



Great Lakes Water Authority Eastlake Reclamation Plant

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Oil Analysis Audit & Survey Report

February 1, 2016

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Technical Services/Field Support
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Summary

Great Lakes Water Authority is instituting an Oil Analysis Program to monitor rotating equipment at the Eastlake Reclamation Plant. TestOil was asked to perform a survey of equipment identified for inclusion in the program to help establish sample procedures, location, and frequencies. This report outlines the recommendations resulting from that survey.

Program Objective

In order to focus the efforts of the program, simple objectives must be established. Based on those objectives, the proper elements of the program can be selected to accomplish effective maintenance practices. During the audit, several points of interest were discovered:

- ❑ *All maintenance activities are either preventative or reactive. There are currently no predictive technologies incorporated in the maintenance plan.*
- ❑ *Oil changes and other preventative maintenance activities are now performed on a six month frequency*
- ❑ *Most equipment observed in the survey exhibited reliable operation in the past*
- ❑ *There are documented lubrication charts in place.*
- ❑ *Lubricants are purchased on an as needed basis from a local distributor. All plants in the company use different distributors*
- ❑ *Toho has incorporated a good CMMS program.*

Most equipment surveyed has not been prone to failure. This is likely due to effective preventive maintenance in the past. With production demands expected to increase, the potential for mechanical problems is increased. ***The Oil Analysis Program's primary objective should be to identify equipment that needs maintenance action.*** By identifying components that require maintenance attention, more effective use can be made of the limited time available during scheduled outages. Additionally, it is recommended that non-invasive tasks such as breather changes and lube sampling be performed during production to reserve time when the equipment is not running for oil changes, filter upgrades, and other more invasive activities.

Contaminants

By identifying potential sources of contamination, it is possible to more effectively monitor the level of contaminants in the lubricating oils. The following sources of contamination have been identified:

1) Water - Water contamination will be monitored directly using the crackle test and Karl Fischer titration. Water contamination occurs as a result of two potential sources.

- Condensation is likely, due to the nature of the plant's operation. Aside from the fact that the Sand Hill plant handles millions of gallons of water each day, equipment in the plant is subject to severe aspiration caused by warm days and cool nights. If a condensation problem is detected, the addition of desiccant breathers would resolve the problem.
- Most of the equipment is located outside. It is very possible for rain to enter equipment through seals or breathers.

2) Silica - Airborne dust and dirt enters a component through breathers, and can be detected by monitoring the level of silicon.

3) Lubricants - The addition of the improper lubricant is a common source of lubricant related problems.

- A different grade lubricant can be mistakenly added to a system. This can be detected by monitoring the oil's viscosity and additive levels, in addition to FTIR Spectroscopy.
- Grease can enter a gearbox sump through seals when the bearings are greased. This would also be detected by the viscosity and additive levels.

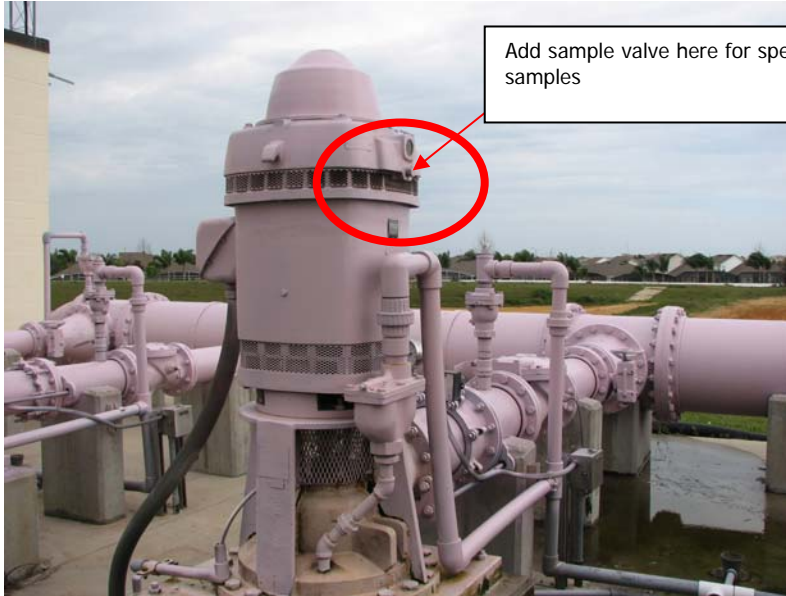
Equipment

Equipment has been listed and recommendations made in the order of the tour given to TestOil personnel. This should help in locating and sampling equipment in a logical route based sequence.

