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WATER CONSERVATION THROUGH RECYCLING: REUSING AIRCRAFT WASH WATER AT SHEPPARD AIR FORCE BASE, TEXAS

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ABSTRACT

With wide swings in recent weather conditions, encroachment, and increased public scrutiny, water conservation requirements have become a priority at Government facilities, particularly at U.S. Air Force (USAF) installations. Wash water at military installations is rarely reused and is instead typically passed to the sanitary sewer system either directly or through an oil/water separator. Oil/water separators are being phased out because they are commonly regulated as solid waste management units (SWMUs) due to potential and existing environmental impact. At an average USAF installation wash water is generated from motor pools, car washes, equipment maintenance shops, and aircraft wash racks. Water usage at each of these facilities can range from hundreds of gallons per day (gpd) to more than 10,000 gpd, representing significant sources of chemical usage, pollution, and water consumption. At Sheppard Air Force Base (AFB) in Wichita Falls, Texas, a water recycling system was installed at an aircraft wash rack to replace an oil/water separator which resulted in both operational and cost efficiencies.

KEY WORDS: Water recycling, water reclaim, water conservation, Executive Order 13423, Sheppard AFB.

INTRODUCTION

Water availability and sustainability are rapidly becoming mainstream topics that extend to military installations and other Government facilities. Water availability and conservation pressures are rising due in part to global warming concerns, drought conditions that have occurred within the southern United States over the past decade or more, and encroachment around military installations that has resulted in a general increase in public involvement. Water conservation has gained momentum with the signing of Executive Order 13423, titled "Strengthening Federal Environmental, Energy, and Transportation Management," in January 2007. The order establishes agency goals in the areas of energy efficiency, greenhouse gas emissions, water consumption, waste prevention and recycling, and other related operations. The main provision of the order is that it establishes agency goals that require various actions including annual reductions in chemical usage, pollution and waste generation, and water consumption intensity. One of the stated goals is to reduce water consumption by 2% annually

through 2015. This management priority has allowed natural resource and conservation managers to receive funding approval for new and innovative water conservation measures.

Sheppard Air Force Base (AFB) is located in Wichita Falls, Texas, approximately 120 miles northwest of Fort Worth. The climate in Wichita Falls is characterized by long, hot summers and dry winters. Annual precipitation averages 28 inches (1971-2000; NOAA, 2008), while the long hot summers create pan evaporation rates that can be over 90 inches (Ewing, 2004). Thus, the annualized net precipitation at Sheppard AFB can be in excess of negative 60 inches. Over the past several years, the region has experienced drought conditions that have forced water conservation measures at all levels. In response, Sheppard AFB has targeted some of the larger water users on the installation for water recycling. Of particular interest was wash water generated at an aircraft washing facility (Building 2550) that discharged to the sanitary sewer system by way of a large oil/water separator. None of the water generated from Building 2550 was reused. Other measures previously employed at the installation include use of treated effluent from a nearby municipal wastewater treatment plant for irrigation of the golf course and extended no-watering periods.

METHODOLOGY

As a water conservation measure, Sheppard AFB identified the Building 2550 aircraft wash rack to be converted to an operation utilizing reclaimed water. The purpose of the project was to address the following three main objectives:

- Reduce the water consumption at this facility and contribute to compliance with the water reduction goal of Executive Order 13423.
- Abandon and close the facility oil/water separator and remove from the Base' list of Areas of Concern.
- Reduce discharges to the sanitary sewer system.

Building 2550 is used for washing small training aircraft as prescribed by U.S. Air Force (USAF) maintenance policy. Typically, up to five aircraft were washed at the facility on a given day using potable water supplied by the City of Wichita Falls. On average, water consumption at the facility ranged from 1,000 to 5,000 gallons per day (gpd). Prior to the water recycling project, wash water was routed out of the facility and into a contained tarmac area containing two influent drains. Biodegradable detergent used for the cleaning operation was dispensed from 5-gallon buckets that were non-uniformly applied to the aircraft at concentrations substantially higher than the manufacturer's prescribed ratio. The influent drains transferred the wash water, detergent residue, and any storm water that collected on the facility tarmac area, to the oil/water separator. The oil/water separator discharge was to the sanitary sewer system.

