Oilmist Lubrication Applications In Refineries- Installation & Maintenance Issues

N Laxman
Deputy Manager- Maintenance-Rotary
Hindustan Petroleum Corporation Limited
Visakh Refinery

ABSTRACT

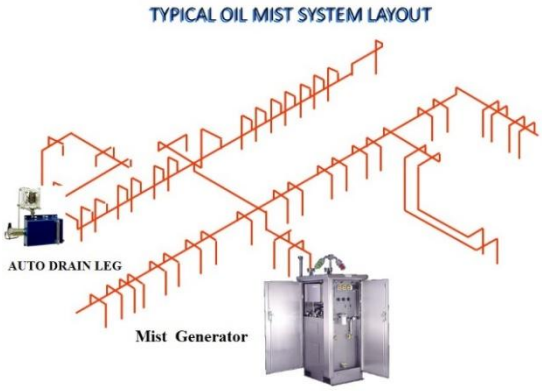
Oil mist lubrication is a proven, environmentally clean and cost effective method for the lubrication of rotating equipment in Refineries. The use of oil mist lubrication has grown drastically in many parts of the world because of the benefits delivered by its use. Since late 1980's many technological advancements have taken place in oil mist system design and methods for applying oil mist lubrication to rotating equipment. Technology for closed-loop, environmentally clean oil mist systems in addition to the latest in centralized mist generator design is reviewed in this paper.

1. OIL MIST LUBRICATION SYSTEM – INTRODUCTION

1.1 What is Oil Mist

Oil mist is a non-homogeneous mixture of one part oil to 200,000 equal parts of air. It is not a Volatile Organic Compound (VOC) or a vapour. It is a lean mixture that will not support combustion and will not explode.

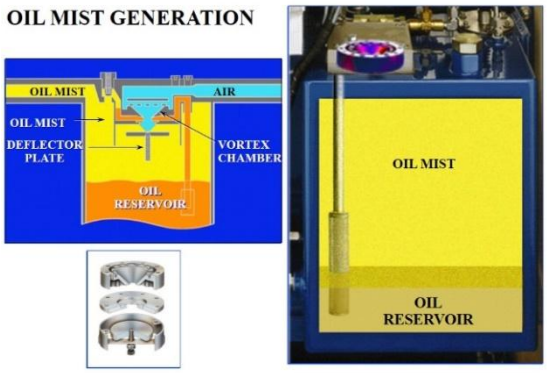
A Centralized Lubrication System that continuously atomizes Oil into Small Particles and then delivers the correct quantity of lubricant to bearings and metal surfaces in pumps which result in improved lubrication and extended machinery life. Typical Oil mist layout shown in Figure.1



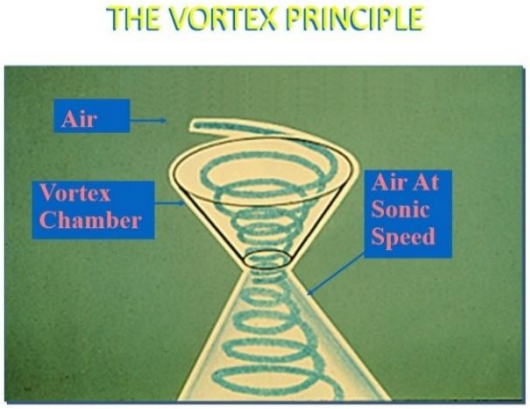
Oil Mist Generator and its layout in Figure.1

1.2. Generating the Mist

An oil mist generator is basically a venturi where high velocity air creates a low pressure as it flows through a restriction. The reduced pressure causes oil to be lifted from a reservoir and atomized as it is impacted by the high velocity air stream. The generation of oil mist and its vortex principle are shown in Figure. 2 and 3



Oil Mist generation in Figure.2



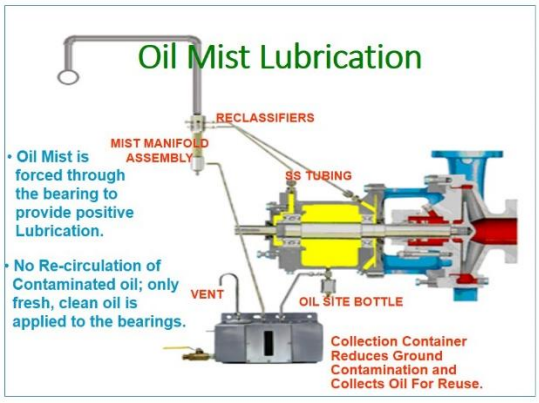
The Vertex Principle in Figure.3

1.3 Header System

Once mist is produced, it must be transported to the lubrication points. This is done in the header system. In large scale oil mist systems, the main header is usually 2” galvanized pipe.Shorter runs can use 3/4" pipe. All branch headers should come off the top of the main header and all branch

headers should be sloped continuously downward toward the main header.

