SUCCESS STORY

SPOTLIGHT ON: TINKER AFB - DECEMBER 1998

PRO-ACT

A Base-level Pollution Prevention Resource sponsored by HQ Air Force Center for Environmental Excellence

Introduction

The United States Air Force recognizes the importance of pollution prevention (P2) in protecting the environment, achieving compliance objectives, and reducing waste disposal costs. Successful P2 programs, including recycling, waste minimization, product substitution, and process changes are planned or underway at Air Force installations worldwide. The Air Force's environmental programs must do more today than ever before, and do it with increased cost-effectiveness.

The Air Force is a leader in fostering environmental awareness and education within its workforce and communities, thereby extending environmental stewardship from a management concept to an individual responsibility. In response to executive orders, regulations, and policies, successful P2 strategies and technologies are continuously being developed, applied, and improved at Air Force bases around the world. As new ways emerge to eliminate compliance burdens, save money, and minimize chemical exposures, the Air Force is committed to collecting these P2 success stories and making them available to Air Force activities everywhere.

Tinker AFB Success Stories

Background on Tinker AFB

Tinker Air Force Base, located in America's heartland, is home to the Oklahoma City Air Logistics Center (OC-ALC), one of five depot repair centers in Air Force Materiel Command (AFMC). The 72nd Air Base Wing and other tenant organizations, including United States Navy Strategic Communications Wing ONE, are also located at Tinker AFB.

Tinker Air Force Base was named in honor of World War II flyer Major General Clarence L. Tinker. The Base was established as a major maintenance and supply depot in Oklahoma City on 8 April 1941, after which it repaired B-24 and B-17 bombers, and fitted B-29s for combat. The Base also played an important role during the Korean Conflict, the Berlin and Cuban Crises, the Vietnam War, Operations Desert Shield and Desert Storm, and most recently, Operation Determined Falcon.

The ALC at Tinker AFB manages an inventory of 2,267 aircraft including the B-1, B-2, B-52, C/KC-135, E-3, VC-25, VC-137, and 25 other Contractor Logistics Support aircraft. The Center also manages an inventory of more than 13,724 jet engines that range from the Korean Conflict vintage J-33 (T-33) to state of the art B-2 engines such as the F118. Missile systems managed by the Center include the Air Launched Cruise Missile, Short Range Attack Missile, Harpoon, and Advanced Cruise Missiles.

Today, with nearly 22,000 civilian and military personnel assigned to the base, logistics work is only a part of Tinker's mission. After the arrival of the Navy, Tinker AFB became one of the Department of Defense's (DoD's) premiere inter-service facilities. Not only is total support of America's defense systems a priority, but protecting and enhancing the environment is a top concern as well. Using aggressive and innovative technologies, Tinker AFB has become a national leader in pollution prevention.

The Integrated Environmental Team (IET) at Tinker AFB is an aggressive environmental program which has set the standard for defense installations

everywhere. The IET is comprised of the Environmental Management Directorate, the 72nd Medical Group's Bioenvironmental Engineering Division, the Base Safety Office, Base Judge Advocate, Public Affairs Office, and the Defense Reutilization and Marketing Office.

The goals of the IET include minimizing hazardous industrial chemicals and wastes, restoration of impacted areas, compliance with environmental, health, and occupational safety laws, preservation of Base natural resources, and positive interaction with the media, regulatory agencies, and the surrounding community.

Many of Tinker AFB's environmental successes are due to the Environmental Management Directorate's ability to seize leading edge technology in the developmental phase and then apply that technology to real-time needs in the field. Over the past several years, this application has been accomplished by the formation of technical coalitions with federal agencies, private industries, and universities. Included within Tinker AFB's Environmental Management Directorate (EM) are five Divisions: Environmental Compliance; Environmental Restoration; Environmental Technology; Plans and Programs; and Pollution Prevention (P2).

Among its many duties, the Environmental Compliance Division oversees the generation and disposition of nearly 7,000 tons of hazardous waste, manages more than 700 air emission point sources, performs Environmental Impact Analyses, and is responsible for protecting the Base's natural resources.

