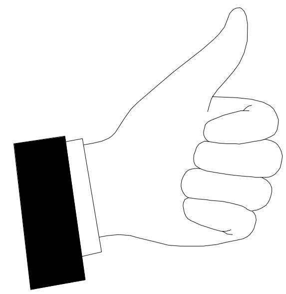
6

SUCCESS STORIES



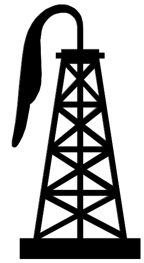
Many oil and gas companies are identifying and implementing waste minimization projects. This chapter presents summaries, of “case histories” of successful waste minimization projects in various areas of operation. All case histories presented in this chapter were submitted by oil and gas companies or presented in technical papers sponsored by oil and gas companies. The Waste Minimization Program may be contacted for additional information on the case histories in this chapter.

You may be able to identify a project in this chapter that can be implemented in your company’s operations. Also, a review of these case histories may help you think of similar waste minimization projects that would be worthwhile.

The Waste Minimization Program would like to receive information on any completed waste minimization project. If requested, the program will provide information regarding companies who submit case histories. However, if a company prefers to remain anonymous, that request will be honored. Additional case histories received by the program will be posted on the program’s Internet web site and considered for addition to this manual in future updates. The mailing address and phone number for the Waste Minimization Program is provided in Appendix H of this manual.

The following case histories are categorized by area of operation. However, all case histories should be reviewed in that a certain case history in one area of operation may be transferable to another area of operation. Each case history is formatted as “Problem,” “Solution,” and “Benefits.” First the problems associated with a particular waste stream are discussed. A waste minimization solution to that problem is then presented. Finally, the benefits gained are discussed. Each of the following case histories demonstrates that important benefits can be gained, such as cost savings and reduced regulatory compliance concerns. Waste minimization can be a good business decision!

The chapter concludes with an inventory control case history: a successful waste minimization technique that can be applied in all oil and gas operations.



CASE HISTORIES OF SUCCESSFUL WASTE MINIMIZATION IN DRILLING OPERATIONS

Closed Loop Drilling Fluid System

Problem: A small independent operator was concerned about the volume of drilling waste in conventional reserve pits at his drilling locations. Waste management costs were a concern, as well as the costs associated with impact on adjacent land due to pit failures. The operator was concerned about the potential for surface water or ground water contamination and the associated potential liabilities.

Solution: The operator was drilling relatively shallow wells in normally pressured strata. Because the drilling plan was relatively simple, the operator investigated the feasibility of using a closed-loop drilling fluid system for these wells. The use of a closed-loop system eliminated the need for a conventional reserve pit. The operator negotiated with drilling contractors to obtain a turn-key contract that required the drilling company to use a closed-loop system and take responsibility for recycling the waste drilling fluid.

Benefits: The turn-key contract was incrementally more expensive. However, because of reduced drillsite construction and closure costs; reduced waste management costs; and reduced surface damage payments, the operator realized a savings of about $10,000 per well. Also, the operator reduced the potential for environmental impact and associated potential liability concerns.

Drilling Rig Lubricating Oil

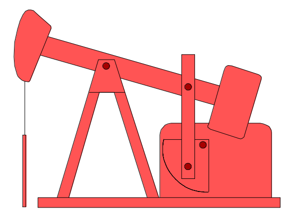
Problem: A drilling company was concerned with the volume of waste lubricating oil and filters generated by diesel power plants on its rigs. Also of concern was the expense of replacement lubricating oil and filters and waste management costs. The drilling company recognized that the problem stemmed from performing oil and filter changes at 500-hour operating intervals as recommended by manufacturer. In general, the basis for the company's concerns was reducing the daily operating costs of its rigs.

Solution: The company extended the operating interval between lube oil changes for the diesel power plants. They performed sampling and analysis of the lube oil to determine the need for a change. Specific analytes, such as contaminants, additives, and metals, were given threshold values. Whenever a threshold value was exceeded, a lube oil and filter change was made. In any event, the maximum operating interval was set at 1,250 hours.

Benefits: The change in the procedure for determining the need for lube oil and filter changes resulted in a decrease in oil costs from $64/day to $41/day in two years, which translates to a 36% reduction in waste generation. Additional cost savings were realized due to decreased maintenance requirements, improved operating efficiency, and reduced waste management requirements. Importantly, no harm or unusual wear was experienced in the diesel power plants.

