Engineering Consulting & Training Services

CARMAGEN Engineering, Inc.

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Preservation of Process Machinery

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In the early nineties, a decommissioned and subsequently mothballed fertilizer plant located in the United States was purchased, dismantled, and reconstructed at a location half way around the world. When I visited this plant about 10 years after it was restarted at its new location, it was producing fertilizer at a fraction of the investment cost of a brand new plant. This attested to good storage protection because the plant had sat idle for a considerable time before it was relocated. This is just one example demonstrating that long-term storage protection of sensitive machinery such as compressors, pumps, and associated drivers saves money.

Appropriate procedures for the preservation or corrosion inhibiting of inactive process machinery depend on the type of equipment, expected length of inactivity, and the amount of time required to restore the equipment to service. Leading companies in the process industries develop their mothballing standards to consider these criteria. One typical mothballing program for indefinite storage was planned and executed as follows and forms the basis for our recommendations.

Large Motors

1. Blank oil return line.
2. Seal shaft openings with silicone rubber caulking and tape.
3. Fill bearing housing with oil containing 5% rust-preventive concentrate.
4. Install a valved standpipe such that the inlet is higher than the bearing housing.
5. Coat all exposed machined parts with Product 1 (See Table 1).
6. Do not rotate motor.

Steam Turbines (Adapt as Appropriate for Gas Turbines)

1. Isolate from steam system.
2. Seal shaft openings with silicone rubber caulking (Sealastic® or equal, black to discourage pilfering) and tape.
3. Dry out with air.
4. Fill turbine casing with oil containing 5% rust-preventive concentrate including steam chest. Hold governor valve open as necessary to ensure chest is full. Vent casing, as required, to remove trapped air. Fill trip and throttle valve with oil.
5. Install a valved pipe on casing which can serve as filler pipe for adding oil to fill casing. Allow space for thermal expansion of oil in pipe.

Upcoming Training Courses being held in Rockaway, NJ

- Course 1613A, *Turnaround Best Practices*
  October 26-28, 2010
- Course 607, *Design and Maintenance of Aboveground Atmospheric Storage Tanks*
  November 9-11, 2010
- Course 910, *Process Plant Piping System Design and Maintenance*
  December 7-9, 2010

For more information, see our website at www.carmagen.com

Work Highlights

Process, Operations & Safety

Provided consultation of a quench tower fractionation and internals revamp, plus participated in vendor review meetings and equipment selection as part of client's team.

Project Management

Completed a 2+ year full-time assignment having overall responsibility for Materials Management of a 1.5 billion petrochemicals project in the Far East. Aligned with EPC contractor and client's Project Management Team to coordinate all aspects of procurement activities, closely monitor progress, and prepare closeout reports.

6. Coat all external machined surfaces, cams, shafts, levers and valve stems with Product 1.
7. Coat space between casing and protrusion of shaft with Product 1. Cover space with tape.
8. Fill bearing housing with oil.
9. Coat casing bolts with Product 1.

Gearboxes

1. Fill gearbox and piping with oil containing 5% Product 1.
2. Plug all vents. Allow space for thermal expansion.
3. Install a valved pipe on casing which can serve as filler pipe for adding oil to fill casing.

Centrifugal Compressors

1. Purge compressor casing of hydrocarbons.
2. Flush internals with solvent to remove heavy polymers.
3. Pressurize casing with nitrogen.
4. Mix 5% rust-preventive concentrate to existing lube and seal oil. Circulate oil through the entire system for one hour.
5. Blank oil return header.
6. Seal shaft openings with silicone rubber caulking (Sealastic® or equal, black to discourage pilfering) and tape.
7. Fill bearing housing with oil containing 5% rust-preventive concentrate by running turbine-driven pump at reduced speed.
8. Fill oil console with mineral oil containing 5% rust-preventive concentrate.
9. Fill compressor with nitrogen when it is at ambient temperature. Turn off all heat tracers.
10. Coat all exposed machined parts, including couplings, with Product 1.

Lube and Seal Oil Consoles

1. Add 5% rust-preventive concentrate to lube and seal oil.
2. Circulate oil throughout piping system. Open and close control and bypass valves so that oil will reach and coat all piping and components. Circulate for one hour. Vent trapped air from all components and high points.
3. Block in filters and coolers. Fill with oil containing 5% rust-preventive concentrate but allow small space for thermal expansion. The water side of coolers should be drained and air-dried. Plug all vents. Lock drain connections in slightly open position.
4. Fill reservoir with oil containing 5% rust-preventive concentrate. Blind or plug all connections to tank including vent stack.
5. Coat exposed shaft surfaces and couplings of oil pumps with Product 1.

