



# Lubrication – the Life Blood of Wire Ropes in Cement Plants

**Jeffrey E. Turner, P.E., Executive Vice President, Lubrication Engineers, Inc., USA,** details the importance of appropriate lubrication for wire ropes.

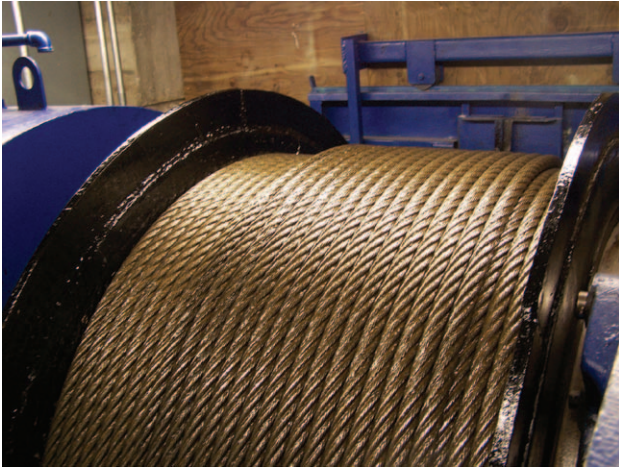
**W**ire rope forms a highly important part of many machines and structures in the cement industry. Generally speaking, wire rope is comprised of continuous wire strands wound around a central core. There are many kinds of wire rope designed for many different applications. Most of them are steel wires made into strands wound with each other. The core can be made of steel, rope, or even plastics.

Wire ropes (cables) are identified by several parameters including size, grade of steel used, whether or not it is preformed, by its lay, the number of strands, and the number of wires in each strand.

A typical strand and wire designation is 6 x 19. This denotes a rope made up of six strands with 19 wires in each strand. Different types of strand sizes and arrangements allow for varying flexibility and resistance to crushing and to abrasion. Small wires are better when the rope is bent sharply over small sheaves (pulleys). Large outer wires are best when the cable will be rubbed or dragged through the dirt.

**Table 1. Steel grades**

Grade	Tensile strength (psi)
Extra improved plow steel	245 000 – 340 000
Improved plow steel	220 000 – 300 000
Plow steel	195 000 – 258 000
Mild plow steel	168 000 – 225 000
Iron	100 000



PPL MT wire rope after lubrication with WireLife Almasol Coating Lubricant.

The core of wire ropes is the central member that supports the strands wrapped around it. There are three general types of cores. An independent wire rope core (IWRC) is normally a 6 x 7 wire rope with a 1 x 7 wire strand core resulting in a 7 x 7 wire rope. IWRCs have a higher breaking strength than a fibre core rope and a high resistance to crushing and deformation. Lubrication while in service is somewhat difficult due to this type of construction.

A wire strand core (WSC) rope has a single wire strand as the core instead of a multi-strand wire rope core. WSC ropes are high strength and are mostly used as static or standing ropes. Field lubrication is usually difficult. As such, the application should be carefully considered to allow for adequate effective relubrication.

Wire ropes also commonly have fibre cores. Fibre core ropes formerly were made with sisal rope; however, today, many use plastic materials. The fibre core ropes have less strength than steel core ropes. Fibre core ropes are quite flexible and are used in many overhead crane applications. Lubrication of fibre core ropes is somewhat easier because the fibre core (sisal) absorbs the lubricant and serves as a reservoir.

Wire ropes are mostly made from high carbon steel for strength, versatility, resilience, availability and lower cost. Wire ropes can be uncoated or galvanized. Several grades of steel are used and are described in Table 1.

Steel cable wire is very stiff and springy. In non-preformed rope construction, broken or cut wires will straighten and stick out of the rope as a burr, causing a safety concern. A preformed cable is made of wires that are shaped so that they lie naturally in their position in the strand and don't pop out and cause injury to hands. Preformed wire ropes also resist fatigue better and are better for working over small sheaves and around sharp angles.

