TREATMENT AND RECYCLE OF HIGH EXPLOSIVE CONTAMINATED WATER

J. Greg Locke

SEPTEMBER 1994

Production Capability Assurance Program
Waste and Hazard Minimization

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TREATMENT AND RECYCLE OF HIGH EXPLOSIVE CONTAMINATED WATER

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ABSTRACT

A polysulfone ultrafilter membrane having a 0.04- μ m pore opening has been used to filter high explosive contaminated water. The water is being recycled for the coolant used during the machining of high explosive billets.

INTRODUCTION

High explosive contaminated wastewater is generated from the machining of high explosives at Pantex Plant. The water is used as the coolant during the machining operation. Typically, the water flow rate is from 2 to 3 gallons per minute. The water must be tempered to about room temperature so that it does not affect the dimensions of the explosive piece being machined. In normal operations, the wastewater and cuttings are allowed to flow to a centralized collection system. The solid explosives are separated from the water using the process shown in Figure 1. The wastewater is collected in an air agitated receiving tank or sump. It is pumped from the sump to a settling cone where the solid particles are decanted off of the bottom. The overflow from the cone is collected in another tank and then pumped through two cyclone separators operated in series. This water is also collected in a holding tank prior to final filtration through a 25- μ m filter. The effluent from the particle filter flows through two activated carbon filters operated in series prior to being discharged to a drainage ditch. This results in an average discharge of about 2000 gallons per operating day from Building 11-50. This project was initiated to develop a method to treat this wastewater and recycle it to the machine, thus eliminating the discharge.

1. Contaminated water from explosives building	6. Plastic collection can
2. Receiving tank from flume (outside building)	7. Holding tank
3. Receiving tank water pumped to settling cone	8. Cyclone separators
4. Settling cone	9. Final Holding tank
5. Collection chamber	10. Final filtration system
5.1 Air operated dump valve (upper)	11. Carbon filter
5.2 Air operated dump valve (lower)	12. Carbon filter
	13. Discharge water

Figure 1. Building 11-50 Wastewater Filtration System

DISCUSSION

The wastewater from machining operations is contaminated with solid and dissolved explosives and oils from lubricating the machine weighs. Most of the solid explosives are collected at the machine using a 100- μ felt filter bag. The dissolved explosive concentration varies with the type of plastic bonded explosive (PBX) being machined. The concentration with TATB (1,3,5-triamino-2,4,6-trinitrobenzene) based explosives is below the detection limit of 10 ppb. The concentration for HMX (1,3,5,7-tetranitro-1,3,5,7-tetraza-cyclooctane) based explosives is about 5 to 10 ppm of both HMX and RDX (1,3,5-trinitro-1,3,5-triazacyclohexane). RDX is an impurity of HMX.

The purpose of this project was to develop a process to produce water pure enough to allow it to be safely recycled to the machine and reused as a coolant. The major safety concerns were handling of high explosive particulates and dissolved explosives. The quality concern was to produce water that could be recycled and reused without detrimentally affecting the quality of the explosive being machined. It was also desirable to provide a mobile system that could be easily moved between locations, was reasonably priced, and did not require any elaborate equipment or procedures to operate. Pantex personnel worked with a local industrial water treatment firm, Canatxx Services, to design and build a treatment and recycle system.

The filtration of explosive particulates from water is a standard practice at Pantex Plant and not a difficult problem. The possibility of crystallization and depositing some of the dissolved explosives from the water into threaded surfaces, etc. was a major concern. For that reason, external threads and plastics were used wherever possible in the design. Since it was not necessary to remove the dissolved explosives, this system was designed with a low pressure ultrafilter. The ultrafilter used was a Desalination Systems, Inc. E-500 series polysulfone membrane, Model No. EW4040F. It has an average pore opening of 0.04 μ s and an active filtration area of 96 ft². The membrane performance is given in Table I.