See also: **Screen Type Lube Oil Filters on Drive Engines** on page 6-8 and **Inventory Control** on page 6-10.

CASE HISTORIES OF SUCCESSFUL WASTE MINIMIZATION IN PRODUCTION AND WORKOVER OPERATIONS



Paraffin Control

Problem: A small independent operator was concerned about excessive paraffin deposition in the well tubing, flowline, and stock tank at a crude oil production site. The excessive paraffin deposition caused problems such as parted rods, ruptured flowlines, and turndowns by the crude oil purchaser. Additionally, the operator had to perform solvent/hot oil treatments every ten days to keep the well producing.

Solution: The operator installed a magnetic fluid conditioner (MFC) on the rod-pump. The installation of the tool required a capital investment of about $5,000. The operator had to pull tubing from the well about seven weeks after installation of the MFC. Minimal paraffin deposition was observed. Also, minimal paraffin deposition was observed in the flowlines upon regular inspection. The MFC was performing as intended. (Note: A MFC is designed to direct the produced fluids through a strong permanent magnetic field which alters the depositional properties of paraffin, asphaltines, and minerals in the fluid. The MFC increases the solubility of the crude oil and affects its cloud point, pour point, and viscosity. Recent research in MFC technology has shown that a MFC must be specifically designed for the well in which it is to be installed, taking into consideration factors such as pump dimensions and crude oil and produced water characteristics.)

Benefits: The formation of paraffin, asphaltines, and scale was minimized. Therefore, the associated problems, such as parted rods, ruptured flowline, turndowns by crude oil purchaser, and solvent/hot oil treatments, were also minimized. The cleanup of soil contaminated by crude oil and produced water from flowline ruptures was minimized. The installation of the MFC proved to be very cost effective. The capital investment was recovered in about six months, and more efficient production and reduced well servicing resulted in increased revenue. Numerous operators have noted that MFCs do not always perform as demonstrated by this case history. However, the technology may be applicable to certain situations.

Separator Coalescor Panels

Problem: A large oil and gas company was concerned about the use of coalescor panels (14 inches deep with ½ inch by ½ inch openings) in horizontal separators used in a large field (about 400 separators). The coalescor panels would plug with solids and ice, resulting in plugging of oil and water outlets and damage to the separator's internal components. The damage was costly to repair (about $4,000). Frequent replacement of the panels resulted in high maintenance and waste management costs (15 to 20 separator coalescor change outs would generate about 25 cubic yards of waste costing about $1,000 for disposal). Also, when a separator had to be serviced due to coalescor panel problems, the production had to be shut-in.

Solution: The operator's solution was to make a simple equipment modification. A ½ inch thick fiberglass baffle perforated with 1 inch by 1 inch holes was designed to replace the coalescor panels. The new baffle costs about $200 to fabricate and install. The new baffle performed well in the separator. Flow characteristics were adequate for optimum performance of the separator.

Benefits: The elimination of the coalescor panels in turn eliminated all of the associated separator maintenance and waste management problems previously experienced. No vessel clean outs or repairs have been necessary for the modified separators. The operator did not provide the specific economics for this project. However, this equipment modification is obviously very cost effective. A simple $200 modification has eliminated repair and maintenance expense as much as $4,000. Therefore, it is apparent that the small capital investment was quickly recovered. In addition, the operator gained benefits such as increased production, reduced waste management costs, reduced regulatory compliance concerns, and improved worker safety due to reduced confined entry.

Automatic Rod-Pump Shut-Off

Problem: A small independent oil producer operates a shallow, 40-well oil field in an area subject to extremely cold winters. The operator's poly flowlines would freeze and rupture in the cold weather. Increased paraffin deposition also contributed to this problem. The flowline ruptures resulted in contaminated soil that had to be cleaned up under Statewide Rule 91. Also, to prevent rupture of the flowlines, the rod-pumps had to be shut down when freezing weather was predicted resulting in loss of production and revenue.

Solution: The operator designed and installed an automatic pump shut-off system on each well. A low cost system was designed (about $75/well including parts and labor). The total investment for installing the devices on each of the 40 wells was about $3,000 ($75/well). The automatic shut-off system was made using an automotive brake light switch (pressure switch), copper tubing, hydraulic fluid, and a simple relay switch. The circuit was designed such that the pump must be manually restarted after the cause of shut-off is determined.