Wire rope lubricants have three principal functions:

1. To reduce friction as the individual wires move over each other.
2. To provide corrosion protection and lubrication in the core and inside wires.
3. To provide corrosion protection on the exterior surfaces.

Internal wear and internal corrosion can be caused by loss of lubricant and corrosion protection, by lubricant degradation, and by fretting due to movement between the wires. External factors that should be considered when choosing a wire rope lubricant are mainly those relating to the operating environment in which the rope is used. These include rain, salt spray, high ambient temperatures, low ambient temperatures, acids, strong bases, abrasive contaminants, and wearing actions on the sheaves, drums and machinery.

There are two basic types of wire rope lubricants: penetrating and coating.

Penetrating type lubricants contain a petroleum solvent that carries the lubricant into the core of the wire rope, then evaporates, leaving a heavier lubricant oil behind to protect and lubricate each strand.

Coating wire rope lubricants penetrate slightly while sealing the outside of the cable from moisture to reduce wear and fretting corrosion. While both types of wire rope lubricants are used, it seems more important to use a penetrating wire rope lubricant because most wire ropes fail from the inside out. A combination approach is best to allow a penetrating lubricant to saturate the core, followed by a coating type to seal and protect the outer surface.

The common types of lubricants used are petrolatum, asphaltic, grease, petroleum oils, and vegetable oils. Petrolatum compounds, with the proper additives, provide excellent corrosion and water resistance. They are translucent, which allows visibility for inspection. If temperatures are too high, petrolatum could drip. At low temperatures they resist cracking.

Asphaltic compounds generally dry to a very dark hardened surface, which makes inspection difficult. They adhere well for extended long term storage but will crack and become brittle in cold climates.

Many types of grease are used for wire rope lubrication. Thickener types that are common are sodium, lithium, lithium complex, and aluminium complex soaps. Greases generally are of a soft, semi-fluid consistency and coat with partial penetration if applied with pressure lubricators.

Petroleum and vegetable oils penetrate best and are most easily applied. Proper additive design gives them excellent wear and corrosion resistance. Fluid oil wire rope lubricants also wash the rope to remove abrasive external contaminants. Generally, transparent oils allow for easy inspection of the wire rope.

During the manufacturing process, lubricant is applied to wire ropes. If a fibre core is used, careful attention is given to it because it is a reservoir for future and continuous lubricant storage. Typical core lubricants are mineral oil and petroleum.

Lubricant is pumped in a stream just ahead of the die that twists the wires into a strand. This allows complete coverage of all wires.



In cranes and other applications, wire ropes perform better and last longer when properly lubricated – during manufacture and in the field.

In field service, relubrication is required due to loss of original lubricant from loading, bending, and stretching of the cable. Also, fibre cores tend to dry out over time due to heat. When dry, the fibre core will often absorb moisture. Field relubrication is necessary to minimise internal corrosion, protect and preserve the rope core, and to extend the service life of the wire rope.

If cables are dirty or have accumulated layers of hardened lubricant or other contaminants, they must be cleaned before relubrication with a wire brush and petroleum solvent, compressed air, or steam cleaner. The wire rope must be dried and lubricated right away to prevent rusting. Field lubricants can be applied by spray, brush, dip, drip or pressure boot. The lubricants used in field relubrication include petrolatum, mineral oils, greases, and solvent cut back asphaltics. Lubricants should be designed to penetrate into the core of the wire rope and are best applied at a drum or sheave where the rope strands have a tendency to separate slightly due to bending. If a pressure boot application is used, it can be placed on straight pulled rope. Excess lubricant quantities should be avoided to prevent safety hazards.

