Sterrex Industries

KICK ZONE
OILFIELD PRODUCTS

KICK ZONE

Tank Cleaning Chemical

PDS-660 Cleaner Case Study

March 2018

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Background

The information in this case study was compiled from a test with Sterrex Industries staff and customers in and around Midland, Texas in March 2018.

Sterrex Industries supplies a Crude Oil Storage tank cleaner called PDS-660. Sterrex Industries manufactures its proprietary formula at its blending facility located in Longview, TX.

Description of Product

The PDS-660 tank cleaner chemical is a brand name of Sterrex Industries and is a patented product and is a solely owned product of Sterrex Industries. Sterrex Industries developed this product as a carrier fluid for their patented DRA (Drag Reducing Agent) used for flow assurance increase in crude oil pipelines that Sterrex Industries also manufactures. Since the PDS-660 is comprised completely from organic materials this product will pass through any LACT unit without issue and does not require to be separated from the treated crude oil before being refined.

Application

The PDS-660 Tank cleaning chemical lowers the viscosity of thick and hardened tank bottom deposits and allows mixture homogenization with fresh crude, reintroducing paraffin's back into the crude oil and into the process stream. The ability of PDS-660 to liquefy paraffin (even heavy asphaltenes) that builds up in the inner walls and bottoms of crude oil storage tanks, makes it a powerful proprietary blend of a paraffin dispersant. With the polar nature of PDS-660 it will form micelles in the crude oil, which when introduced to turbulent flow conditions inside the tank via the tank mixer rapidly enhances the hard pan bottoms liquefication.

Sterrex Industries recommends 1 tote (330 gallons) of PDS-660 chemical per 1,000 thousand barrels of bottom sludge volume and mixing for at least 14 days, ideally for 30 days depending on scheduling and out of service time. Equal volumes of fresh crude to tank bottom are recommended and then agitation via tank mixers is conducted. Tank is then filled with crude and mixing is continued. No heat should be applied; the chemical is effective at ambient temperatures. Applying heat to the PDS-660 will negate the effectiveness by flashing off additives in the product and results of cleaning the tank will be marginal.

PDS-660 tank cleaner achieves better results than mechanical cleaning can produce. PDS-660 has also been introduced into producing well bores with great results as well.

Sample Cost Comparison between

Conventional/Mechanical Tank Cleaning vs. Sterrex Industries PDS-660 Tank Cleaner

Example 1

600,000/bbl. Capacity Crude Tank, assumption: 30,000 bbl. of bottom removal

Conventional Method

Tank Cleaning Crew with Rescue Team	$6-8K Daily	$7K for 10 weeks	490,000
Disposal	$10/bbl.	30,000 bbl.	300,000
Frac Tank Rental	$100/day/tank	60 Tanks	420,000
Disposal transport	$150 tank	60 Tanks	9,000
			1,219,000

PDS-660

PDS-660 Chemical	$30/gallon	9,900 gal	297,000
Cleaning Crew	$6-8K Daily	$7K for 8 Days	56,000
			353,000

Example 2

100,000/bbl. Capacity Crude Tank, assumption: 5,000 bbl. of bottom removal

Conventional Method

Tank Cleaning Crew with Rescue Team	$6-8K Daily	$7K for 7 weeks	343,000
Disposal	$10/bbl.	5,000 bbl.	50,000
Frac Tank Rental	$100/day/tank	10 Tanks	49,000
Disposal transport	$150 tank	10 Tanks	1,500
			518,500

PDS-660

PDS-660 Chemical	$30/gallon	1650 gal	49,500
Cleaning Crew	$6-8K Daily	$7K for 8 Days	28,000
			77,500

Note:
The above examples do not include:

- Tank Entry Supervisor
- Vacuum tanks of approximately 60 bbl. size
- Roll Off Bins for solids (iron sulfide/sand)
- Mixer operational costs
- **Lost Inventory Cost and Recovery**

Any future user of the PDS-660 chemical should expect different but similar outcomes, based upon labor, equipment and related expenses at the time and location work is performed, in addition to variances in tanks, condition and composition of bottom sludge to be removed.

