil. Soil contaminated with POL is brought to the bioremediation facility where sunlight, exposure to air, and the addition of horse manure encourages bacteria to quickly consume the POL contamination. After the soil is tested and determined to be sufficiently free of POL contamination, it is mixed with finished compost from the composting operation to create usable topsoil.

(6) Spring and Fall Cleanups. Each spring and fall, both military and civilian residents of Fort Riley pitch in to clean up the entire installation. During the spring 1997 cleanup, over 70 percent of the materials collected were recycled. (Figure A-2 shows the picking line at Fort Riley.)

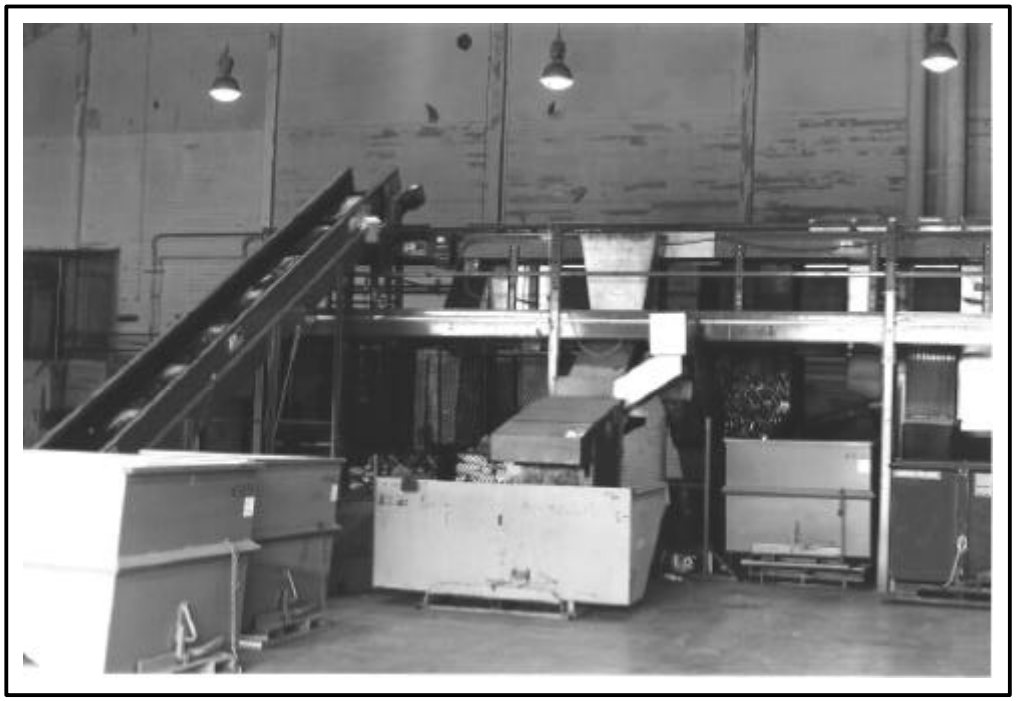


Figure A-2. Picking line at Fort Riley.

(7) Recycling of POL Containers, Used Fuel, Oil and Fuel Filters. POL containers present a unique problem since they cannot be reused, and the residual POL they contain can contaminate surrounding areas. Fort Riley's self-help system enables every Fort Riley unit with a used POL container to use container crushing equipment to crush and drain the POL containers, after which they are sold as scrap metal.

(8) Recycling Off-Specification Antifreeze. Fort Riley uses centralized antifreeze recycling equipment located on the installation to increase the quality of off-specification antifreeze so it can be reused. In 1997, the Environmental Waste Management Center received 12,000 gal of used antifreeze, which yielded approximately 2250 gal of usable ethylene glycol.

(9) Instituting and Education and Awareness Program. Fort Riley actively works to educate the troops on the installation about the need for recycling, and encourages all residents of Army family housing to avail themselves of the available recycling programs. Fort Riley also hosts field trips for children of area schools to explain the benefits of recycling and to show them "how it's done."

b. Fort Sill.

i. Fort Sill, OK has successfully established a recycling program that combines military and community participation, and has won awards for its efforts. In FY95, Fort Sill recycled a total of over 3,000 tons of material, including cardboard, plastic, low and high grade papers, aluminum, steel, and glass. (Figures A-3 and A-4 show paper recycling facilities at Fort Sill.)

ii. The recycling center processes material from a variety of sources. Soldiers collect recyclables from the post (offices, shops, etc.). The soldiers' battalion receives a percent of the recycling revenues for their own MWR type activities. All tenant units participate in recycling.

iii. The eight recycling dropoff stations around the post are intended to collect recyclables from resident military (family housing), and non-resident military.