Reclaim Pumps 1-4

Criticality: While these pumps are important to operations, the plant could run for a given period of time without them. While lube analysis is not recommended, vibration monitoring should be considered in the future.

Sampling: Should special sampling be needed on these pumps, there is only one small reservoir on the outboard motor bearing. It is recommended that a valve be installed at the oil drain to aid in lube changes and for ease of sampling.



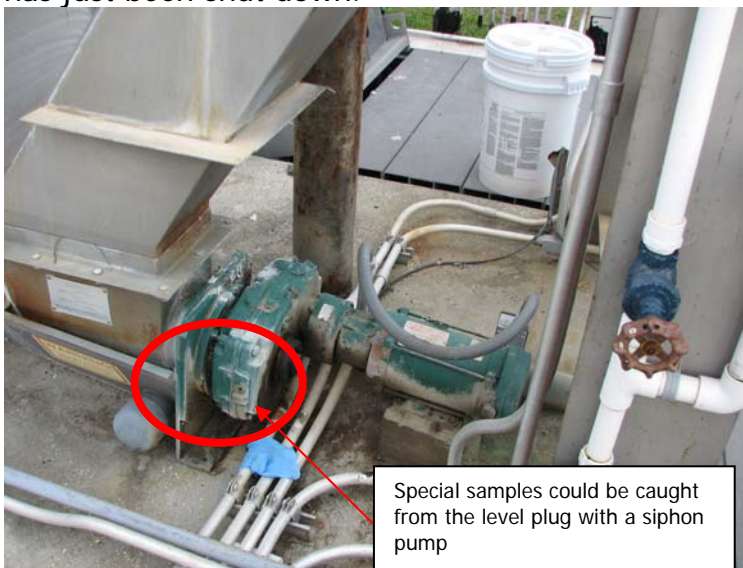
Add sample valve here for special samples

Reclaim Pump

Aqua Guard Gearbox

Criticality: This gearbox is not critical to operations. Past maintenance history shows that this is not a candidate for lube analysis.

Sampling: If a need should arise to catch a special sample form this gearbox, it is recommended that the sample be caught from the oil level plug when the unit has just been shut down.



Special samples could be caught from the level plug with a siphon pump

Aqua Guard

Screener Gearbox

Criticality: The screener gearbox is not critical to operations. This unit is only run 3-4 hours per day. Past maintenance history and repair/replacement cost do not justify this unit for lube analysis

Sampling: This unit is not recommended for sampling.