It is suggested reader also consider feedstock recovery, discussed beginning on page 20 of this case study.

Benefits

- High recovery of feedstock crude from sludge
- Reduction/elimination of hazardous disposal, associated costs and environmental exposure
- Reduction of tank cleaning intervals, shorter time out of service
- Reduced tank operating expense
- Substantial costs savings of chemically cleaning large storage crude oil tanks with PDS-660 when compared to conventional mechanical cleaning
- PDS-660 can be used in lower volume amounts to maintain cleaner tanks
- Shortens the turnaround time to put tank back in service when API 653 inspection is required
- Substantially lowers the amount of time for workers to be inside of tanks
- Lower risk of employee accidents and or injuries

Overview: Inspection of API 653 - Tank Inspection, Repair, Alteration, and Reconstruction

API 653, Tank Inspection, Repair, Alteration, and Reconstruction, Fifth Edition, is a standard developed and published by the American Petroleum Institute (API) and covers the inspection, repair, alteration, and reconstruction of steel aboveground storage tanks used in the petroleum and chemical industries. The first edition of API 653 was published in January of 1991. The fifth and most recent edition of the standard was published in November of 2014.

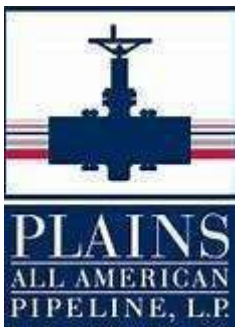
The requirements set forth in API 653 are meant to cover those steel storage tanks that were constructed under the standards of API 650 and its predecessor API 12C. If there are any conflicts found between this standard and those, API 653 is to take precedence. While it was specifically written to apply to those tanks constructed under API 650 and API 12C, API 653 can, at the owner's discretion, be applied to tanks constructed under other standards as well.

This standard provides the minimum requirements for maintaining the integrity of welded or riveted, non-refrigerated and refrigerated, atmospheric pressure, aboveground storage tanks after they have been placed into service. It only applies to maintaining the integrity of the foundation, bottom, shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange, first threaded joint, or first welding-end connection of the tank.

Frequency: Inspection of API 653 - Tank Inspection, Repair, Alteration, and Reconstruction

The **frequency** of an in-service **inspection** is typically every 5 years. Tanks that are in more corrosive service or accelerated corrosive conditions are **inspected** at shorter intervals, which **frequency** is determined by rate of deterioration and remaining metal thickness.

List of companies known to use chemical cleaning to maintain getting ready for API 653 inspections.