Benefits: Since installation of the automatic shut-off systems, the operator has not experienced a single flowline rupture. As a result, soil cleanups and loss of production and revenue have been eliminated. The operator did not provided the specific economics for this project. However, it is clearly cost effective. The savings from reduced soil cleanups and increased revenue from more efficient production would easily recover the nominal capital investment.

Pump-Jack Gear-Box Lube Oil

Problem: A small independent operator felt that the cost of replacing lube oil in pump-jack gear boxes, including maintenance and waste lube oil management, was excessive. The operator investigated opportunities to reduce these costs and the management of the waste lube oil.

Solution: The operator found a very simple solution. A service company was contracted to regenerate the gear box lube oil. The service company filters and treats (purifies) the lube oil on-site. The reclaimed lube oil is returned to the gear box for reuse. The cost is about $35 to $40 per pump jack.

Benefits: The operator's use of this service eliminated the generation and management of waste lube oil and the associated maintenance requirements. The change in procedure was cost effective. New replacement lube oil costs about $175 per pump jack; therefore a savings of about $135 per pump jack is realized. Additional savings are realized because of reduced waste management and maintenance costs.

Produced Water Filters

Problem: A small independent operator generated a large volume of waste filters from a produced water injection system for a water flood. About 14,000 barrels of produced water is reinjected each day. Two produced water filter units at 36 injection wells were replaced twice per month resulting in about 1,700 waste filters per year. The operator spent $4,148 per year for new replacement filters ($2.44 per filter x 1,700 filters). Additional expense was incurred from waste filter management and maintenance.

Solution: The operator changed the procedure by basing filter replacements on differential pressure, rather than on a twice-monthly schedule. Valves were installed on filter inlet and outlet to accommodate a temporary pressure gauge hookup for differential pressure measurement. A capital investment of $1,800 was required for installation of the valves.

Benefits: The operator's procedure change and simple equipment modification resulted in a significant reduction in the volume of waste filters. In the year following the change, a total of 28 waste filters were generated. The change was very cost effective due to reduced maintenance requirements, reduced waste management, and reduced filter replacements. The operator saved about $4,000 per year due to the reduced filter replacement costs. The capital investment was recovered in about five months, based only on the reduction in new filter costs. Additional savings were gained from the reduced maintenance and the reduced waste management.

See also **Inventory Control** on page 6-10.

CASE HISTORIES OF SUCCESSFUL WASTE MINIMIZATION IN NATURAL GAS PROCESSING PLANT OPERATIONS

Cooling Tower Blowdown

Problem: Frequent cooling tower blowdown due to poor solids dispersion generated a large volume of wastewater. This resulted in considerable waste management costs (disposal in a Class II well). The cooling water system used a scale inhibitor sensitive to high pH; therefore, sulfuric acid was added to the system to maintain a lower pH. Additionally, the chemicals were added to the system in batches.

Solution: First, a substitute scale inhibitor was selected. The new scale inhibitor functions at a higher pH and has better solids dispersion qualities. A chemical dosing, or metering, system was installed so that chemicals were introduced into the cooling water system continuously, rather than in batches. Also, bromine was substituted for chlorine as a biocide.

Benefits: The new scale inhibitor provided improved solids dispersion resulting in reduced make-up water volume and reduced wastewater volume. The use of sulfuric acid was eliminated. The bromine biocide offered greater worker safety. The chemical dosing system resulted in more efficient use of chemicals and operation of the cooling water system. All of these improvements resulted in saving several thousands of dollars per year per cooling tower. (Note: The contributing operator did not provide specific dollar amounts.)

Heat Medium Oil Filters

Problem: A large volume of conventional filters was generated by a heat medium oil system in a natural gas processing plant. The system had three sets of filters: a 36-filter set changed weekly; a 3-filter set changed bi-weekly; and a 54-filter set changed bi-monthly. The costs associated with the filter change-outs, new filters, and lost oil were high. Also, the plant had changed to a new type of oil that more effectively cut deposits in the system, resulting in the need for more efficient filtering.

Solution: The operator installed spinner (i.e., centrifugal) filter units in place of the 36-filter set and the 3-filter set. The heat medium oil is circulated out of the system, cooled, and run through the spinner filter units. The spinner filter units require clean-out three times per week.