Based on the facility operations, the demand for this application was specified by the user at 1,000 gallons per hour (gph), and stringent water quality requirements were imposed for the aircraft that utilize the facility. Segregation of the wash water from the stormwater was also required, and stormwater discharges were to be directed to the storm sewer system. The user also specified that the size of the available washing area not be reduced by placement of bulky equipment and tanks; that, because of base operations, the washing operations could not be

interrupted for any significant amount of time; and that system maintenance requirements had to be very low due to limited staff availability.

System Design

With the project goals and objectives defined, a design phase was completed to formulate the process and equipment requirements for the system. A technologically advanced biological treatment system manufactured by Water Reclaim Systems, Inc. (WRS) (www.waterreclaimsystems.com) was selected for the Sheppard AFB application. The main treatment process uses aerobic degradation by means of self-regenerating, naturally occurring bacteria. This "closed-loop" water reclaim system captures, treats, and then stores the wash water for reuse. This treatment process differs from other water recycling systems in that it does not rely on filtration, which only results in wastes being transferred to another media. This treatment process instead relies on degradation of the contaminants entering the system.

Prior to construction and installation, a design phase was implemented where the specifics of the washing operation were defined; these primarily related to water quantity (demand), chemical cleaning agents and detergents used in the washing operation, and the water quality requirements of the washing operation. Analysis of the wash water and detergents, while not initially conducted, was also completed to define the existing and probable pollutants and the persistence of these and the detergents/cleaning agents used at the operation. User-supplied information and observations of washing operations allowed the system to be custom designed for Building 2550. Additional design considerations for the biological treatment system that were evaluated during the design phase include some or all of the following:

- Water hardness and activities that could contribute to buildup of salts
- Detergent characteristics (MSDS sheets and manufacturer's specifications)
- Use of any biocides
- Dilution rate requirements for detergents
- Estimated water usage (average) per day
- Number of aircraft washed (average) per day

A process diagram for the Sheppard AFB system is provided in Figure 1. As shown in the diagram, wash water enters a drain system installed within the washing facility and is transferred to a grit trap where particulate matter is collected. A trench drain system was installed inside the facility to eliminate collection of stormwater; a requirement of the project. From the grit trap, wash water is picked up and transferred to an aeration tank through a hydrocyclone where solids are further removed, and then to a sealed biochamber where the main treatment process takes place. The biochamber is filled with media providing a growth area for a naturally forming aerobic bacteria that degrade hydrocarbon-based materials (e.g., oils, detergents, and waxes) in the wash water. The biochamber is aerated to maintain an aerobic condition that promote efficient biological activity. When the system is not in use for extended periods, the water is recirculated via gravity between the reuse aeration tank and the biochamber to maintain the bacterial activity.

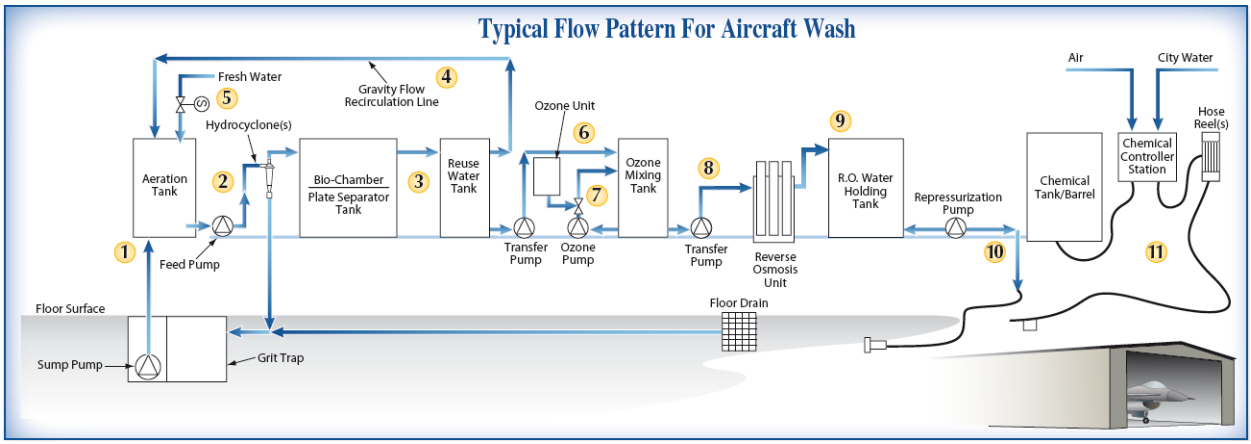

Figure 1. Process flow diagram for the Building 2550 water recycling system.

