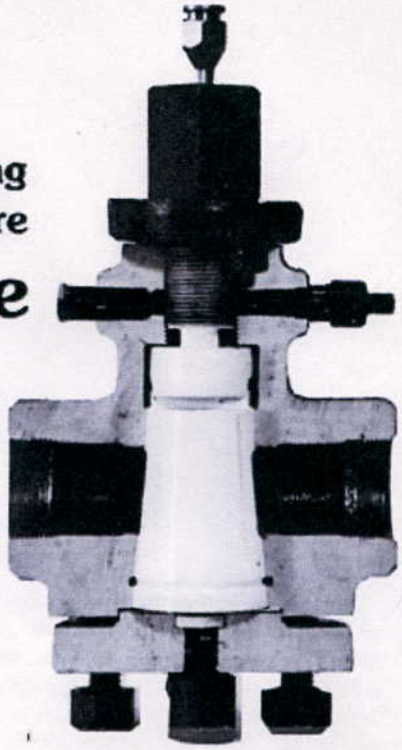
Reprinted from Pipeline & Gas Journal, July 1986

Correct Cleaning, Lubrication, And Sealing Of Plug, Gate, And Ball Types Will Insure

Proper Valve Maintenance



Plug valves are the most common of all valves, and generate the most complaints about becoming inoperable because of lack of lubrication or improper lubrication.

3Rs REPORT

by W.J. Chisholm, *President, Sealweld Corporation, Houston, Texas*

Plug valves are the most common valve in use in the energy pipeline business and, because of the sheer numbers, the most common complaint involves the plug valve.

That complaint is that plug valves become inoperable if lubricated over a period of time with stick type lubricants. Stick lubricants create these problems because, to make the lubricating product into stick form, clay or other solid based thickeners are added.

As the lubricant polymerizes or hardens in the valve, the solids are left behind. This fills the lubricant grooves as well as the cavities above and below the plug, causing the valve to seize.

The solids content of stick type lubricants is much greater than that of greases contained in pails or cartridges. The only advantage of making lubricants in stick form is that they are easier to handle when loading into grease guns. Their lubricating qualities are greatly reduced.

The hardening or drying process begins in most lubricants when they are injected into a valve. This is caused by several factors such as heat, pressure, and the polymerization process that occurs naturally because of the contaminants in processed gases or liquids.

Stick type lubricants have a shorter shelf life than that exhibited by other lubricants and old products can be hard or quite dry before they are placed in the valve, if they have been in a warehouse for some time.

Operating a valve of any type with dry or hard greases "cemented" into lubricating grooves causes sealing surface damage, which very often can only be corrected by having affected surfaces machined.

Until effective valve cleaners were developed, the only solution to these problems was to remove the valve from service and have it "shopped." Sometimes these valves were seized so badly that a hydraulic press was utilized to remove the plug from the valve body.

When such valves were still in the line, it was frequently necessary for two or three men to use a 6- to 10-ft long cheater bar to operate some of the valves. Sometimes a backhoe or pickup truck has been used to force a valve to "break;" this drastic measure can twist the stem off the valve, necessitating a shutdown of the system or, worse, cause injuries to workmen.

Cleaning. Proper lubrication is not possible until the cleaning process has been completed because the valve is full of dry materials and there is not room for lubricants.

The injection of valve cleaner can be accomplished very easily through use of handheld or power operated grease guns. Power operated equipment will operate more freely when purged by the cleaner.

Even a program of semi-annual lubrication, a favored method, is not satisfactory because the old grease remains in the valve and under those circumstances, the injection of a lubricant/sealant is a hit-or-miss proposition at best.

The valve cleaner softens old hardened grease and, when followed by an application of proper lubricant, makes the seized or hard to operate valve easier to operate.

Cleaning should be done as often as needed to keep the valve free. Some valves may require cleaning and lubricating once each year. A valve in more critical service, or one that does not seal tightly, will lose some of its lubricant and will require servicing several times each year.

Most operators will be able to determine how often to perform this function by the amount of torque required to operate the valve.

Where automatic valve operators are used, the sound made by the automatic operator while the valve is being turned will help indicate how dry the valve has become.

When cleaner is being injected, the valve should be operated to assure that a film of cleaner will be smeared over the plug and body surfaces, shortening the time needed to purge the valve.

The valve cleaner should be of sufficient strength to clean the valve within 10 to 30 min, and should be nonflammable. The detergent or solvent in the cleaner should be checked to insure that it is compatible with the elastomers contained inside the valve.

The cleaner should also contain a lubricant that will allow the valve to operate even before the injection of the regular lubricant/sealant. This should be a type of lubricant that is unaffected by the detergent in the cleaner.

If the cleaner used exhibits no lubricating qualities, it may clean the valve, but it will also cause the valve to seize because of the the metal-to-metal contact of the plug and body.

Valve adjustments. Adjusting the nut on the bottom of a plug valve should be discouraged. Unless the person performing this task knows what to expect, he adds to the problem.

Loosening the bottom nut creates a leak path around the plug and, if it is left loose, a much heavier sealant is required to produce a seal.

