



Case Study

New Install
Siemens and MHI Compressor Train

Purpose:

This case study presents a detailed overview of 11 high velocity hot oil flushes performed by PetrolinkUSA at a customer's new production facility.

Synopsis of Work:

PetrolinkUSA was contracted to perform High Velocity Hot Oil Flushes (HVOF) on every lubrication system installed in the customer's new ammonia unit. The oil capacity of the lubrication systems ranged from 100 to 5,200 gallon. A multitude of contamination opportunities existed during the installation and fabrication processes of the lubrication equipment and piping. Metal shavings, welding slag, and airborne contaminants (i.e. dust, dirt and sand) were able to enter into the lubrication system this period. This study highlights the contamination consistently seen in lubrication systems after initial installation and the effectiveness of PetrolinkUSA's high velocity hot oil flush services at removing the contamination.

Project Details:

The lubrication systems flushed by PetrolinkUSA included 4 large lube oil systems, each with over 600' of 4" piping, 600' of 6" piping, a few hundred feet of 1.5"-3" piping and a section of smaller diameter control oil piping. The remaining 7 HVOFs were performed on smaller systems ranging from 100 – 700 gallons. All of the systems were new installations with stainless steel piping. Before arriving onsite, PetrolinkUSA was informed that all the piping was cleaned prior to installation. However, as documented in the pictures, the flushing process proved vital to cleaning the systems and ensuring the commissioning of this system was successful. PetrolinkUSA's services were paramount to removing the contaminants introduced during the installation process that would have caused premature wear or possible catastrophic failure of the internal components.

Project Scope:

- Pre-flush Reservoir Inspection
- Flow Circuitry Engineering
- Installation of Engineered Flow Circuitry : Jumper Installation to Bypass Non-Flushable Components
- Complete System Integrity Verification
- High Velocity Hot Oil Flush
- Manual Decontamination of Non-Flushable Components
- Post Flush Reservoir Inspection/Clean; Rundown Tank Inspection/Clean

Project Objectives:

- Perform all work safely and within OSHA, Customer and PetrolinkUSA standards
- Decontaminate all lube oil systems in the new Ammonia Unit using PetrolinkUSA's knowledgeable technicians and custom flushing equipment
- Exceed API 614 pipe cleanliness guidelines for lube oil piping (100 mesh screen checks)
- Manually decontaminate all reservoirs and rundown tanks
- Confirm system cleanliness after each flush through laboratory testing

High Velocity Hot Oil Flushes

PetrolinkUSA arrived on site fully prepared for the 11 flushes with pre-engineered jumpers and components for each system. The custom flushing and heating equipment were rigged up safely and efficiently. All of the flushing equipment was staged in secondary containments provided by PetrolinkUSA to contain any leaks or spills. Prior to each flush, PetrolinkUSA and the designated customer representative performed a thorough system walk down to ensure the optimal flow path and that it was free of leaks.

Proper lock out tagout procedures were followed and safety meetings were held during every shift, which was especially important due to other contractors were performing in the immediate vicinity. PetrolinkUSA's trained technicians utilized sound judgement during each job to prevent accidents and provide efficient service. The customer representative was updated with daily reports and constant communication. The final cleanliness of each system was verified and approved by the designated customer representative. This was done through visual screen analysis and laboratory testing.

Screen Analysis

The pictures below illustrate the progression of the system cleanliness and the contamination present on various API 614 screen checks during the project. These screen checks were performed on screens installed in the lube oil and control oil discharge headers of the Mitsubishi and Siemens trains. These screens were inserted at the start of each flush and located at the extreme end of each discharge header before entering each respective console. Each screen reflects the first run and screen pull for each system. The duration of the first runs was 30 minutes. The contamination in each system is evident in these photographs.

Right: Discharge header screen checks after first 30 minutes of flushing



The screens pictured below were located on the discharge end jumper points. These screens helped identify the specific areas of heavy contamination inside the piping. The flow path was then manipulate to target these areas and remove the heavy contamination . Furthermore, it ensures the customer that the most sensitive lines (bearing, gearbox supply lines) are clean before startup. It's critical that these supply lines have little to no contamination present to prevent premature wear or worst case scenario, cause catastrophic failure.