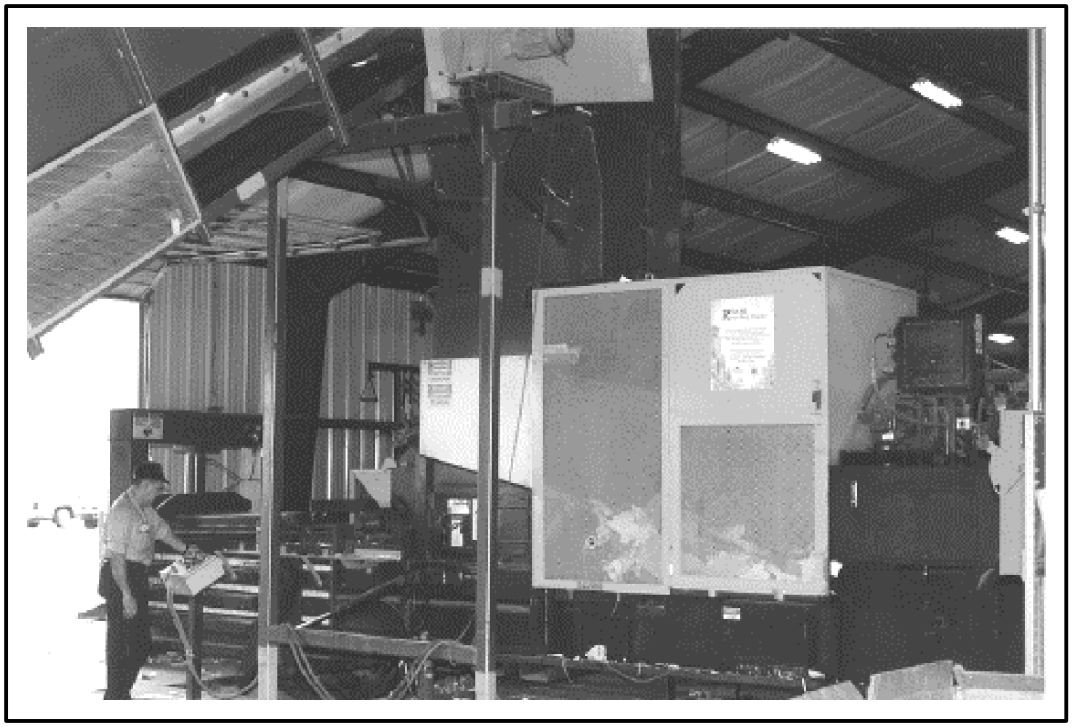


Figure A-3. Paper baler at Fort Sill.

Figure A-4. Paper sorting at Fort Sill.

iv. Fort Sill's ample storage space acts as a buffer against poor markets. For example, if the market price for old corrugated cardboard (OCC) takes a short term drop, bales of OCC can wait in the storage building until the price recovers to a satisfactory level. Program managers have built up a network of market outlets for Fort Sill's recyclables, including brokers and direct sale to end users.

c. Anniston Army Depot. Through a variety of innovative Recycling Programs, Anniston Army Depot recycles about 10 million lb of solid waste per year at an estimated annual cost saving of about $230,000. Since 1993, Anniston has reduced its solid waste by 40 percent

d. The Vermont Army National Guard has an extensive, proactive recycling program that has received much recognition. Most notably, their recycling efforts have added appreciably to the total processed recyclables to their region. By working with their local solid waste district, the District now has a steady, larger stream of recyclables to market, which garners better prices for the program, and makes the program easier to manage.

e. Fort Hood, TX earned first place in the 1996 DA Recycling Award for Non-Industrial installations. The installation's recycling center processes more than 350 tons of paper, bottles, cans, and cardboard each month, and between 1.5 million and 2.5 million lb of scrap metal are recycled each quarter. Contributing to this success has been Fort Hood's practice of crushing and recycling oil filters, and purchasing retreaded tires whenever possible. Fort Hood has also reduced lead/acid battery purchases (and avoided disposal of spent batteries) by 35 percent, by extending battery life through regular maintenance and recharging.

f. Notable achievements at other locations include:

i. Fort Campbell. Raw wood (trees, brush, stumps, etc.), waste previously disposed at the regional SW facility, is now chipped/shredded with a tub grinder into mulch, a process that decreases SW disposal. The purchase of 100, 8-cu yd refuse

dumpsters for cardboard has increased the total cardboard recycled by 100 percent.

ii. Fort McPherson. Fluorescent light bulbs and spent batteries are sent off site for recycling. More than 5500 tons of cardboard, scrap metal, aluminum, and paper were collected in 1996 for recycling.

iii. Fort Irwin. Sparse vegetation and dry, windy conditions cause very dusty conditions, such that tanks require frequent air filter changes. The M-1 Abrams tank has three air filters. Under these severe conditions, all three filters require replacement after each training rotation, at a cost of $120 for each filter. Sheridan tanks air filter changes cost about $3150 and involve more than 2000 tanks. Past practice was simply to dispose of used air filters after each training rotation, either through DRMO or in the landfill. In March 1997, Fort Irwin began its recycling program, which includes cleaning and recycling air filters. This eliminates waste and saves about $45 per filter. Since the program's inception, Fort Irwin's air filter recycling program has saved the Army more than $2,000,000. Furthermore, the program is projected to produce a savings of $5,000,000 per year based on 10 training rotations per year.

iv. Fort Gordon. In 1998, the Fort Gordon Recycling Center processed 4 million lb of paper, cardboard, plastics, metals, and glass. These items, diverted from the Richmond County landfill, are now used as sources to create new products.

v. Fort Jackson. Nearly 2050 tons of material were recycled at the center between October 1993 and December 1995, including 1772 tons of paper (including cardboard), 17.5 tons of aluminum, and 44 tons of glass. From January 1996 to December 1998, the Center anticipates processing nearly 3000 tons of paper products alone. During fiscal years 1994 and 1995, Fort Jackson recycled approximately 20 percent of its trash.

g. **Summary.** Experience with Army installation recycling programs shows that applying the concepts of recycling at different locations yields programs as diverse as the locations themselves. In all cases, recycling programs offer a host of

benefits, both to the environment and to the installations by reducing the volume of disposable waste and avoiding the costs of disposal, by increasing the efficiency of installation operations, and by generating income from the sale of recyclables.

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15 July 2000