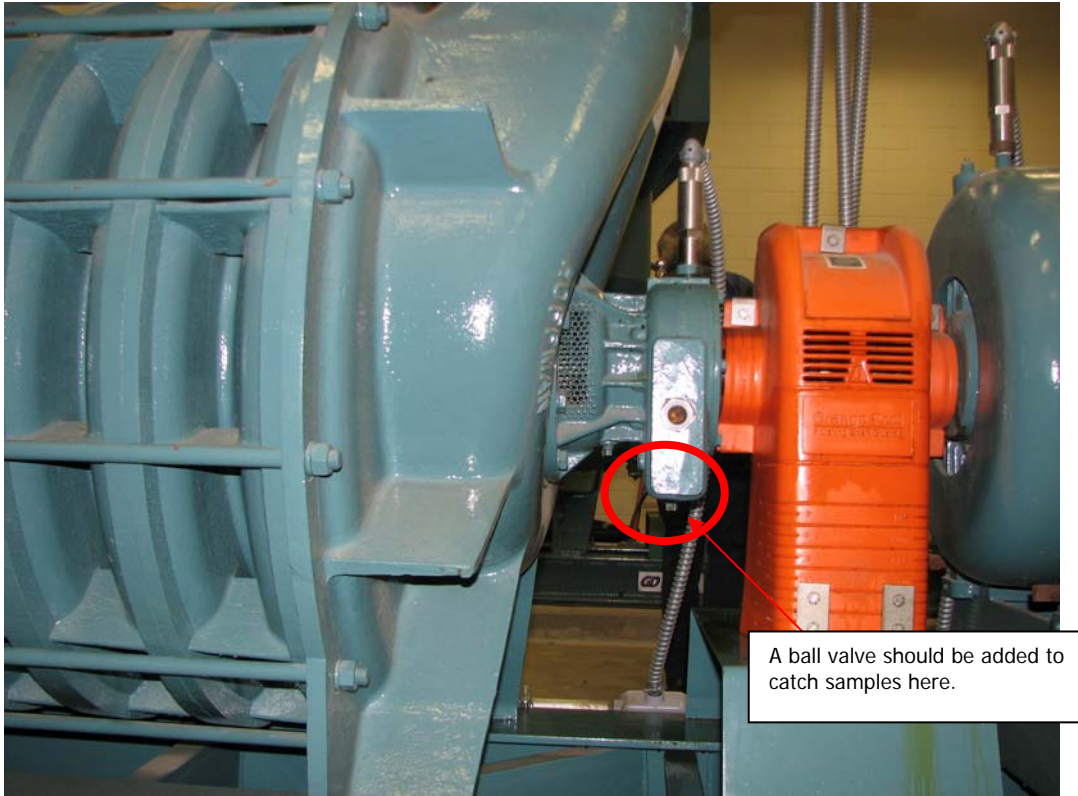
Screener Gearbox

Air Compressors 1, 2, 3

Criticality: These components are very critical to operations of the plant. Because of the high criticality to operations and high replacement cost, these units should receive routine sampling. These blowers should also receive routine vibration analysis. An ISO 150 mineral oil is used in these units.

Sampling: These blowers should be sampled while running. Because of the size of the reservoir, samples should be taken from the drain plug while adding

oil to the fill port. A ball valve should be added to the drain for ease of sampling. At a minimum, this equipment should be sampled no less than quarterly.

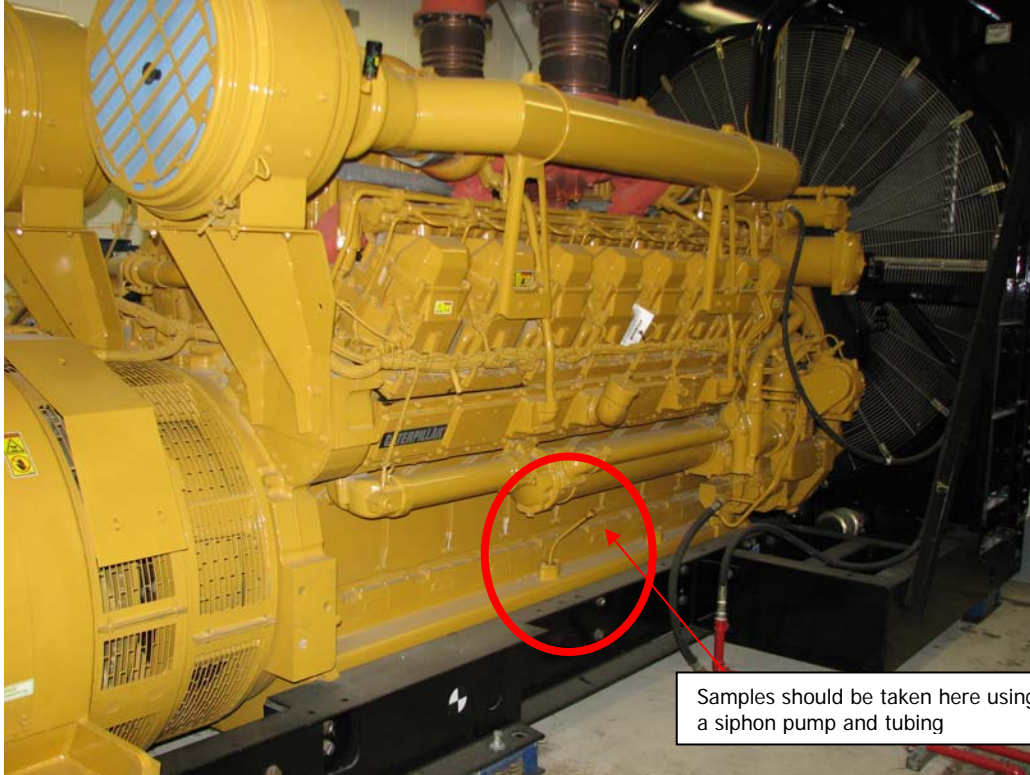


Air Compressor

Emergency Generator #2

Criticality: This unit is critical to the operation in the event of power loss. Failure of these units to function properly would result in catastrophic results. Lube analysis should be performed on these units.