Tinker AFB's P2 Division aggressively introduces new and innovative technologies into all of the Base's maintenance processes and, as a result, has succeeded in protecting the environment and preventing further pollution. Tinker continually transfers documented innovations among DoD, regulatory, and scientific/business communities. Tinker AFB's P2 Division has played a major role in the Air Force's new emphasis on non-generation of hazardous waste in lieu of traditional tracking/ reduction of hazardous waste streams. This fundamental change in goals has drawn attention, praise, and awards from the DoD, Air Force, and international environmental scientists. Tinker AFB's P2 program goal is simple: reduce to as near zero as possible all hazardous discharges by the year 2000.

For more information about environmental programs at Tinker AFB, contact Ms. Darla Booker, Environmental Public Affairs, (405) 739-2036 or Mr. Carlos Nazario, OC-ALC/EMV, DSN 884-7071.

Tinker AFB P2 Success Stories

High Pressure Spray Washer for Wheel Bearings

OC-ALC/LIPPCC operates the only Level Two aircraft wheel bearing overhaul unit in the USAF. Aircraft wheel bearings arrive coated with a thick layer of heavy grease and grime that was traditionally removed in a 1,1,1-trichloroethane (TCA) vapor degreasing unit. In 1994, LI (Commodities Directorate) began a process to identify an aqueous cleaning system that could remove the grease. With P2 funding provided by HQ AFMC/CEVV and procurement assistance from the Defense Supply Center Richmond (DSCR), a highly effective aqueous spray washer was identified and procured. The new system ($120,000) was delivered, installed, and made operational at OC-ALC in January 1997. This system was well received by shop personnel and has not interfered with the maintenance schedule. Depending on the level of grease and grime on the bearings, the new cleaning system cleans in the same time or less than the traditional vapor degreaser. This project reduced TCA use by a total of over 2,400 pounds from a 1994 baseline, and reduced material costs by $9,000 annually. Furthermore, it eliminated the use of ozone depleting compounds and the compliance requirements associated with the National Emissions Standard for Hazardous Air Pollutants (NESHAP) for halogenated solvents.

IWTP Sludge Dewatering

Oily Bottoms Sludge (OBS) is the single largest hazardous waste stream generated by the Industrial Wastewater Treatment Plant (IWTP) at Tinker AFB. In fiscal year (FY) 1997, almost 3 million pounds of

OBS were disposed at a cost of $750,000. OBS is typically 90% water, so this project sought to expand and improve the wastewater treatment plant's existing sludge dewatering system. An alternative sludge conditioning process was implemented which allowed the OBS to be dewatered in the existing filter press. In addition, the filter press operation was improved by adding the capability to precoat the filter press membrane to ease sludge cake removal. Dewatering the OBS sludge reduces its mass by 70% and the remaining sludge "cake" can be disposed of at a lower cost per pound than the liquid sludge. Expected savings will be around $600,000 per year.

Aqueous Immersion Flush System

OC-ALC/LIPPMS manufactures replacement tubing for air, fuel, hydraulic, and oxygen systems for both engine and aircraft overhaul operations. The manufacturing process leaves a film of forming lubricant inside the tube. This oily film was traditionally removed using a TCA vapor degreasing unit. Beginning in 1993, the Pollution Prevention Division teamed with LI and enlisted contractor support to develop an alternative aqueous cleaning process. This project required considerable testing and research to determine appropriate flushing rates and process times. In 1995, a large two-basin immersion tank capable of holding tubes up to 10 feet in length was designed. In 1996, the system was fabricated, delivered, and installed at OC-ALC for $150,000. The cleaning process consists of immersing and flushing the tubes with an aqueous cleaning solution and then rinsing the tubes with deionized water. This project has reduced TCA usage by a total of over 14,000 pounds from a 1994 baseline and has saved $55,000 in annual material costs. Furthermore, it eliminated the use of ozone depleting compounds and the compliance requirements associated with the halogenated solvents NESHAP.