Following treatment in the biochamber, the water is transferred to a storage tank for reuse in the washing operation. From this point, the treated water can be used directly or passed along for supplemental treatment depending on the application. For Building 2550, supplemental treatment provisions (i.e., ozone addition and reverse osmosis) were added to the system design to increase the quality of the reuse water according to the user specifications. An additional holding tank was added to the system design for treated water storage prior to reuse.

Installation

Construction of the water recycling system was conducted off-site at the WRS facility. The equipment was custom fabricated into a climate control-equipped mobile container that was then transported to Sheppard AFB as a modular unit. Prior to delivery, a concrete containment pad was constructed with all of the necessary utility connections. The utility connections included potable water, electricity, and sanitary sewer (for occasional cleaning and equipment blowdown only if required, as the system is designed to operate as a closed-loop process). Once delivered, the utility connections were made and the system was commissioned for turnover to the end user. The offloading and start up phase was completed in less than one week.

Shortly after startup, it was found that the system was not operating as designed and accumulations of detergent and emulsified material were observed in portions of the treatment system. In addition, the treated water did not exhibit the expected clarity characteristics. After sampling and several rounds of troubleshooting activities, it was determined that the user was applying the detergent at levels substantially higher than the manufacturer's specifications and the system design. Following this discovery, a chemical application control and delivery system was added to the treatment system to control application and meter in the detergent at the prescribed dose. Addition of the chemical control components solved the emulsion buildup, and the system has since operated as designed.

Following successful operation of the unit, the oil/water separator was cleaned, sampled, abandoned, and closed. The stormwater conveyance piping from the tarmac area outside of the washing facility was subsequently disconnected from the sanitary sewer system and connected to the on-base stormwater system. Sheppard AFB has been able to remove this SWMU from its list of Areas of Concern.

The maintenance requirements are minor and essentially consist of replacing a nutrient cartridge approximately once per quarter, and general inspection to ensure proper equipment function and condition. Feedback from the user after installation has indicated that system operations are very simple, and the system provides a better overall wash since the detergent is applied at its optimal cleaning concentration. As a result, the number of post-wash inspection write-ups and issues requiring rewashing have declined dramatically. This improvement has increased the efficiency and has reduced the cost of the facility operations, and the improved process has further contributed to reductions in water and detergent usage.

RESULTS

The water recycling system has been operating for almost 1 year, and no significant issues or concerns have been reported from the user. Several benefits of the system are already being realized at the facility, including the following:

- Recycling of 100% of the collected water, resulting in approximate 90% reduction in water consumption (estimated 10% loss to evaporation and overspray).
- Significant reduction in detergent usage as a result of prescribed chemical application metering (80% reduction in detergent usage).
- Very low maintenance, typically a few hours per month.
- Increased operational capabilities through direct application and metering of the detergent resulting in faster application, reduced time for cleaning, and cleaner aircraft.
- Improvement in the washing process, resulting in fewer deficiencies requiring rewashing, which translates to an overall increase in efficiency and reduced facility operation cost.

With this system, Sheppard AFB has realized these additional benefits:

- The pollutants are destroyed/consumed by the self-regenerating bacteria, not just filtered out.
- The oil/water separator has been removed from the system and the current operation produces no discharge to the environment.
- The treated water has no odor and the biochamber cleaning process has been demonstrated to be exceedingly effective to justify discontinuing the ozone and reverse osmosis supplemental treatment.
- Using preliminary performance measures, these benefits equate to cost savings that will be realized annually by Sheppard AFB.

REFERENCES

Ewing, J. E., Jones, T. L., Pickens, J. F., Chastain-Howley, A., Dean, K. E., and Spear, A., 2004. *Groundwater Availability Model for the Seymour Aquifer: Final Report*.

National Oceanographic and Atmospheric Administration (NOAA), 2008. *1971-2000 Average Monthly Data for Precipitation, Snowfall, Temperature, and Wind, Wichita Falls, Texas.* (www.srh.noaa.gov/oun/climate/getnorm.php?id=sps)