Benefits: The elimination of the conventional 36-filter set and 3-filter set resulted in elimination of 1,950 waste filters per year. The maintenance and waste management requirements were reduced. The cost savings were significant. Approximately $18,500 per year was saved due to: reduced filter replacement costs; reduced labor and maintenance costs; and reduced lost oil costs. The operator is investigating the feasibility of replacing the 54-filter set with spinner filter units. The operator estimates that the savings could increase to about $32,000 per year if all conventional filters can be replaced with spinner filters.

Screen Type Lube Oil Filters on Drive Engines

Problem: A natural gas processing plant operator was concerned about the volume of waste sock lube oil filters and lost lube oil created by filter changes on 16 drive engines. The seven sock filters on each drive engine were changed four times per year. Each filter change required about 40 gallons of new lube oil. For a sock filter change, each new filter cost $7.71 and the replacement of the 40 gallons of lube oil cost $107.00. The total cost per year for the 16 units was $10,315.00.

Solution: The operator made a simple equipment modification. Oberg screen type filters were installed on each of the drive engines in series with the existing sock filters. The screen filters were installed in parallel so each could be bypassed for cleaning while the unit continued to operate. As a result of switching to the screen filters, the sock filters required replacement only once per year.

Benefits: This simple equipment modification was cost effective. The reduced sock filter changes saved $7,736.00 per year, not including the savings from reduced management and disposal costs for the eliminated waste sock filters. The operator also gained the benefit of reduced regulatory compliance associated with waste management.

Contaminated Amine

Problem: A major oil company had a spill of unused amine. The spilled amine was recovered in drums, but was contaminated by dirt and unsuitable for use in the sweetening unit. The operator initially considered filtering the contaminated amine so it could be used in the sweetening unit, but the cost of filtering was prohibitive. Also, the amine was contaminated by residual surfactant in one of the drums.

Solution:

The operator considered disposal of the amine, but first “brainstormed” to see if a use for the amine could be found. Their corrosion engineer suggested that the contaminated amine could be used as a corrosion inhibitor. Amine is used as an ingredient in corrosion inhibitors and can also be used alone as a corrosion inhibitor. The operator identified several sites where corrosion inhibitors were needed and injected the amine at those locations.

Benefits:

First, the use of the amine as corrosion inhibitor saved the operator the cost of disposal. Also, it negated the need for the purchase of new corrosion inhibitor, making this recycling decision even more cost effective. This case history is simple, but still an excellent example of how wastes that were previously disposed of as a matter of accepted waste management practice can actually be beneficially recycled, resulting in cost savings.

See also **Inventory Control** on page 6-10.

CASE HISTORIES OF SUCCESSFUL WASTE MINIMIZATION TECHNIQUES IN CRUDE OIL AND NATURAL GAS PIPELINE OPERATIONS

Spent Sandblast Media in Compressor Painting Operations

Problem: The operator was using the typical sandblast procedure to remove paint, rust, and scale in preparation for repainting. The problem with this procedure was the large volume of contaminated sandblast media generated in a typical compressor paint job. Additionally, the old paint on compressors was lead-based. Each operation generated 27 drums of characteristically hazardous waste due to lead toxicity. The total cost to dispose of this hazardous oil and gas waste was $6,426 ($238 per drum). Increased regulatory compliance concerns were also a problem. The large quantity of hazardous waste generated by this process required the operator to register the site as a large quantity generator (LQG) and comply with stringent hazardous waste regulations. Also, a hazardous oil and gas waste generation fee of $2,000 was paid for the site.

Solution: The operator’s solution to this problem was to implement a procedural change at subsequent compressor paint jobs. The operator elected to use pneumatic needle scalars instead of sandblasting for paint removal and surface preparation. Paint removal and cleaning with needle scalars was somewhat slower. However, this was offset by a faster, less labor intensive cleanup of generated waste, which consisted only of paint chips.

Benefits: The operator gained impressive benefits by implementing this procedural change. Most impressively, the operator saved about $8,200 per compressor paint job, primarily due to an 8% reduction in labor costs and reduced waste management costs. Because only one drum of hazardous paint chips was generated (rather than 27 drums of spent sandblast media), disposal costs were reduced to about $240.