Sampling: This unit is only run 1 hour per week for test purposes. It is recommended that the unit be samples immediately after shutdown through the dipstick tube. Sampling would be performed using a siphon pump and tubing provided by Insight. The unit should be sampled every 6 months.

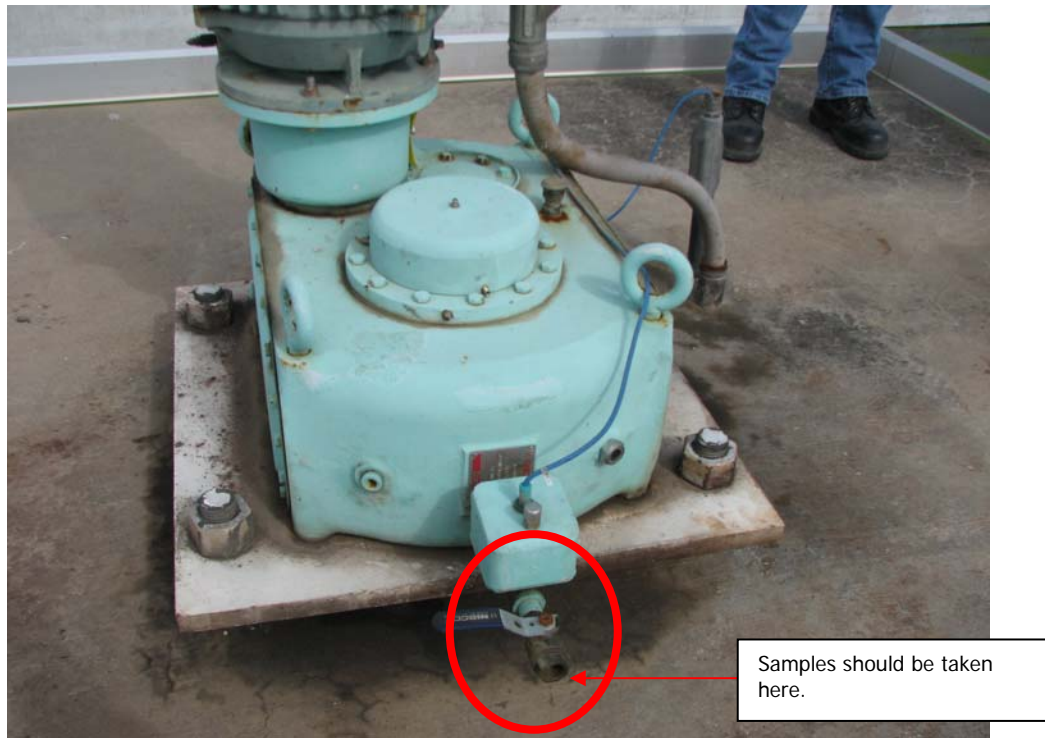


Emergency Generator #2

#1 and #2 Mixers

Criticality: While these mixers are not currently running, they will run in the future and will be critical to plant operation. When running these machines are candidates for lube analysis.

Sampling: The oil in these units appears to stay agitated due to the rotation of the gear set. A number of sampling methods would result in acceptable results provided the procedure is used consistently. Sampling should be on a monthly basis. The easiest method would be to sample from the drain valve already in place.



Mixer Gearbox

#1 and #2 Aerators

Criticality: While these Aerators are not currently running, they will run in the future and will be critical to plant operation. When running these machines should be sampled for lube analysis.

Sampling: The oil in these units appears to stay agitated due to the rotation of the gear set. A number of sampling methods would result in acceptable results provided the procedure is used consistently. The easiest method would be to sample from the drain valve already in place. When running, these units should be sampled each month. These units should also be considered for vibration monitoring. The Aerators use ISO 220 gear oil.