1.4. Manifold blocks and Reclassifier, Drain Legs.



Accessories of Oil mist lubrication in Figure.4

Manifold blocks, or mist manifolds, are the connections between the header system and the piece of equipment being lubricated. The only functions of manifold blocks are to provide a place to locate the reclassifiers and to collect any liquid mist that should coalesce in the drop point. In a properly designed and operated system, the amount of lube oil collected here is minimal.

Reclassifiers or mist fittings are devices that increase the mist particle size by accelerating the mist through a small orifice. The increased velocity and turbulence causes impaction of small particles and agglomeration into larger particles. Reclassifiers are most often located in the manifold block, but in some cases, can be located on the equipment bearing housing. In some instances, it is necessary to use a drain leg at the end or middle of a system. They are usually required where a change in elevation or a loss of clearance in an overhead pipe rack occurs. *Drain legs should be avoided in all cases possible. Oil Mist accessories are shown in Figure. 4*

2.0 Essential components of an Oil Mist Lubrication system

2.1 Lube Oil and Instrument Air Supply

Oil mist lubrication system comprises of a mist generator where the mist is prepared, a header piping system which transports the mist to the lubrication point of all the pumps in the unit, reclassifiers where mist particle size is increased, vents and drains are for collecting left out mist after lubrication in the bearing housing of both sides of the pumps. The more erudite drain leg includes a drain leg manifold assembly, reservoir, float switch, air solenoid, air pump and two return lines (one for stray mist and one for liquids).

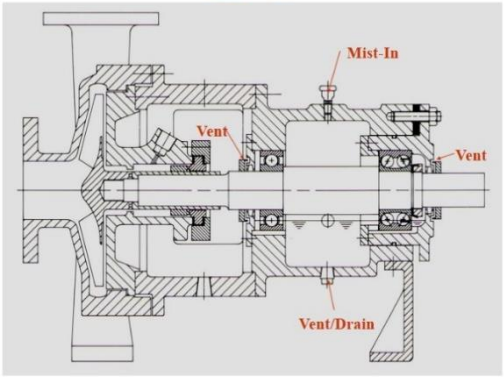
Twomore essential features of an oil mist system are the oil and air supply systems to the generator. Air supply is normally provided from the instrument air header. It is normally selected because it is the most reliable and driest source of air in a Refinery. If the instrument air system fails, the entire refinery units get shut down. Oil supply is from a bulk tank (capacity ~200 ltrs) to Main reservoir (capacity ~30 ltrs) and is automatically filled whenever oil level is low as per presetting done by the vendor during commissioning of the unit.

3.0 OIL MIST TYPES

3.1 Purge Mist

This is combination of conventional splash lubrication and purging with pure mist. This is used mainly to purge critical service Pumps bearing housings. Doesn't give all the benefits of oil mist but keeps the contaminants out of the bearing housing due to pressurized housing.

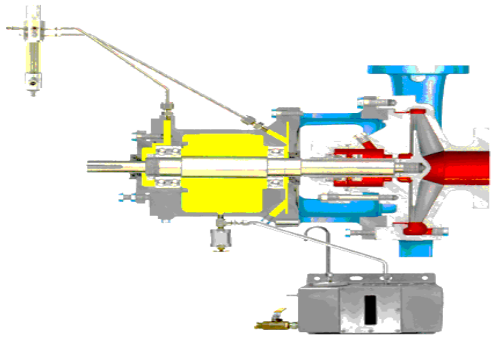
A typical wet sump connection is shown in Figure.5



Purge Mist in Pumps in Figure.5

3.2. Pure Mist

It is also called dry Mist and gives maximum advantage of Oil Mist. Bearing housing is drained off of oil completely, all the openings are blocked and the oil leveller and splash rings are removed.A typical dry sump connection shown in figure. 6



Pure Mist in Pumps in Figure.6

4.0 Good Installation practices

- All branch headers should come off the top of the main header and all branch headers should be sloped continuously downward toward the main header.
- Piping should be free from leaks and assembled with a light coat of PTFE-containing paste a couple threads hack from the end of the pipe.
- Never use PTFE tape in an oil mist system between the generator head and bearing housing.
- Oil stippled to an oil mist system must be kept as dry as possible. Water can lead to suction screen and generator head plugging. Both the air and oil systems should be provided with nonlinting filters.