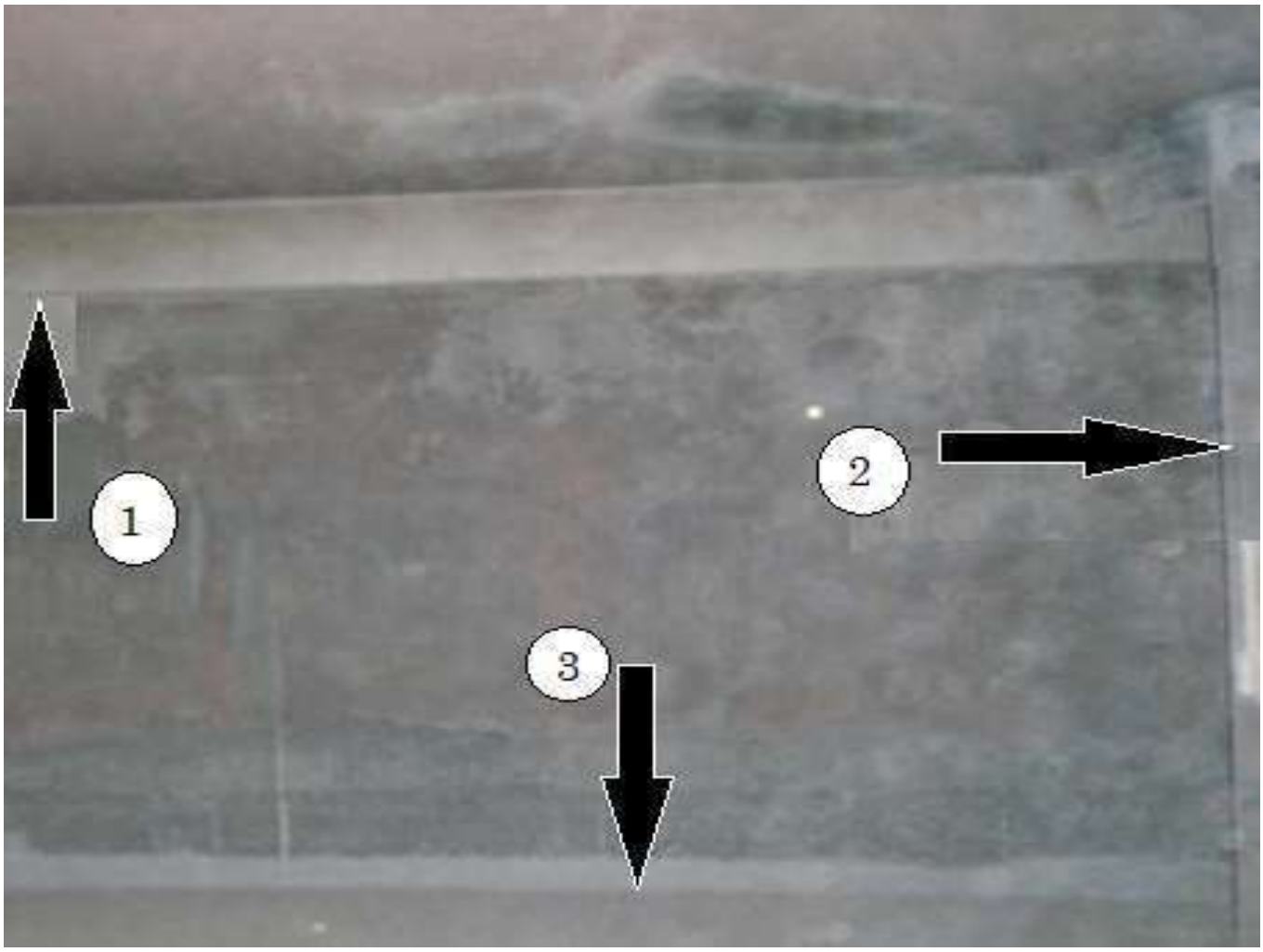
Sterrex Industries PDS-660 CRUDE OIL TANK CHEMICALLY CLEANING RESULTS

The following six photographs (pages 8 through13) were taken inside a 100,000/bbl. After being chemically cleaned using the proprietary Sterrex Industries PDS-660 Cleaner. In these photographs it is also being readied for an API 653 inspection after the chemical cleaning process using the PDS-660 Cleaner.

Photograph 1 of 6
PDS-660 CHEMICAL
CLEANING RESULTS

This tank was chemically cleaned using the Sterrex Industries PDS-660 cleaner.

This 100,000/bbl. crude oil storage tank was being cleaned so it could be readied for an API 653 inspection. Arrow indicates open hatch, through which personnel gained access to the empty, nearly clean tank.



Photograph 2 of 6
PDS-660 CHEMICAL CLEANING
RESULTS

1. **Arrow 1 - Inside the tank, the edge of floating roof where it meets tank wall.**
2. **Arrow 2 - Floating roof leg stop.**
3. **Arrow 3 - Tank wall where it meets tank floor.**

This portion of the tank had already been lightly sand blasted after being chemically cleaned using the PDS-660 cleaner.

Photograph 3 of 6
PDS-660 CHEMICAL CLEANING
RESULTS

The men in the picture are pointing to scale remaining on the tank wall, prior to sand blasting. Appearance indicates it is silicate (sand) and iron sulfide residue. The scale fell off to the touch and could easily be removed with a handheld scraper.

Bright spot in this picture is camera flash reflection and is an indicator of the PDS-660 cleaner effectiveness. Subsequent photographs of an adjacent tank cleaned in the mechanical or conventional methods will highlight the success achieved using the chemical cleaning option using the PDS-660 cleaner.