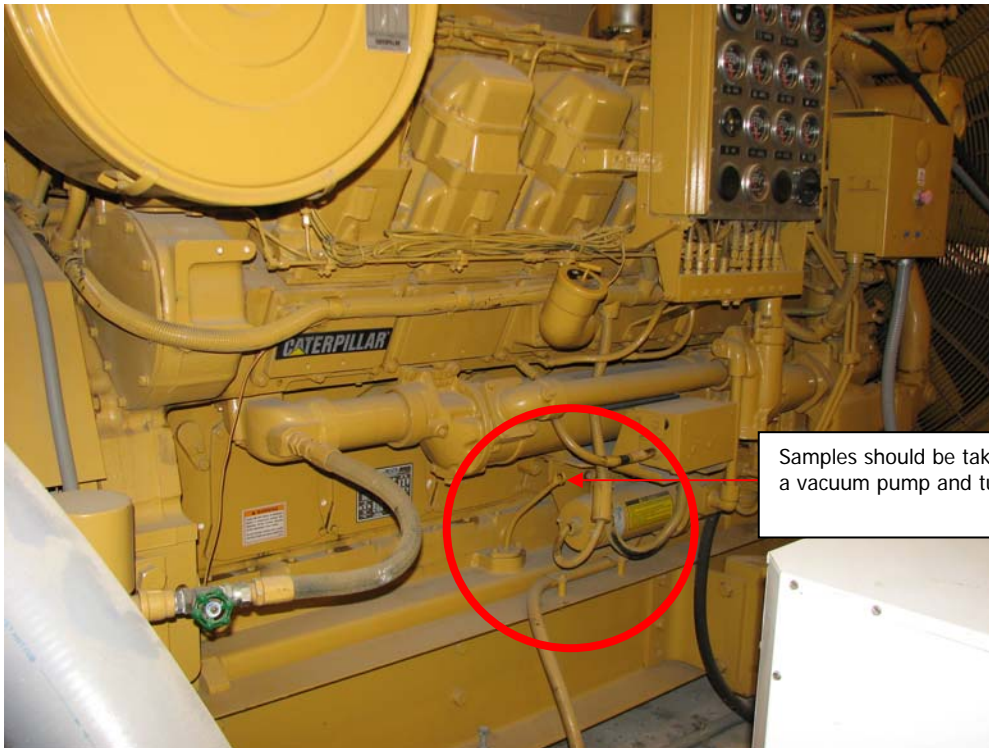


Aerator Gearbox

Emergency Generator #1

Criticality: This unit is critical to the operation in the event of power loss. Failure of this machine to function properly would result in catastrophic results. Lube analysis should be performed on this generator.

Sampling: This unit is only run 1 hour per week for test purposes. It is recommended that the unit be sampled immediately after shutdown through the dipstick tube. Sampling would be performed using a vacuum pump and tubing provided by Insight. The unit should be sampled each 6 months.



Emergency Generator #1

#1, #2 Internal Recycle Pumps

Criticality: These pumps are very critical to plant operation. The bearing on the motors are oiled bearings and should be included in the lube analysis program.

Sampling: The reservoirs on these motors hold a small amount of oil. The sample should be collected every six months. Sampling should be at the fill cap using a vacuum pump and tubing.



Internal Recycle Pump

#1, #2, #3, #4 Effluent Pumps

Criticality: These pumps are very critical to plant operation. The bearings on the motors are oiled bearings and should be included in the lube analysis program.

Sampling: The reservoirs on these motors hold a small amount of oil. The sample should be collected every six months. Sampling should be at the fill cap using a vacuum gun and tubing.



Effluent Pump

#1, #2 Effluent Reuse Pumps

Criticality: These pumps are very critical to plant operation. The bearing on the motors are oiled bearings and should be placed on the lube analysis program.

Sampling: The reservoirs on these motors hold a small amount of oil. The sample should be collected every six months. Sampling should be at the fill cap using a vacuum pump and tubing.