Reciprocating Compressors

1. Purge compressor cylinders of hydrocarbons.
2. Blank compressor suction and discharge.
3. Fill crankcase, cooling water jacket and valves with oil containing 5% rust-preventive concentrate. Install a valved standpipe. Allow space for thermal expansion.
4. Coat all exposed machined parts with Product 1.
5. Top-up oil level in the cooling water jacket.

A Strategy for Short-term Equipment Storage

The probability of equipment failure is high following commissioning of equipment, whether for initial operation or following a rebuild. Machines can often sit at a new industrial site for months while the slow process of site construction progresses. Unless the buyer clearly specifies storage measures in the technical purchase specification, it is likely that machinery would be shipped without adequate provision for storage. Onsite storage preparation for the three to twelve months that machinery may sit idle at a construction site before commissioning usually entails a preventive maintenance (PM) program. Adequate storage protection plans would typically look like the following (assuming a northern, dry climate):

Rotation

Rotate all equipment such as motors, turbines, gears, and compressors every two weeks.

Visual Inspection

When rotating exposed machined surfaces, check shafts and couplings to confirm that a protective coating has been applied and has not been removed. Reapply coating if needed.

Check all lubricating lines to see if any tubing, piping, tank or sump covers have been removed. Retape ends and cover as needed. If flanges are open on machinery connections, notify the pipe fitter first line supervisors or other designated personnel to reinstall the covers.

Draining of Condensate

Drain condensation from all bearing housings, sumps, and oil reservoirs on a once-per-month schedule. If excessive condensation is found, recheck once a week, or at two-week intervals, depending on the amount of condensate present.

Bearings

Fill all bearing housings that are oil-lubricated but not force-fed with rust preventive concentrate, bringing the oil level up to the bottom of the shaft. For force-fed bearings, the upper bearing cap and bearing must be removed. A coat of heavy, inhibited oil can be applied to the journal and bearing surfaces. This should be reapplied as needed.

Electric Motors

Electric motors with greased bearings need not be lubricated. If received with a grease fitting, it should be removed and plugged or capped.

Turbines

Spot-check turbines by removing the upper half of the turbine casing and visually inspect. Plan to open a sampling of these turbines, selecting from the first preserved and those in the worst condition. This should be done on a three-month schedule. Other turbines may be inspected by the manufacturer's field service engineer on his monthly visits through the opening in the top casing as the rotor is being rotated. This should be done on a three-month schedule.

Gears

Fog the interior of housings with rust-preventive concentrate. Coat tooth contact points with an inhibited grease or heavy, tacky oil. Remove inspection plates and visually inspect interiors on a three-month schedule.

Compressors

Manufacturers' representatives should inspect the compressors during monthly visits. Any preservatives needed can be applied under their supervision. Fog centrifugal compressors, and consider placing desiccant bags in these machines. Inspect these compressors on a two-month schedule. Inspect high-speed air compressors on a three-month schedule. Inspect and fog axial compressors on a three-month schedule.

Other Considerations

In a warm, high-precipitation climate, it is wise to look for other solutions to the problem of field storage during construction and prior to start-up. If oil-mist lubrication is not already part of the original design, it should be seriously considered, because in many cases it provides the best protection against contaminant ingression.

References:

Practical Machinery Management for Process Plants: Volume 4*; Major Process Equipment Maintenance and Repair,* Second Edition by H.P. Bloch and F.K. Geitner, ISBN 0-8841-5663-X, 1997, www.gulfpub.com

Pipeline and Gas Technology Magazine, June 2007

Table 1
Corrosion Inhibiting Materials for Machinery Protection

Product	Type	Application	Trade Name
1	Solid Film Corrosion Inhibitor	Hot Dip Hot Brush	or equal *
2	Solvent Cutback Rust Preventive	Spray After Thinning	or equal *
3	Solvent Cutback Rust Preventive	Spray Brush	or equal *
4	Rust Preventive Concentrate	Mix or Full Strength	or equal *
5	Barrier Material-Grade C Waxed Paper	Wrap	US Govt. Spec. MIL-B121-D or equal
6	Oil and Moisture Resistant Coating (Aluminum Paint)	Spray	Aluminum Phenolic
	Unctuous)	Hand Apply	Vaseline or equal

* Insert preferred trade name

Fred Geitner has over 40 years of experience in the design, maintenance, operation, and troubleshooting of machinery used in process plant and transmission pipeline applications. Please contact Vince Carucci (varucci@carmagen.com) if you'd like more information on Carmagen's expertise in this area.