# System control, monitoring and piping considerations for automated grease system

MATTI LOPPONEN


## ABSTRACT

*As a result of higher productivity demands and workers' safety requirements, many mills have started to automate grease lubrication in the most critical areas of the mill. This is a natural direction, since more than two-thirds of the bearings in the mill are lubricated by grease and some of them require frequent attention. Circulating lube oil systems have traditionally been the only automatic lube systems in the mill.*

***Application:*** *This paper discusses the basic engineering considerations regarding automatic grease lube systems.*


THE USE OF AUTOMATIC GREASE lube systems has increased in North American pulp and paper mills during the last few years. The two main reasons for this are:

- More than two-thirds of the bearings in the mill are lubricated by grease.
- The average number of bearings in an integrated North American mill is 17,500.*

In Europe, most critical lube points in a mill typically are covered by automatic grease lube systems.

Compared to a mill's process control systems, the automatic lube system controls are extremely simple. Normally a stand-alone control panel is furnished. With a larger system, there may be a need to zone areas to be lubricated by using logic control or by including the system in a mill's logic control or distributed control system.

Traditionally, only pressure has been monitored in an automatic lube system main supply piping. Today there is technology available to electronically monitor the actual grease flow into the bearing.

Piping is perhaps the most critical part of an automatic grease lube system. A poorly installed system, with improperly selected materials, will not survive in the harsh pulp and paper industry environment. There should be minimal need to touch any piping during machine operation or service. For regular maintenance, the piping should be designed to allow easy disconnection and reconnection when bearings require service.

If controlling, monitoring, and piping are designed and installed properly, an automatic grease lube system is one of the most invisible pulp and paper mill systems, doing exactly what it is supposed to do — preventing lubrication-related failures and downtime.

## CONTROLLING AND MONITORING OF AN AUTOMATIC GREASE LUBE SYSTEM

The simplest possible lube system controller turns the system pump on and shuts the system down after a preset time. No electronic monitoring is included, and the system inspection is based on mechanical indicators of the feeding devices. Without any electronic monitoring features, this type of system should only be applied on very small, noncritical pieces of equipment.

### *Typical stand-alone system*

A system controller-monitor handling most typical pulp and paper industry applications should have the following control features:

- Adjustable lube interval setting
- Adjustable monitor time setting.

The lube interval setting should be adjustable from 1 min to a few days so that a one-style panel could be used in various areas of the mill.

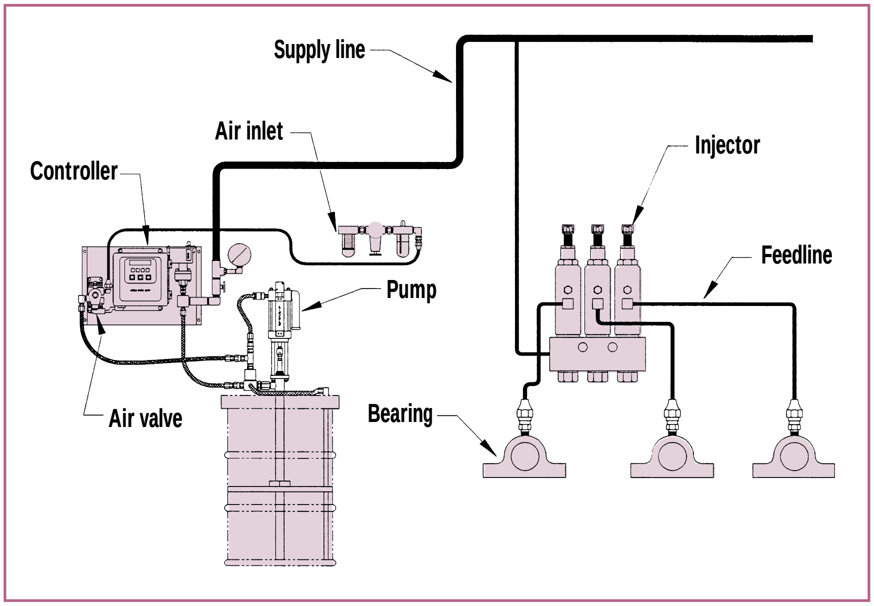
The following monitoring features should be included:

- Pressure switch or limit switch input, depending on the system type
- Lubricant reservoir low level monitoring
- Machine on/off monitoring.