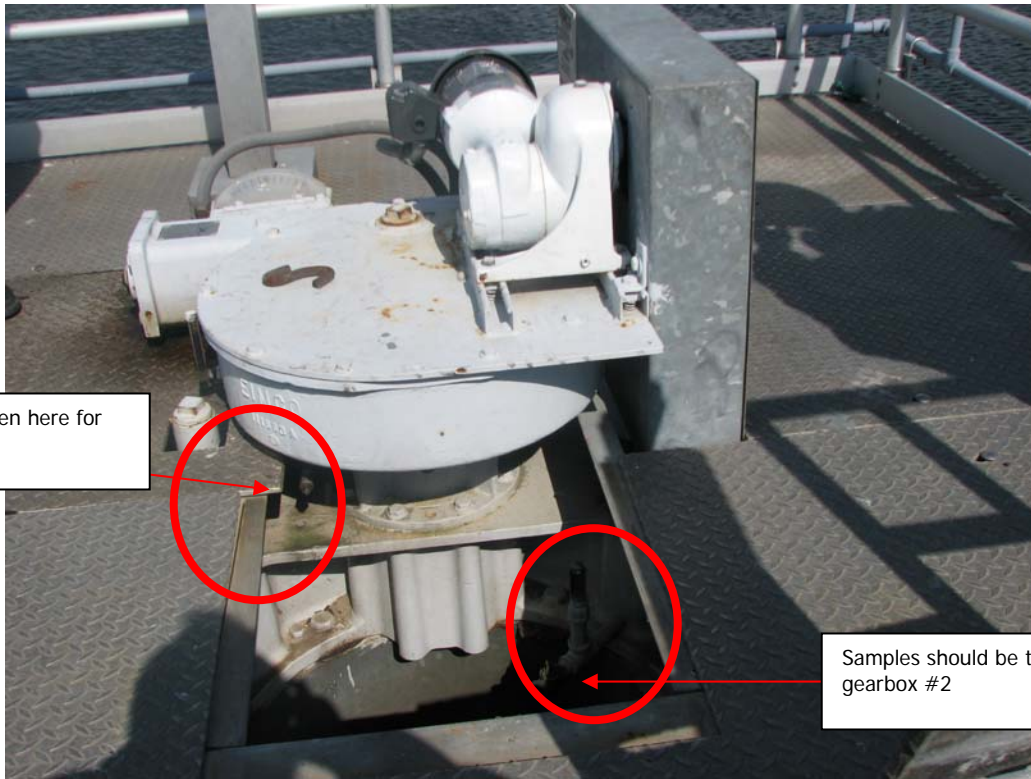


Effluent Reuse Pump

#1, #2 Clarifier Gearboxes

Criticality: These gearboxes are very critical to plant operation. It should be noted that three motors have been replaced on these units during the past six months. The gearboxes should be included in the lube analysis program and the vibration monitoring program.

Sampling: There are 2 reservoirs on these units. Each reservoir should be sampled at the drain valve. It should be noted that one of the sample points will be below the removable metal floor. The samples should be collected every six months.



Samples should be taken here for gearbox #1

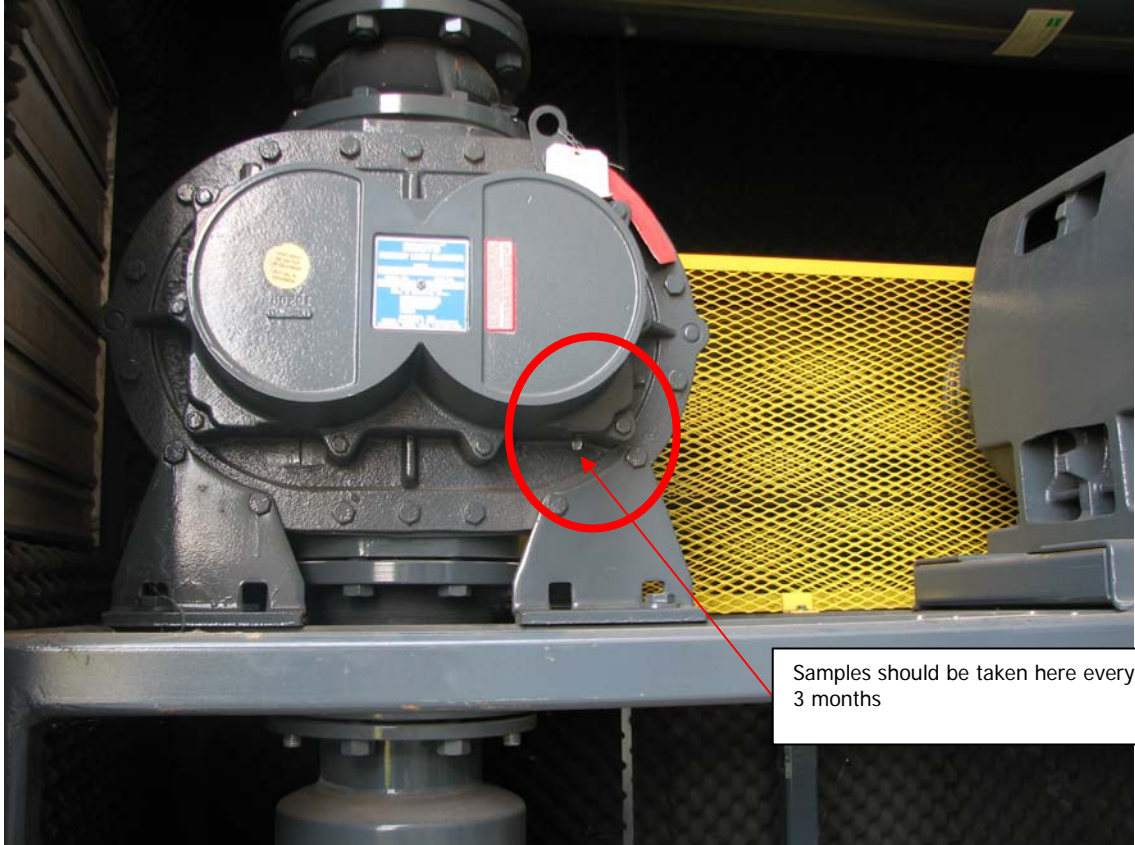
Samples should be taken here for gearbox #2