5.0 Do's and Don'ts on Oilmist lubrication system for Mechanical Maintenance.

1) **Do's**

- WhilereplacingOilFilterCartridge,pleaseensurethattheAirvalvetoOilTransferPumpisshut(toavoidoilspilling)astheoiltransferpumpstartsautomaticallyoncethelowlevelissensedbythelevletransmitter.
- PleaseensurethatthesupplyOilpressureis <1Kg/cm^2(checkthepressuregaugemountedonthesolenoidvalve).
- *Ensurethefixingoftheplugimmediatelyafterremovingthere-classifiersontheMistmanifoldforthepump.*
- Removetubinggentlyandkeeptheendsoftubingproperlycovered,ifpumpistoberemovedforrepairs.
- PleaseensurethattubingispurgedthoroughlywhilerefittingPleasedraintheMistmanifoldifevenonemofoillevelisthereinit.

2)

3) **Don'ts**

4)

- Don'tchangethesizeofre-classifierwhilerefittingthepump(keepthenumberrecordedifmorethanonepumpisinMaintenance).
- Don't keep the drain ofventcollectionassemblyopen(ifprovided).

6.0 Routine Maintenance

- Checktheoillevelinthereservoirand fillasnecessary.Theoillevelwillbeautomaticallymaintainedatapproximatelyhalffull astheauto-filloptionisinstalled.
- Checkingthereservoiroiltemperature.Temperaturesoutsidethenormalrangemayindicateanoilheatermalfunction.
- Checkingtheairtemperature(ifequippedwithAirHeater).Temperatureso u t s i d e thenormalrangemayindicateanairheatermalfunction.
- Checkingtheregulatedairpressureandmistheader pressure.Changesinmistpressurereadingsindicatebrokenorpluggedlinesorfittingsthatmustbecorrectedbeforeadjustingtheregulatedairsupply.

Semi-annualProcedures

- Replaceairfilterelement.
- Inspectandcleanoilsuctionscreen.
- Inspectandcleanreservoirinterior.
- Checkandverifyoperationofhighandlowalarms.
- Checkthemistdistributionsystemforleaksorotherproblems.

7.0 ***Various problems in an Oil Mist system and their solutions***

7.1 ***LowMistPressure:***

Checkandverifytheregulatedairpressure,iflow, thenensurethattheinstrume

Ifthemistpressureevenafterincreasingtheregulatedairpressureto3.5kg/cm²(50PSI),remainsneartheLowAlarmSetting(25mBar/10inchofH2Ocolumn)checktheoilmistheader

systemsforbrokenmisttubingorpipesandalsotheoilmistgeneratorforleaks.

7.2 *HighMistPressure:*

Checkforpluggedreclassifiers.
Checktheoilmistdistributionheaderandbranchlinesforsagsorlowpointsthatcancollectoilandobstructthemistflow.
Mistpipeblockageswillresultinasurgingmistpressure.

Checkthattheregulatedairpressureisnotincreased.Decreasetheregulatedairpressuretoachieveoilmistpressure of50-60mbar/20inchofH_2Ocolumn.

7.3 *Low Regulated Air Pressure*

Checkthesupplyairshutoffvalve in the mainunita n d ensurethevalveisinthefullopenposition.

Checkthatthesupplyairpressureisintherangeof3–7kg/cm²(42–100PSI).

Ensurethatoilinallthecollectioncontainershavebeenproperlypumpedintoreturnloopandareemptiedout.

7.4 *HighRegulatedAirPressure*

Checkthattheregulatedairpressurehasnotbeenchangedfromthepreviousssetting.
Incaseadjustmentof MistPressure, Regulatedairpressure(high/low)isnottakingplacebyadjustmentofairregulator,itcanbeconcludedthattheairregulatorisdefectiveandshouldbereplaced.

7.5 *Low MistDensity*

Turnmistinspectionvalveto"Open"position.Visuallyinspectoilmistquality.
Checkoillevelinmisttank.ConfirmOilSupplyLevelalarmisnotactive.Lossofoilresultsinlossofoilmistproduction.
Checkairtemperatureisnormal,setpoint(120°F-49°C).Ifairtemperatureislow,itcancausetheoilviscosityto increaseresultinginadecreaseinmistproduction.Checkqualityofoil,changeinoilqualitymayaffectoilmistproduction.

7.6*HighMistDensity*

Checkairtemperature,increaseinAirTemperaturewillcausetheoilviscositytodecreaseresultinginanincreaseinmist production.
Performoilconsumptiontestonoilmistconsole.Adjustoil consumptionto0.65cu.inoil/Hour/SCFMairusingmisthead adjustments.