A good system controller-monitor should have provisions for a remote alarm, have a capability to handle different types of lube systems, and retain data in case of a power failure. A manual "extra lubrication" feature is extremely practical when using and troubleshooting a lube system. Naturally, a system control panel must be suitable for a pulp and paper industry environment and be user friendly when operated and programmed.

**Figure 1** illustrates a typical parallel lube system schematic with a controller and a system pressure switch. The system operates as follows: A controller turns the pump on, based on the programmed interval. After all injectors have operated, the pressure switch will sense the pressure increase and shut down the pump. The controller will start

**Pulp and Paper Maintenance 1989 Conference Program Directory,* Miller Freeman, San Francisco, p. 25.




*1. Typical parallel system schematic*

counting a new interval.

A progressive type system utilizes lubricant feeders that operate in series. Typically the last feeder unit activates a limit switch that will shut down the pump. The system has then fully operated and is ready for the next cycle. Progressive type systems are used only for relatively small pieces of equipment, such as winders, chip dosers, and other rolling stock.

***Utilization of a mill's existing PLC to control and monitor a grease lube system***

It is possible to use a mill's existing system. Experience suggests that a local control panel is more practical, since the user can program any changes and use the panel to check the system's operation. If a mill's PLC is used, usually it is more complicated.

***Large multizone systems***

A controller is usually capable of handling one system only with one interval, one pressure switch, and one pump. Normally this is enough for most applications. If part of the production line shuts down for a long period of time while other areas are in operation, there may be a need to isolate various production lines with isolation valves in the main header piping. Fail-safe type valves should be used. In case of a failure, the valve remains open, guaranteeing lubrication. With a large system, each zone isolated by a valve should include individual system pressure switches in order to ensure pressure buildup in remote piping locations.

***Other considerations***

All lubricant feeders should have mechanical indicators to verify their operation. A periodic system check is recommended as a part of the PM program. Pressure monitoring covers the main lines between the pump and the feeder manifolds in a single line or dual line parallel system. Limit switches are used with a progressive system to indicate system operation. Feed lines are not monitored. Sometimes access to the lube points is limited even when the machine is down. For these points or other critical points, there is technology available to monitor lubricant flow into the bearings. A flow sensor is installed on the bearing house grease port. **Figure 2** shows a typical monitoring system.

Sensors utilizing thermistor technology sense the lubricant passing the sensor tip that is installed on the bearing housing grease inlet port. Sensor scanning is synchronized with the lube controller lube cycle.

### AUTOMATIC GREASE LUBE SYSTEM PIPING

Piping is perhaps the most critical part of the whole system. It must be installed correctly to withstand chemicals, material buildup, falling logs, heavy maintenance, or other hazards, depending on the application. It must be installed in such a way that there are no components requiring unnecessary removal when the machine is operated or maintained. Qualified installation is key to a system's longevity.

***Materials***

Both tubing and pipe are used. If supply headers are larger than 1 in., pipe is normally more cost effective. Many mills have standardized on stainless steel tubing and pipe. Carbon steel is recommended in dry areas only, such as a finishing room or converting operation. Lube points that move, such as tension rolls, should be furnished with steel braided rubber hoses, SAE 100R1T. High-temperature applications require hoses made of PTFE with stainless wire braid. Plastic feed lines should be avoided because they are susceptible to damage. Copper feed lines are not recommended because of potential reaction with lubricants and low mechanical strength.