To tighten the nut sometimes reduces a leak, but will cause the plug to wedge into the body. Usually the valve then becomes inoperable.

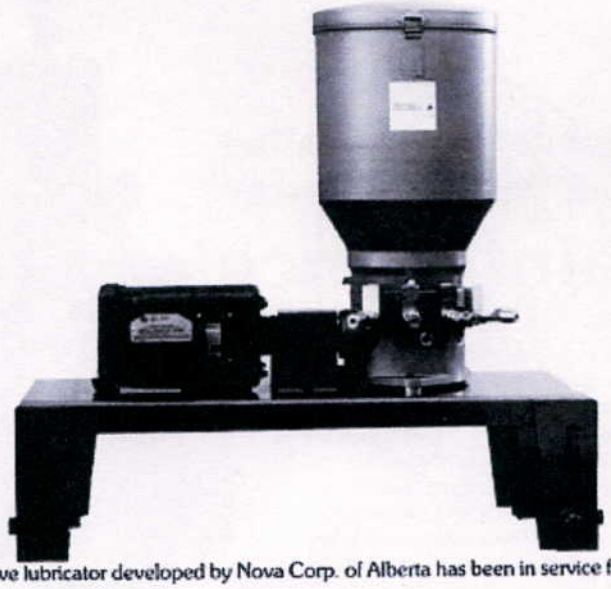
The way to prevent such problems is to use a lubricant that contains a very small amount of gelling agents. This precludes the use of lubricants in stick form.

Some services in which valves are used will cause lubricants to harden in the valve, and by monitoring these situations, more frequent injection of lubricant into those valves can prevent problems.

Packing. If introducing cleaner into a seized or hard-to-turn plug valve does not solve the problem, the next step is to remove the old, dry packing from the stem area. If this is not possible, the injection of cleaner into the stem packing area should "break" the valve and soften the packing so that it can be reformed to make a seal and to let the valve operate freely.

For safety reasons, the removal of stem packing should not be attempted while the valve is under pressure.

Once the stem is repacked, a good quality combination packing and lubricant



Automatic valve lubricator developed by Nova Corp. of Alberta has been in service for more than 3½ years.

Residue from stick type lubricants that was scraped from valve grooves.

should be used to assure ease of operation and a positive seal at all times.

Sealants. These are simply lubricants that are made very heavy or contain bridging agents that move into leak paths, creating a seal.

If bridging agents or solids are required to seal a worn or damaged valve, these agents should exhibit very high lubricating qualities. They should also be combined with a synthetic carrying agent that will encapsulate the particles so that separation does not occur inside the valve.

Some semi-liquid packings are designed to quickly separate after injection into a packing gland. They almost always use hydrocarbon-based greases as the carrying agent. This type of packing should not be used except in pump and valve packing glands.

Gate valves. Cleaning and lubricating gate valves is basically the same as that of plug valves, and may be handled by the same steps – cleaning and lubricating at proper intervals. The frequency at which any valve should be serviced is best determined by the operator. When the valve becomes difficult to turn, the application of cleaners and lubricants is the first step toward making the job easier, and toward saving money. Valves permited to deteriorate to where they seize, are difficult to operate, or leak badly are not far from the scrap heap.

Gate valve stem packing and lubricating can usually be accomplished by cleaning first to lower operating torque and then by injecting a good quality semi-liquid packing material.

Ball valves. The life of a ball valve can be extended dramatically by proper cleaning and lubricating. Some manufacturers now recommend the frequent use of a good quality lubricant to avoid the problems encountered as a result of operating the valve dry.

Most pipeline companies use ball valves on their mainlines, and many of these valves are in the $50,000 to $100,000 cost range. Proper servicing is of great importance to the owners and operators.

Inherent in natural gas pipelines is a residual build up of varnishes and foreign materials that have the appearance of an amber, waxy substance on the ball and seal ring faces. This buildup forces seal rings away from the ball and allows a leak path to develop, causing serious leak problems that, if not corrected, will cut a permanent groove in the ball and seal.

Such a leak may occur in either the open or closed position. Although the velocity of the gas or liquid that leaks when the ball is in the open position is often much less than that occurring when the valve is in the closed position, the result is the same.

Old polymerized or dry lubricants add to the problem by building up behind seal rings, freezing the rings in one position and preventing them from sealing against the ball.

Introduction of proper cleaners will purge ball and seal ring surfaces and allow the valve to seal in a few minutes without the application of lubricant or sealant. If only slight damage has occurred to the seal rings, a lightweight lubricant usually will affect a seal.

If more serious seal or ball damage has occurred, either by leaking or operation of the valve in a dry state, an application of much heavier sealants may be necessary to create a drip tight seal.

Consistency and particle size used in the heavier ball valve sealants is dictated by the size of particle that can be introduced through a large button head fitting.

The bridging agents contained the sealant should not plug orifices through the check valve system inside the fittings. If this occurs, it may become necessary to blow down the system and replace the fittings.

Cleaners, lubricants, and sealants should be injected while the ball valve is in either the fully open or fully closed position. Otherwise, half of the seal ring surface on each side of the valve is exposed to the line flow and will be flushed off as the valve is being cycled.

