

## Storage Preservation of Compressors and Other Process Machinery

There is the story of how a decommissioned and subsequently mothballed fertilizer plant in the Southern United States was purchased, dismantled and resurrected in Pakistan. This happened in the early nineties and when we visited this plant several years ago it was humming along producing fertilizer at a fraction of the investment cost of a brand-new plant. We thought this attested to good storage protection because, according to our recollection, the plant had sat idle for a considerable time before it was moved. Long-term storage protection of sensitive machinery such as compressors and drivers saves money.

Preservation or corrosion inhibiting of inactive process machinery depends on the type of equipment, expected length of inactivity, and the amount of time required to restore the equipment to service.

Petrochemical companies will usually develop their standards to take these criteria into account. 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 five percent 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.

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

**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
7	Petrolatum—(Neutral		

\* Insert preferred trade name

### Gearboxes

1. Fill gearbox and piping with oil containing five percent 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 five percent 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 and tape.
7. Fill bearing housing with oil containing five percent rust-preventive concentrate by running turbine-driven pump at reduced speed.
8. Fill oil console with mineral oil containing five percent 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 five percent 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 five percent 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 five percent 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 five percent 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 rebuild. Machines can often sit at a new industrial site for months while the slow process of site construction moves along. Unless the buyer clearly specifies storage measures in the contract, it is likely that machines would be shipped without provision for storage. Onsite storage preparation for the three to 12 months at a construction site usually entails a preventive maintenance (PM) program. Storage protection plans would look like the following, again, in 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 see that a protective coating has been applied and has not been removed. Reapply if needed.

Check all lubricating lines to see if any tubing, piping, tank or sump covers have

been removed. Re-tape ends and cover. If flanges are open on machinery, notify pipe fitter first line supervisors or other designated personnel.

### **Draining of Condensate**

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

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### **References:**

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2. *Practical Machinery Management for Process Plants: Volume 4; Major Process Equipment Maintenance and Repair*, 2nd Edition by H.P. Bloch and F.K. Geitner, ISBN 0-8841-5663-X, 1997, www.gulfppp.com

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