Table I. Polysulfone Membrane Performance					
Compound	Molecular Weight	Rejection (%)	Test Conditions		
			Feed (%)	Pressure (psig)	Temperature (°F)
PVA	60,000	98	11	60	181
Dextran	70,000 110,000 500,000	68 75 96	1	7	77
Polyethylene Glycol	6,750 35,000 5.5×10^6	93	6700	44	68
Polyacrylamide	5.5×10^6	93	6700	44	68

Figure 2 is a flow diagram of the system, Figure 3 shows the layout of the equipment on a 4 X 4 ft. base, and Figure 4 is a photograph of the installed system. The wastewater and cuttings from the machining operation as with normal operations are first filtered through a 100- μ m felt filter bag before being discharged to the collection sump. The wastewater is pumped from the sump by an Osmonics double-diaphragm pump through the filtration system. Pressure gauges are provided on each side of every filtration device to provide differential pressure and indications of plugging. The first filtration step is through a 25- μ m felt filter bag. The second filtration step is through a 5- μ m cartridge filter which has seven filter elements, then through two activated charcoal filters operated in series. The charcoal is to remove any oils that are picked up by the water from the machine weighs. The water flows from the activated charcoal filters to the ultrafilter. The reject water from the ultrafilter is discharged back to the sump to be recycled and the clean water is collected in a 300-gallon storage tank. A 300-gallon storage tank was chosen in order to provide enough residence time for the water to return to room temperature and not affect the explosive dimensions. Another double-diaphragm pump is used to supply water to the machine through a pressure tank which is used to dampen the pulsation flow of the diaphragm pump.

Figure 2. Flow Diagram of the System

CANATXX SERVICES

ADVANCED WATER TREATMENT
COMMERCIAL/INDUSTRIAL/MEDICAL
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P.O. BOX 8709 AMARILLO TX. 79114-8709
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26	1	AIR VENT ASSEMBLY
25	23	HOSE ASSEMBLIES
24	2	POLYHEAD ASSEMBLY
23	1	GAUGE G3
22	1	REGULATING VALVE R2
21	1	GAUGE G2
20	1	REGULATING VALVE R1
19	1	GAUGE G1
18	1	BURP TANK (SEE SH. 2)
17	1	FLOW METER M3
16	1	DIAPHRAM PUMP P2
15	1	STORAGE TANK (SEE SH. 2)
14	1	FLOW METER M2
13	1	FLOW METER M1
12	1	REGULATING VALVE R3
11	1	ULTRA FILTER ASSEMBLY UF1
10	1	GAUGE G8
9	1	CARBON FILTER C2
8	1	GAUGE G7
7	1	CARBON FILTER C1
6	1	GAUGE G6
5	1	CARTRIDGE FILTER F2
4	1	GAUGE G5
3	1	BAG FILTER F1
2	1	GAUGE G4
1	1	DIAPHRAM PUMP P1
PC RO	BILL OF MATERIALS	

HE FILTRATION SYSTEM
MODEL: PTX-1000

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Figure 3. Layout of the Equipment on a 4 X 4 Ft. Base

Figure 4. Photograph of Installed System

RESULTS

This equipment was installed and has been in operation since September 1991. The maximum water flow rate through the ultrafilter is approximately 6 gallons per minute at a feed pressure of 25 psig. This is two to three times the required water flow for the machining operation. Therefore, the water flows were adjusted to about 3 gallons per minute for the reject water and 3 gallons per minute for the clean water. Initial testing of the water indicated that the dissolved explosives were being removed by the activated charcoal filters. In order to test the performance of the ultrafilter, the charcoal filters were bypassed while filtering water contaminated with PBX 9404, an HMX based explosive. The feed water from the sump contained approximately 4 ppm of both HMX and RDX. The clean water and the reject water from the ultrafilter both had about the same concentration of HMX and RDX as the feed water. This indicates

that the ultrafilter will not remove the dissolved explosives as expected.

In an effort to determine whether the system could be "forced" to remove the dissolved explosives, a reverse osmosis membrane was purchased and installed in the system for evaluation. The feed water was again about 4 ppm of both HMX and RDX and the activated charcoal filters were bypassed. The HMX concentration was reduced by 92% to 0.36 ppm and the RDX concentration was reduced to less than the detection limit of 0.05 ppm. The reverse osmosis membrane required an operating pressure of 100 psig which is the maximum allowable for the system. Under these conditions with minimum reject water flow, the membrane would produce only 0.5 gallon per minute of clean water. This was inadequate to meet the supply need of 3 gallons per minute.

CONCLUSIONS

This wastewater filtration and recycle system has been in operation at Pantex Plant for over a year without any problems. The operators are very pleased and satisfied with the system operations. If desired or necessary, it would be possible to remove the dissolved explosives using reverse osmosis but the filtration area would have to be increased by four to six times, and the discharge pressure of the pump would have to be increased above 100 psig.

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