Right: Heavy contamination was found on the screens located at the bearing jumper lines





4" Inboard Turbine Supply on Mitsubishi Train 3" Outboard Compressor Supply Line Siemens Train 1.5" Outboard Journal Bearing Supply Line on ThyssenKrupp Train 2" Inboard Thrust Bearing Supply Line on ThyssenKrupp Train

PetrolinkUSA was able to remove all harmful particulates that would have otherwise caused excessive wear and major damage to these sensitive systems during production. PetrolinkUSA's flushing skids are engineered specifically for any situation a customer may have. The pumps used for these flushes had pump rates ranging from 60gpm to 700gpm. All ferrous and airborne debris were removed through the use of an optimized schedule of purging, temperature ramps, and velocity changes. Highly efficient BETA 1000 micro fiberglass filters were utilized to remove particulates from the system during the flush. These filters were installed inline on the flushing equipment.

Several screens checks captured a wide range of contamination ranging from plastic, metal shavings, gasket material, grease, rubber, and even cardboard. A few examples of these items are shown on the right.

The time period between screen checks was gradually extended as the system cleanliness increased during the flush. The initial screen checks were performed after 30 minute of circulation to gauge the contamination level of each system. The flushing period between screen checks slowly increased up to 4 hours, depending on the severity of the contamination. At the end of every flush, PetrolinkUSA performed verification runs to ensure each system was ready for final customer approval. The one hour long verification runs were complete once two consecutive runs produced clean screens. The customer requirements exceeded API 614 industrial pipe cleanliness standards and required screens completely free of particulates. PetrolinkUSA successfully met these cleanliness requirements for all of the 11 systems.



Metallic Debris pulled off screen



Rubber and Plastic present on screen pull

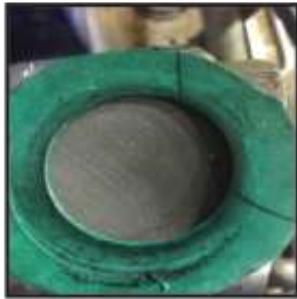


Plastic found on 8" screen on end of header



Cardboard found within lube oil piping

The pictures below show examples of the screens pulled following verification runs. These lack of particulates on the screens clearly indicate the systems had met the required cleanliness specifications.



1" inboard thrust bearing supply line ThyssenKrupp



8" discharge header screen on Siemens Train



2" outboard Journal bearing supply line Mitsubishi Train



1.5" inboard gearbox supply line ThyssenKrupp

Reservoir and Rundown Tank Cleaning

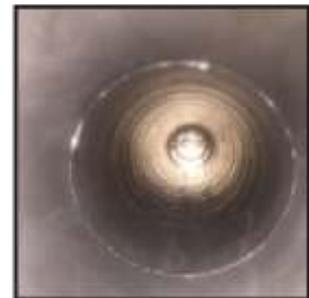
Following each completed flush, PetrolinkUSA performed a reservoir cleaning on each console and the rundown tank (where applicable). The oil was removed from the reservoirs and held in external reservoirs until completion of the reservoir cleaning. During this part of the project, oil samples were taken and sent for laboratory analysis. The testing included particle count analysis to determine the equivalent ISO code for the final oil cleanliness. Any issues with a high particle count, was remedied with side stream filtration of the lubricant with a filter cart. The oil was filter filled into the clean reservoir upon completion of the reservoir cleaning. Listed below are some pictures of the consoles we cleaned post flush. Pictures of a cleaned reservoir and pipe interior are shown below.



After pictures of cleaned 550 gallon ThyssenKrupp Reservoir



After picture of rundown tank on Mitsubishi train



Final interior picture of 6" stainless steel post flush

Conclusion

The 11 flushes were safely completed and met all customer requirements for approval. At the completion of each flush, extensive oil analysis was performed by PetrolinkUSA and to confirm and document each system's final cleanliness. The customer reported high satisfaction with the flush process and requested PetrolinkUSA's services on additional hot oil flushes on subsequent projects.