Two-Part Paint Stripper

OC-ALC/LAP, TIE, LCR, LAK, LAH, CE, and EMV recently implemented the use of an aerospace NESHAP compliant chemical paint remover. This effort is an excellent example of in-house teamwork among the various organizations at OC-ALC. No contract funds, with the exception of lab testing, were required to meet the incredible challenge of identifying, qualifying, and implementing the paint remover. The use of this alternative stripper will eliminate the use of over 500,000 pounds of methylene chloride used each year to strip paint from C/KC-135, E-3, and B-52 aircraft at OC-ALC. This new paint stripper works faster than methylene chloride based strippers and it is less labor intensive. Additionally, it reduces stripper usage by 60% and effects a four-fold reduction in health risk to personnel. The use of this new stripper will save Tinker AFB from investing millions of dollars (~ $6M) in pollution control equipment and allow them to meet the 1999 Toxic Release Inventory (TRI) goals ahead of schedule.

PCE Reduction

In 1990, Tinker AFB's various propulsion shops operated 11 vapor degreasers. By 1994, all the degreasers had been shut down and replaced with aqueous washers except for two located in the plating shop. Those two degreasers consumed more than 70,000 lbs. of perchloroethylene (PCE) annually. The primary workload for these last two degreasers was plating wax removal. Secondary workloads included hard-to-clean applications for other propulsion shops that were not adequately cleaned by aqueous means. In 1997, the Propulsion Directorate shut down one of the plating shop degreasers in anticipation of replacing it with a system using more environmentally friendly technologies. Further, the operation of the remaining degreaser was curtailed and controlled in order to maintain compliance with federal and state regulations. The propulsion shop now operates only one degreaser and consumes less than 15,000 lbs. of PCE on an annual basis. The goal of the propulsion directorate is to eliminate as much perchloroethylene as possible. Three other replacement projects are underway and include an aqueous parts washer for plating wax removal, a closed-loop vacuum PCE vapor degreaser, and implementation of an alternative water-soluble masking for electroless nickel and borazon plating.

Aircraft Component Stripping (ACS)

Aircraft depainting is a vital step in the corrosion control and maintenance program at the OC-ALC. For years, chemical stripping has been the primary method of depainting aircraft and aircraft parts. Chemical stripping poses hazards both to personnel and the environment. Replacement technologies focus on mechanical paint stripping alternatives such as the Aircraft Component Subsystem (ACS), which incorporates medium-pressure water and robotics, and reduces the use of hazardous chemical strippers. The ACS is a soundproof, enclosed work cell of

modular construction. The water pump is capable of producing water pressure of 36,000 pounds per square inch (psi), while the water reclamation unit has a 10 gallons per minute (gpm) capacity with filtration to 0.35 microns. Examples of parts to be stripped in the ACS include inboard and outboard flaps, wheel well doors, engine cowlings, spoilers, and rudders. The ACS process will eliminate, on an annual basis, the use of approximately 140,000 lbs. of methylene chloride, 3,300 lbs. of ODCs (primarily 1,1,1-trichloroethane), 100,000 lbs. of hazardous waste, 76,000 lbs. of hazardous waste sludge at the Industrial Water Treatment Plant (IWTP), and 8.3 million gallons of wastewater. These reductions are anticipated to result in annual cost savings of $1.1 million dollars. Perhaps the most impressive benefit of the ACS is that it removes personnel from the hazardous work environment created by the chemical stripping process. Development of alternate stripping technologies like the ACS enables the Air Force to remain in the aircraft depainting business.

Cadmium Plating Replacement– Aluminum Ion Vapor Deposition (IVD)

OC-ALC operates one of the largest electroplating shops in the nation. A variety of hazardous materials, including cadmium and nickel-cadmium, were previously used during the plating processes. Cadmium and nickel-cadmium tank electroplating were eliminated at Tinker in 1991 and replaced with Ion Vapor Deposition of Aluminum (IVDAl). The introduction of IVDAl into the plating process, via a collaborative project between Tinker AFB and McDonnell-Douglas, has eliminated 50% of cadmium usage (195 lbs./yr.) in Tinker's Propulsion Directorate. IVDAl deposits a uniform coating of aluminum on the parts, has superior performance in comparison to cadmium, and has been successfully substituted on parts previously plated with cadmium and nickel-cadmium, such as tie rods and landing gear bolt pins. Before the elimination of cadmium tank plating, Tinker used over 400 lbs. of cadmium per year. Today, only 40 lbs. per year are being used in small-scale brush plating operations. In addition, with the elimination of cadmium tank plating, cyanide products that are normally present in cadmium plating baths were eliminated.