Upstream and downstream seals should be serviced. A seal is more quickly obtained by injecting lubricant/sealant into the upstream seal after cleaning.

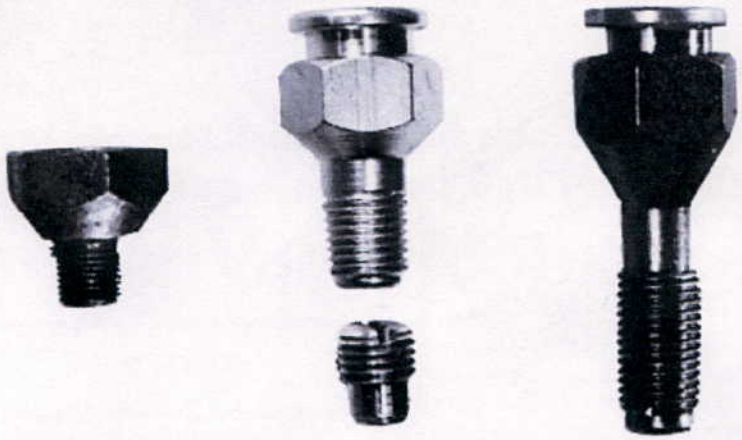
Automatic lubricators. Several companies have experimented over the years with automatic lubricators, usually with disappointing results.

Among problems encountered with old style, home-made lubricators were frequent servicing; larger quantity of lubricant pumped into valve; all sealant/lubricant fittings received the same amount of material regardless of conditions; small lubricant capacity, and low injector pressures.

All of these problems appear to have been resolved by a new automatic valve lubricator developed by Nova Corporation of Alberta, Canada. This automatic lubricator has been in service for more than 3 ½ years and results have been excellent.

Features of the lubricator include its ability to service up to six ball valves with one unit (24 injection fittings). A valve requiring more sealant/lubricant than another can be serviced by double porting to some fittings. A valve requiring less lubricant/sealant can receive that by adjusting the flow from each individual piston.

The unit has a large lubricant reservoir; high injection pressure (up to 6,000 psig); controlled lubricant flow, so that a seal is obtained with less material than using old manual sealing and lubricating methods; operates from any power source, including air; valve always operates on a lubricant film never on dry surface; can be



Fitting types. At left is two-piece fitting with top missing. In middle is one piece fitting with insert valve below. At right is a combination button head fitting and screw type injector.

used at remote, unmanned facilities; no modification of valve is needed – simply attach lubricant line to lubricant fitting; valve life is extended, and payback period is rapid (when installed on valves that leak in the closed position and are vented to the atmosphere, unit will pay for itself in a few weeks).

Lubricant fittings. Many lubricant fittings, especially those purchased and replaced in the field, have a two-piece body construction. Some valve manufacturers install this type of fitting at the plant. Although usually reliable, such fitting have been known to separate under pressure.

The two-piece fitting can be identified by looking at the bottom of the fitting. If the bottom is flat, this usually indicates that the top section (button) has been pressed into the lower body and is held in place by a very fine metal lip.

Do not remove the fitting to look at the bottom, especially if the valve is under pressure. This type of fitting was originally designed by the automotive industry and is used for grease fittings on bearings of trucks, bulldozers, and construction equipment.

Most fittings today are of one piece body with a double ball check sealing system. The obvious exception is on fittings through a needle-like probe is installed to vent a valve cavity, such as on gate valves. These fittings can have only a single check system.

Most ball valves have an internal check valve installed below the button head fitting and, though those check valves usually perform the function for which they were intended, if they become dirty or if a heavy sealant has blown the check mechanism out of them, they will fail.

Removal of the button head fitting can be very hazardous if there is pressure on the valve, and should NEVER be removed under such conditions.

The only fitting that can be removed safely from any type of valve under pressure is the combination button head fitting and screw type injector, which is found in the top center of the plug valve stem. This valve has a double check system installed at the lower end of the stem and has been designed so that the long fitting may be removed.

Conclusions. The proof of the pudding is in the eating, as the saying goes, and to prove how effective proper servicing can be, locate all the valves you have tagged for removal from the line and then clean and relubricate them. You will leave a majority of those tagged valves in service. This "cure" could represent a very substantial savings of time and money.

Effective plug valve maintenance can be accomplished using cleaners and introducing the proper lubricant at regular and frequent intervals. This will assure efficient and safe operation of thousands of valves that are now being removed and repaired or discarded each year.

It has been suggested that increasing the frequency of servicing valves automatically places more grease into pipelines and other facilities. Not so. Injection of small amounts of lubricant will provide proper lubriction of valves at all times and, ultimately, require less lubricant.

Cleaning and lubricating a valve, like changing oil in a new car, is a must if economical operation and long life are expected. **P&GJ**

ABOUT THE AUTHOR

W. J. Chisholm has spent 35 years in the oilfield supply business, 22 of them in the manufacturing of pipeline valve lubricants, sealants, cleaners, and related items. He has conducted valve maintenance schools in many countries and recently completed an educational film on the subject.