Photograph 4 of 6

PDS-660 CHEMICAL CLEANING

RESULTS

View of floating roof from inside of tank, showing radial ribs. Bright spot in this picture is camera flash reflection. We were told by tank company personnel that this roof had not been cleaned in any way other than by application of Sterrex Industries PDS-660 chemical.

Photograph 5 of 6
PDS-660 CHEMICAL CLEANING
RESULTS

View of the inside of the floating tank roof, closer to the center of the tank.

1. **Arrow 1 indicates one of the roof legs stops for the floating tank roof.**

Photograph 6 of 6
PDS-660 CHEMICAL CLEANING
RESULTS

Photograph of floating tank roof from inside crude oil storage tank.

1. **Arrow 1 indicates step ladder that is extending through an access hatch or man way through the floating roof.**
2. **Arrow 2 indicates one of the roof legs stops for the floating tank roof.**

CONVENTIONAL/MECHANICAL CRUDE OIL TANK CLEANING RESULTS

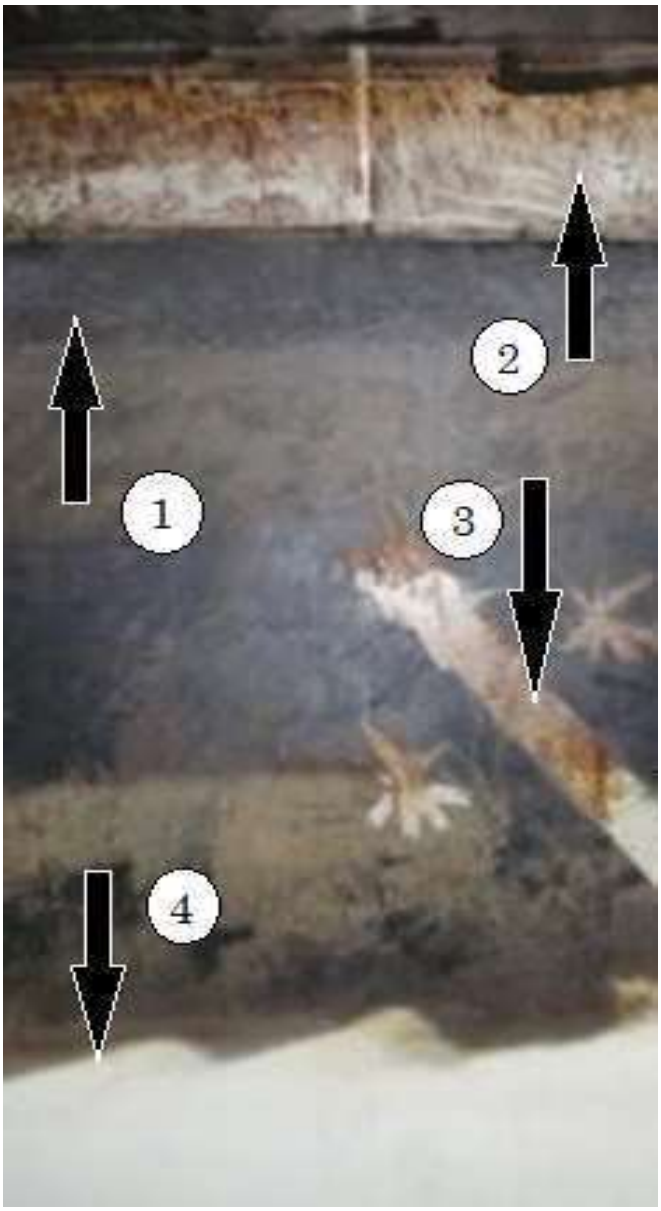
The following six photographs (pages 14 through 19) were taken inside and next to a similar 100,000/bbl. tank on the same tank farm depicted above. In these photographs it is also being made ready for an API 653 inspection, in the middle of a conventional cleaning process.