Success in the Making: High Velocity Oxygen Fuel (HVOF)

The electroplating of jet engine components is being replaced with a robotically controlled high velocity oxygen fuel (HVOF) metallic powder coating system. The new process provides a coating with wear and hardness qualities superior to those obtained from chrome plating. When fully implemented, the HVOF technology is expected to eliminate over 400 tons of RCRA-regulated waste, including 35 tons of hazardous chromium containing waste and waste chlorinated solvents. Additional savings occur because the purchase of chromium compounds is reduced by 40%.

Non-Ozone Depleting Solvent Systems

A Glove Box Washer manufactured by ADF Systems is in use at the Fuel Control cleaning area. The cleaning solution is a mild alkaline, low-foam sodium silicate detergent heated to 160°F. The spray gun in the cleaning chamber can deliver solution at 500 psi and is very effective at removing soils from various metal fuel control parts. After a part is cleaned, a tap water rinse gun is directed at the part to remove any residual cleaning solution. The final step in the cleaning process is an air-drying step that uses a compressed air supply located within the cleaning chamber. In addition to fuel control parts, the glove box washer has been tested for the cleaning of wheel bearings. The primary wheel-bearing soils are thick greases and grimes wedged into gears and crevices. This type of bearing is traditionally cleaned in a 1,1,1-trichloroethane (TCA) vapor degreaser. Preliminary testing has shown that the glove box washer delivers cleaning performance equivalent to the vapor degreaser. In addition, the high-pressure washer has the capability to deliver the cleaning stream to heavily soiled areas of a part, making the glove box washer versatile and applicable to many cleaning needs. The washer, in conjunction with an aqueous ultrasonic cleaning system, has replaced an ultrasonic cleaning tank that used Freon-113 to clean parts. By converting to an aqueous cleaning process, yearly usage of over 4,000 lbs. of Freon-113 has been eliminated. Consequently, the waste Freon-113 (approximately 1,800 lbs.) and air emissions (approximately one ton of VOCs) have been eliminated.

Aqueous Pressure Spray Washer Cleaning Systems

Pressure spray washers are used for general parts cleaning and degreasing. The spray washers eliminate 1,1,1-trichloroethane and Freon-113 degreasers, PD-680 solvent cleaning, and some hand cleaning processes. Several pressure spray washers are currently in use at Tinker AFB. The

washers are essentially very large dishwashers in which parts are loaded, the door is closed, and the switch is set to a pre-programmed cleaning cycle. The spray washers offer several advantages over conventional degreasing. First, they remove both dirt and oils, whereas a degreaser will only remove the oils. Second, the detergent is biodegradable and produces no organic vapors, and the spent solution can be discharged to a wastewater treatment facility instead of being disposed of as hazardous waste. Third, the spray washers eliminate worker exposure to solvent vapors, making the workplace safer. Finally, the spray washer technology is sustainable because the biodegradable detergents will not compromise the environment for future generations. In addition to meeting all the cleaning requirements of the previous processes, the pressure spray washers have also decreased process times. Pressure spray washers have eliminated, on an annual basis, the use of 25,000 lbs. per year of Freon-113; 220,000 lbs. of 1,1,1-trichloroethane; and 8,000 lbs. of PD-680. Continued use of the pressure spray washers will lead to additional uses, which will result in less hazardous material purchases and exposures.