Also, the operator obtained the benefit of reduced regulatory compliance concerns. The reduced amount of waste generated by use of pneumatic needle scalars resulted in the site being classified as a conditionally exempt small quantity generator (CESQG) site. The CESQG site classification eliminates many of the regulatory compliance requirements and expenses of an LQG site (e.g. no annual generation fee).

Waste Brine From a LPG Salt Cavern Storage Operation

Problem: Two pits had been used to hold brine for use in displacing LPG from an underground storage facility (solution-mined salt cavern). The operator elected to discontinue use of the pits. The RRC required that all salt and brine be removed from the pits prior to their closure. One pit was about an acre in area and contained about a foot and a half of concentrated brine. The other pit was about 7 acres in area and contained about two feet of crystalline salt and silt. The operator was faced with expensive pit closures.

Solution: The operator determined that the concentrated brine and crystalline salt could be used to produce 10 ppg brine for use by drillers operating in an area requiring drilling through salt formations. The contents of the 1-acre pit were moved to the 7-acre pit, allowing closure of the 1-acre pit. Fresh water was then added to the 7-acre pit to generate 10 ppg brine, which was made available to interested drilling operations. This approach to managing the salt waste in the pits was agreed to by the RRC. In just the first year, about 1,200 truck loads of 10 ppg brine water had been hauled from the pit and had resulted in the removal of about 8,000 tons of salt. An additional year of 10 ppg brine removal was estimated for complete removal of the salt from the pit.

Benefits: The recycling of the salt in the pit as 10 ppg brine enabled operators to obtain free brine water for drilling through salt formations. Once the salt waste has been removed from the pit by solution, the operator will be able to close the pit at a greatly reduced expense. This recycling project was a win-win situation. The operator will reduce his pit closure costs and potential liability; and other companies reduced their drilling costs.

Reuse of Waste Lubricating Oil During Salt Cavern Leaching

Problem: An underground natural gas storage operator was leaching a new salt cavern and required protection of the cavern roof during the process. At the same time the operator recognized the costs associated with managing the waste lubricating oil from its operation (sent to a burnable fuels program).

Solution: The operator determined that their operation's waste lubricating oil exhibits no hazardous waste characteristics and is suitable for reuse in their operations. The waste lubricating oil is mixed with diesel to produce a mixture suitable for protection of salt cavern roofs during the leaching process. The diesel/lube oil mixture is returned to the surface at the end of the leaching process. The recovered mixture is then sold to a distillate fuels recycling facility.

Benefits: The management of the waste lube oil and the associated costs were eliminated, while the waste lube oil was reused in the leaching process. In addition, the recovered diesel/lubricating mixture is sold to the recycling facility for about $0.25 per gallon. The operator did not have to make a capital investment, but only incurred a minor vacuum trucking cost for mixing the diesel and lube oil. Therefore, this project was profitable for the operator.

Inventory Control

See **Inventory Control** below.

A CASE HISTORY OF A SUCCESSFUL WASTE MINIMIZATION TECHNIQUE THAT CAN BE APPLIED IN ALL OIL AND GAS OPERATIONS

Inventory Control

Problem: The staff of an area of operation (which included drilling, gas production and compression) of a major oil and gas company determined that its inventory of chemicals was excessive and that much of the generation of chemical waste was unnecessary. The company was also concerned about the generation of hazardous wastes resulting from its chemical inventory management.

Solution: The company addressed the problem by designing and implementing an inventory control system. The inventory control system is based on a complete inventory of all chemicals in the area of operation. To minimize chemical waste the company identified suitable (e.g., less toxic) substitute chemicals, eliminated the use of all halogenated and nonhalogenated organic solvents, determined instances where a specific chemical could be used for multiple purposes, and eliminated the use of 55-gallon drums, where possible. An important part of the system is the evaluation of a chemical prior to its purchase using material safety data sheets (MSDSs) and other manufacturer's information. The purchase of a new chemical is approved only after it is determined that the chemical complies with the inventory control system guidelines. Finally, all purchased chemicals are closely tracked to ensure efficient usage.

Benefits: The company eliminated about 32 unnecessary chemicals and products within 6 months of the program's initiation, which resulted in reduced regulatory compliance concerns (e.g., hazardous waste regulations) and savings in operating costs. Waste management concerns and costs were reduced due to the reduction in the number of 55-gallon drums on inventory. Also, the company's chemical suppliers were aware of the inventory control system and worked to supply chemicals which would be approved by the company's system.