Photograph 1 of 6
CONVETIONAL MECHANICAL CLEANING

The photo above and the next photos below are of a tank that was being cleaned conventionally or mechanically, NOT using the proprietary chemical from Sterrex Industries called PDS-660 cleaner. Bright spots in the bottom center of photograph is light entering through open access hatch. Radial roof ribs and roof underside appear in the upper foreground.

Photograph 2 of 6
CONVETIONAL MECHANICAL CLEANING

Underside of the floating roof; white areas are hard paraffin deposits; darker splotches are remaining residual sludge.



Photograph 3 of 6
CONVETIONAL MECHANICAL CLEANING

1. **Floating roof edge where it contacts the tank wall.**
2. **Floating roof flange impression that has been physically scraped off.**
3. **Hard sludge and paraffin physically scraped off wall in a long diagonal strip.**
4. **Plastic floor covering to catch sludge removed from walls.**

Photograph 4 of 6
CONVETIONAL MECHANICAL CLEANING

One roof rib from side looking towards center. Note: Paraffin deposits on roof rib extending from foreground to center circular piece.

Photograph 5 of 6
CONVETIONAL MECHANICAL CLEANING

Sludge remaining on tank floor. Floor is whitish gray in person and cleaning is still in process to finish the job.

Photograph 6 of 6
CONVETIONAL MECHANICAL CLEANING

Drums of paraffin sludge removed from the tank placed within spill containment dikes. There were seven drums of the paraffin sludge that would be blended with crude and sold for nominal value to offset some of the cleaning costs. Extracted paraffin does have commercial value.

Ongoing Considerations

The PDS-660 formula **HAS** been patented; thus, its chemical formulation is protected by patent and similar intellectual property laws.

Purchase agreements need consider production capacity, and risks of loss, sale or transfer of the formula or current production facility.

Feedstock Recovery

Sterrex Industries and customers report typical 90% recovery of feedstock crude from the homogenized bottom sludge. It is not anticipated that the chemical will have any adverse effect on refinery equipment or output. No mention was made by any user of any adverse effect upon tanks, mixes, pumps, pipelines, valves or any other apparatus with which the newly treated sludge makes contact.

Assuming use of the recommended application of 1:1000 (tote/bbl.) is followed plus the addition of a similar volume of fresh crude to bottom sludge will produce a concentration of 0.007857%

The material safety data sheet supplied by Sterrex Industries indicates a solvent package to make up 90% to 97% of the chemical. It is not expected that concentrations of less than 1 percent will have any adverse effect on equipment such as cokers or fractional distillation columns.

It should be expected that customers will mix the chemical with sludge and crude samples in the concentrations to verify.

No inclusion of the value feedstock recovery was included in cost comparisons on page 4 because of differing inventory accounting methodology, crude price variations and expected effect on refinery output.

This is because of possible FIFO/LIFO accounting variations, differing accountings for loss between receipt and entry into process stream, as well as ever changing prices for crude when refined. Composition of treated, removed bottom is unique to each tank, including API of fresh crude introduced and mixed, and output composition, and thus selling price, will also see variations.

Nevertheless -•• as an example -•• 10,000 bbl. of tank bottom sludge that results in 9,500 bbl. of previously lost feedstock, at $60 bbl. = $570,000

Combinations of costs and recovery are attractive, and one additional aspect of costs should be noted when estimating the combined economic benefit; full cleaning of a tank for inspection/repair versus in-service bottom removal to regain tank volume. The second scenario has a reduced out-of-service interruption period and no tank crew expense, as entry, sandblasting, etc. are not conducted.

Sterrex Industries also reports that calculations of existing tank bottom volumes are often low. They generally recommend assumption of 30% more bottom material than what results from their calculations and correspondingly increased application of PDS-660 tank cleaner. One contributing factor is "lumps" or thicker sections within bottoms, often resulting from tank inlet diffusers and their location relative to mixers. Above all it should be noted that bottom sludge is rarely homogeneous.

Summary

The reduction of cleaning costs, substantial reduction or outright elimination of hazardous waste disposal expense and recovered feedstock at nil cost represent significant positive effects for refiners.

END OF CASE STUDY

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