The life to failure and performance of wire rope is reduced by many factors of operation, care, and environment. Cables can be abused by worn-out sheaves, bad winding practices, bad splicing and improper storage. Neglecting to properly field relubricate a wire rope will also reduce the service life. High stress loading from shock or jerking up loads, or rapid acceleration or deceleration will wear on the fatigue life of the cable. These types of failures are cumulative over time.

Corrosion can cause shortened rope life due to metal loss, pitting, and stress risers from pitting. If a machine is to be shut down for a long time, the cables should be removed, cleaned, lubricated, and stored properly. In service, corrosion is caused by fumes, acids, salt brines, sulfur, gases, salt air, humidity and temperature. Proper and adequate lubricant application in the field can reduce corrosive attack of the cable.

Abrasive wear occurs on the inside and outside of wire ropes. The inside of the rope moves one wire, one strand against the other, causing abrasive rubbing that must be lubricated to achieve long rope life. The outside of the cable is exposed to abrasive dirt (drag rope) and also contaminants from sheaves and drums, which wear away the outer wires and strands. Abrasive wear usually causes


rope diameter to be reduced and can result in core failure and internal wire breakage. Penetrating wire rope lubricants reduce abrasive wear inside the rope and also wash off the external surfaces to remove contaminants and dirt.

Several types of cement plant applications use wire ropes. These include cranes and elevators. Each application has specific needs for the type and size of wire rope required. All wire ropes, no matter what the application, will perform at a higher level, last longer, and provide greater user benefits when properly cared for with the necessary lubrication with proper lubricants at manufacture and during field relubrication. Field relubrication is most important to maintain the integrity and safety of the wire rope and to prevent shortened life or safety hazards.

Some of the key performance attributes to look for in a wire rope lubricant are wear and corrosion prevention. For wear protection, look for wire rope lubricants with high values for Four-Ball EP (ASTM D-2783) such as a weld point of over 350 kg and a load wear index of over 50. For corrosion protection, look for wire rope lubricants with a Salt Spray (ASTM B-117) test result of over 60 hours and a Humidity Cabinet (ASTM D-1748) of over 60 days. These are very useful benchmarks for comparing the products available from different manufacturers, in order to select a product with the best possible performance. This information should be on their technical data sheets.

Lubrication Engineers has found, through years of field experience, that longer wire rope life can be obtained through the use of penetrating type wire rope lubricants (such as Wirelife™ Monolec® or Low Tox® penetrating lubricants), both when used alone and when used in conjunction with a coating type wire rope lubricant (such as Wirelife™ Almasol® coating lubricant). The wire rope life is typically doubled in this manner.

For example, 44 mm ropes have had their lives extended from an average 18.5 months to 43 months, while at another site the life of four 43 mm x 2073 m ropes were prolonged from an average 8 months to 12 months. In another study, 5 to 10 t overhead cranes in the US, using 3/8 in. and 5/8 in. diameter wire ropes, saw the life of the rope more than double. The increased performance is attributed to the ability of the penetrating lubricant to displace water and contaminants while replacing them with oil, which reduces the wear and corrosion throughout the rope. A good spray with penetrating type wire rope lubricant is essentially an oil change for wire ropes.

In these and countless other cases, the savings in wire rope replacement costs (downtime, labour and capital costs) were substantial and dwarfed the cost of the lubricants. Cement companies that have realised the importance of proper wire rope lubrication have gained a huge competitive advantage over competitors that are still purchasing the lowest priced lubricant, or no lubricant at all, and replacing their ropes on a much more frequent basis. Quality wire rope lubricants provide cement plants with excellent value, return on investment and improved reliability. 

## Bibliography

- *Wire Rope Users Manual*, Second Edition, American Iron and Steel Institute, copyright 1981. Second printing 1985. Pp 5-17, 67-68.
- *CRC Handbook of Lubrication*, Volume 1. CRC Press, Inc., copyright 1983, pp 193 – 201.
- BREWER, A. F., *Effective Lubrication*, Copyright 1974, Krieger Publishing Co. pp 236 – 242.