7.7*LowSupplyAirPressure*

Checksupplyairpressureatthesourceascomparetothe MistGenerator.
Checktheballvalveinstalledinthemainairsupplylinetothe MistGenerator.Confirmthevalveisinthefullopenposition.
Checkairfilterelement.Adirtyorcloggedfilterelementmayresultinadifferenceinpressure.Changefilterelementifnecessary.
Increasesupplyairpressureatthesourceabove LowAlarm Setting(25PSI–1.75kg/cm²).

7.8 *HighSupplyAirPressure*

Checksupplyairpressureatthesourceas comparetotheMistGenerator.
ReducesupplyairpressureatthesourcebelowHighAlarm Setting(150PSI–10.0kg/cm²).

7.9*LowOilLevelBulkOilTank*

AddrequiredlubeoiltoBulkOilReservoirthroughtheFillPortlocatedonthetopofthetank.
Ifbulkoillevelreadingissignificantlylowerthanlevelinbulkoilsightglass,replaceOilLevelTransmitter.

7.10 *HighOilLevelBulkOilTank*

TheBulkOilReservoirhasbeenoverfilled.Visuallyconfirmthereservoirlevelindicatedbytheoillevelsightglass.Normaloperatinglevelis175–200Lt.(40–58Gallons).
Drain excess oil through bulk reservoirDrainValvetomaintaingreenstatuslight.
Ifbulkoillevelreadingissignificantlyhigherthanlevelinbulkoilsightglass,replaceOilLevelTransmitter.

7.11 *LowAirTemperature*

Thesolidstatecontrollerwillnotpermittheairheaterelementtoenergizeifthemainoiltankreservoirlevelisbelowlowalarmpoint.
ChecktheoperationoftheAirheaterelementandtherelayswitch.

7.12*HighAirTemperature*

AHighAirTemperaturealarmcanoccuriftheambienttemperatureiswarmerthantheHighAirTemperaturealarmsetting.Iftheambienttemperatureisaboveornear theHighAir Temp.AlarmSetting(140°F-60°C),increasethesettingofHighAirTemperaturealarm.
ConfirmAirHeaterSettemperature(120°F-49°C)isbelowhighalarmsetting.IfrelayLEDlightis"ON" andnotcuttingoffreplacetherelaybytakingstandbyunitin operation.

7.13*LowOilLevelinMistTank*

Confirmlowoillevelthroughsightglass.TheLowoillevela larmisinitiatedifoillevelinmisttankislessthan3″fromtheb ottomofthesightglass.
CheckttheOilSupplyPump.Ensureitssuctionvalveisinfull openposition.Airpressureis availabletothepump;regulatetheairpressuretoensurepum poperation.
Checktheoillevelinthebulkoiltank.Refillthebulkoilreser voirifadditionaloilsupplyisrequired.
CheckOilFilterelement.Adirtyoilfilterwillnotpermitoilt opassthrough.Replaceifnecessary.

7.14 *HighOilLevelinMistTank*

Confirmhighoillevelthroughsightglass.Thehighoillevel alarmisinitiatedifoillevelinmisttankis3″fromthetopofth esightglass.
StopOilSupplyPumpbyclosingitsairsupply.Checkthesol enoidvalvegettingsignal.IfYESreplaceleveltransmitter,i fNOreplacesolenoidvalveoperation.

7.15 *LowOilTemperature*

EnsurethattheheatersupplyisON.
CheckthatheateriscuttingON andOFF.
Checkthethermostatandreplace.
CheckthatheateriscuttingONandOFF.

7.16 *HighOilTemp*

If heaterisnotcuttingOFF,reducethermostatsetting.Ifn otresponding,changethethermostat.

Ensurethatthemisttanklevelisnormaltochangethesetting ofthermostat.SwitchOFFthepowerbeforeopeningthecov erofthethermostat.

CONCLUSION

Oil mist system with its clean and efficient lube oil network and trouble free operation has gained immense popularity in most of the Petroleum Refineries. Conventional systems are also being proposed for conversion into oil mist system in views of the significant advantages of the system. There is no doubt that with its significant advantages, all the new projects will be implemented with the Oil mist lubrication system for all the rotating equipment. There is scope for application of the Oil mist system in Electric motors and Cooling tower Gear boxes, Blowers etc.

Routine observation and maintenance programs are mandatory if an oil mist system is to continue to perform reliably for extended periods. A well designed, installed and maintained oil mist system can make a significant contribution to improved reliability and operability of refineries.

Apparently, initial costs will be increased but they can be compensated by the reduced maintenance costs brought about by an oil mist system.

References:

1. **Oil-Mist Lubrication Handbook: Systems and Applications by Heinz Bloch.**

2. Oil-Mist lubrication Installation and Maintenance Manual.