Clarifier Gearbox

#1, #2, #3 Sludge Blowers

Criticality: These gearboxes have medium criticality to plant operation but replacement cost warrants placing them on the lube analysis program. Bearings and timing gears use the same oil in a splash lubrication system. These blowers are also candidates for vibration monitoring. It should be noted that there are other blowers in the plant but all except these three are maintained and monitored by a contracted service.

Sampling: These blowers should be monitored on a three month frequency with the samples being pulled at the indicated drain port.



Sludge Blower

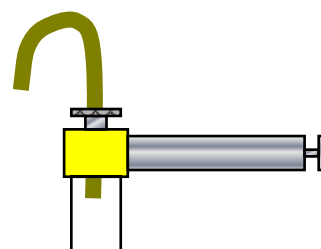
Suggested sampling frequencies

It is suggested that all sample points be sampled at one month frequencies for the first 4 months. This would enable TestOil to establish trends for each piece of equipment on the sample program. After the initial 4 months the following table would be suggested for sampling frequencies.

Equipment	Lubricant ISO Viscosity	Sample Location	Sample Frequency
<i>Reclaim Pumps 1-4</i>	R&O 32	Drain Valve	Special Samples Only
<i>Aqua Guard Gearbox</i>	680 Gear	Oil Level Plug	Special Samples Only
<i>Screener Gearbox</i>	680 Gear	No Sampling	No Sampling
<i>Air Compressors 1, 2, 3</i>	R&O 150	Drain Plug	Quarterly
<i>Emergency Generator #2</i>	15W40	Dipstick	Bi-Annual
#1 and #2 Mixers	220 Gear	Drain Valve	Monthly
#1 and #2 Aerators	220 Gear	Drain Valve	Monthly
<i>Emergency Generator #1</i>	15W40	Dipstick	Bi-Annual
#1, #2 Internal Recycle Pumps	R&O 32	Fill Cap	Bi-Annual
#1, #2, #3, #4 Effluent Pumps	R&O 32	Fill Cap	Bi-Annual
#1, #2 Effluent Reuse Pumps	R&O 32	Fill Cap	Bi-Annual
#1, #2 Clarifier Gearboxes	Main Gear—460 Worm Gear--680	2 Drain Valves	Bi-Annual 2 Sample Points
#1, #2, #3 Sludge Blowers	Unknown	Drain Valve	Quarterly

Sample Valves / Ports

Sample Pump and Tubing – These are used to extract samples from breathers, dipstick tubes, etc. They are provided by TestOil.



Push Button Sample Valves – These can be installed in systems operating from 0 to 600 PSI. They are available in numerous styles and thread sizes. They are available through Fluid Line Products, Willoughby, Ohio (440-946-9470).



Pitot Tube Sampling Ports - These sample ports can be installed in non-pressurized systems, and the flexible tube can be directed to best sampling location. An adapter allows samples to be extracted using a sample pump.