Electromechanical Devices Cleaning System

The Chem-Tech Mobile Cleaning Cabinet is an alternative process implemented to clean parts containing electrical components. Engineering staff of the Commodities Directorate, with the assistance from the Pollution Prevention Division, ceased cleaning these parts with 1,1,1-trichloroethane (TCA) and Freon-113 - both of which are ozone depleting substances (ODSs). The substitute solvent that was chosen is an isoparaffinic hydrocarbon that is similar to kerosene but more refined. The solvent cleans and performs as well as the previously used ODSs and does not conduct electricity. Drawbacks to this new hydrocarbon solvent are its slower evaporation rate and combustibility. The alternative cleaning process is designed to reduce the effects of these drawbacks by adding two features to the cabinet that make it particularly compatible with the hydrocarbon solvent. First, the unit has a ventilation system that provides a means of safely applying the solvent at 45 psi. This allows the system to recapture and condense any atomized solvent, virtually eliminating any possible fire hazard. Second, the solvent is recirculated through a filter that keeps it in maximum performance condition. This means that less solvent must be purchased as its lifetime is extended. This alternative cleaning process has eliminated the annual usage of 4,000 lbs. of TCA and 23,000 lbs. of Freon-113. Other benefits include reductions in material costs and hazardous waste generation.

Robotic Waste Reduction

One robotics instrument in use at Tinker is the Water Jet Knife, which directs a stream of high-pressure water at 20,000 pounds per square inch to remove dampening rubber from aircraft vanes. The vanes are in a cool part of the engine and are coated with rubber to control vibrations. It is necessary to remove the rubber during engine overhaul so the vanes can be inspected and repaired. In the past, rubberized coatings were removed by soaking them in a tank of methylene chloride for two to three days, after which the rubber would be scraped off by hand with a putty knife. Today, the robotic water jet knife removes the rubber in a matter of minutes. The water is later recycled by passing it through a vibrating screen to remove the rubber particles. Invented and patented by two engineers from Tinker AFB, the water jet knife has had a payback on investment of less than one year and avoids the use of 24,000 lbs. of methylene chloride annually. In addition, the technology is currently being expanded to remove flame spray coatings and other metallic coatings that currently use hazardous chemicals. The technology will also be applied to other chemical stripping and cleaning processes at Tinker, and is used as a working model for other depot maintenance installations.

For more information about these and other Pollution Prevention Success Stories at Tinker AFB, contact Ms. Darla Booker, Environmental Public Affairs, (405) 739-2036 or Mr. Carlos Nazario, OC-ALC/EMV, DSN 884-7071.

Technological Coalitions at Tinker AFB

Many of the leading-edge technologies developed at Tinker AFB have been advanced and demonstrated through the efforts of technical coalitions with federal agencies, private industries, and universities. These coalitions, by matching technological developments to true environmental needs, have proven effective in delivering the most advanced environmental technologies to Tinker AFB in a relatively short time. The technological discoveries made by these coalitions are now helping solve the most pressing environmental challenges facing the DoD today.

Several reports are available on the World Wide Web (**http://www-iet.tinker.af.mil/ietold/techcoal.htm**) which highlight successful Technological Coalitions in which Tinker AFB has been a participant. These reports fall under several different categories, as listed below, and can be used as an additional source of information on many of the P2 successes highlighted in this document:

Pollution Prevention
Advanced Plating Technologies
Electromagnetic Particle Deposition
Electroless Nickel Plating Bath Rejuvenation
Large Aircraft Robotic Paint Stripping (LARPS) and Aircraft Component Subsystem (ACS)
Water Jet Knife
Pressure Spray Washers
Engine Manifold Cleaning System
Cadmium Replacement through Ion Vapor Deposition of Aluminum (IVDA)
Carbon Dioxide (CO2) Blast Booth
FRIGC©: A Viable Alternative for R-12
Energy Program
Base Safety Office
Compliance
Remote Air Monitoring Technologies
Fourier Transform Infrared Spectrometer (FTIR) and Thermal Infrared Imaging Spectrometer (TIRIS)
Automatically Monitored Underground Storage Tank (AMUST) Dual Containment and Leak Detection System
Environmental Laboratory Cooperative
Environmental Restoration
Characterization, Monitoring and Sensor Technology Program
Characterization, Monitoring and Sensor Technology Advancement
Cone Penetrometer with Laser Induced Fluorescence Detector for Site Characterization
Pneumatic Fracturing Innovative Technology Demonstration

The AFCEE Team - Recognized as a customer-oriented leader and the preferred provider of environmental, planning, design, and construction services.

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Need more information? Contact PRO-ACT at DSN 240-4214, (800) 233-4356, or **http://www.afcee.brooks.af.mil/pro-act**.