***Pipe sizing***

System piping must be adequately sized to handle maximum grease consistency at minimum operating temperature. The temperature factor is critical when the system is installed outside, such as a system in the woodyard. A rule of thumb is

**KEYWORDS**

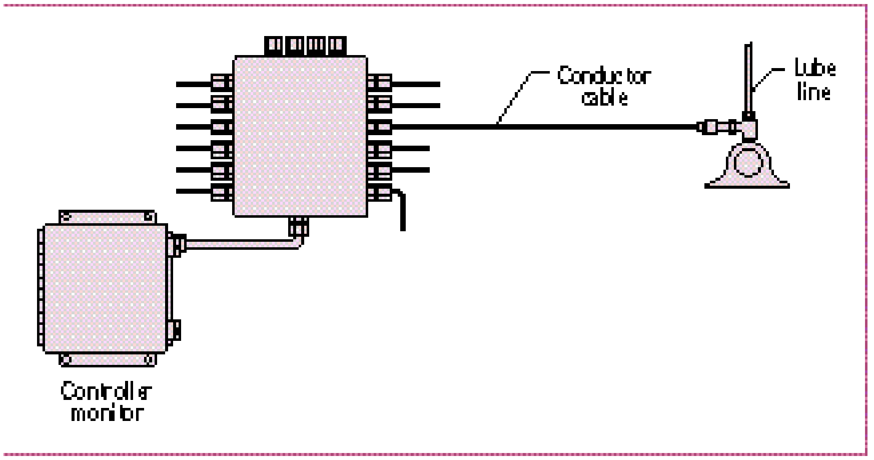
*Automatic systems, control equipment, engineering, grease, lubrication, maintenance, monitoring, piping, systems engineering.*

that if grease will pump, it will operate in the system. NLGI classification will not directly tell how grease flows in the system piping. That is why the pressure drop characteristics of the grease should be known for proper piping sizing.

Maximum operating pressure in the system is typically limited up to the 25 MPa range by using an air regulator with a commonly used air-operated pump. The pressure is intermittent, so the system is not like most other hydraulic systems. Feed lines should be no smaller than OD 6mm. Usually the largest piping size is 50mm. In case there are plans to expand the system, headers must be sized large enough to make the future expansion possible.

***Automatic lube system engineering***

Machine operation and maintenance practices must be taken into account when the system piping layout is designed. Header and feed lines should have a minimal number of disconnects. Inspection covers, roll movements, and other machine details should be discussed with machine operators before the installation. If possible, lubricant feeder manifolds must be installed in locations that are accessible while the machine is running. Enough room should be reserved for feeder removal and adjustment. Locations where the manifolds or piping is subject to damage should be avoided. If necessary, extra brackets should be built to protect the feeders. In some applications, such as a slasher deck, the feed lines should be protected with angle or channel iron. The control panel and pump should be installed in an easily accessible location. Provisions should be made to protect the equipment. Temperature and humidity levels should be checked at the controller location. Pipe clamps should be adequately sized and spaced. In case stainless cladding is penetrated, proper arrangements such as welding or sealing should be utilized to prevent corrosion. Hoses should be well supported on both ends. When there is a risk of improperly reconnecting hoses after they are disconnected, use different fitting configurations or sizes for each line. A solid feed line should always have a union close to the grease inlet to make future maintenance work easier.




***2. Feed line monitoring schematic***

## CONCLUSIONS

A good automatic grease lube system control unit has flexibility to control and monitor different types and sizes of lube systems. At the very least, pressure control in the main supply piping should be used in a parallel type lube system. A limit switch input from the last operating feeder of a progressive system should be used. Technology is available to monitor the actual lubricant flow into the most critical bearings.

Piping material must meet with the mill's specifications. Often all stainless steel AISI 316 is used. Piping layout and installation are the most critical parts of the system. Designing for operational and maintenance needs will guarantee a system's longevity.

The right system design allows easy system inspection, adjustments, and future expansions. **TJ**

*Lopponen is industry specialist with Lincoln Industrial, Atlanta, GA 30339.*

*Received for review June 28, 1995.*

*Accepted Aug. 10, 1996.*

*Presented at the TAPPI 1995 Engineering Conference.*