



Whitepaper

The lubrication of ropeways.

Increase efficiency and longevity

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Executive Summary

Ropeways are an important means of transportation in many parts of the world and for many different purposes. While they are often regarded as a typical transport system in ski areas, ropeways are also more and more frequently used as a transportation solution in different climatic regions, like tropical areas, near the sea or in urban areas.

These applications normally have to work for many hours per day, and every day throughout the year. This as well as the increase of operational speeds of new ropeways in ski areas have produced a rising need for high-performance lubricant solutions. Ensuring reliable performance under different conditions can be challenging for lubricants: While the lubricant must ensure effective lubricity at temperatures down to $-20\text{ }^{\circ}\text{C}$ so as not to overload the drive

motor, it is equally important that the lubricant does not become too liquid in hot climate zones or in the summer heat, to prevent soiling people and polluting the environment. It is also important to consider compatibility with materials as well as resistance to water and extreme vibrations during operation. Good corrosion protection is also a necessity, since this contributes to operational reliability and the longevity of machinery. And of course lubricants are expected to reduce the need for maintenance and hence minimise operating costs.

Over the years Klüber Lubrication has gained more and more competence in the lubrication of ropeways, both by expanding its experience in the field with operators and by intensifying the collaboration with major OEMs in the sector.

Wire rope lubrication: at the heart of ropeways

Wire ropes are the central component of ropeways. Lubricants play an important role, especially for the rope's longevity. As indicated in working paper no. 28 by O.I.T.A.F.* both initial lubrication during manufacturing and relubrication during operation increase the operational life of a wire rope dramatically.



Wire rope on roller with elastomer lining

*International Organization for Transportation by Rope



In Europe, a wire rope for people transportation applications should be manufactured according to EN 12385-8. This norm contains indications for the lubricant to be used as the first fill:

- The friction coefficient determined according to DIN 21258 at 20 °C must be >0.22.
- The swelling of the pulley lining material: tests carried out with the most commonly used elastomers, method according to DIN 53521. The volume change must be <20 %; the hardness reduction must be <10 Shore A.
- Breaking point according to DIN 21258: 1986.
- The content of water-soluble acids according to DIN 21258 must be <2 mg/100 g.
- The flash point according to ISO 2592 must be >55 °C.

In addition, the lubricant should:

- Be an oil and not a grease or bitumen (with or without solvents) in order to avoid problems where water has entered the rope and cannot be removed as the rope is covered by grease. An oil, by contrast, can have a de-watering effect, preventing water and moisture from causing excessive corrosion.
- Be compatible with zinc coatings for use also on galvanised ropes.
- Be compatible with the lubricant used during manufacturing (applies to relubrication).
- Be easy to dispense.
- Be stable over time.
- Improve the fatigue life of the rope compared to the technologies in use

In cooperation with Redaelli Tecna, a leading manufacturer of wire ropes for people transportation applications, Klüber Lubrication has developed a specific lubricant, meeting all the afore-mentioned requirements: Redaelli 9 R 100. Thanks to its special formulation, Redaelli 9 R 100 has been tested successfully according to requirements in EN 12385-8. It can be used both for initial lubrication of wire ropes and for relubrication.

Normally, relubrication is required every "season" with the recommended following quantities: $Q [kg] = 0.1 * d * L$
where: d in mm is the wire rope diameter, L in km is the wire rope length.

Redaelli 9 R 100 is also effective in very small quantities, bringing the added advantage of having little lubricant on the rope and hence minimising the risk of dripping from the rope.

Vehicle lubrication: increasing comfort



Vehicles may differ, depending on the ropeway's type and function. The major task for these vehicles is to be the physical transportation element for people or goods. When transporting people, comfort is also an important factor to take in consideration. In fact any vehicle in a ropeway has pivoting elements, typically pin-bush elements, where incorrect lubrication can generate jerky movements and noise such as squeaking that would compromise comfortable transportation.

Klübersynth EM 94-102 has been especially developed for the lubrication of such components, for example detachable grips, regardless of the climate. Due to its wide service temperature range, it can be used in a multitude of applications under different climatic conditions, from the low temperatures of alpine environments to the warmer tropical areas or ropeways by the sea, where corrosion can be an issue. In applications where there is very little relative movement, and where relubrication is not possible over longer periods of time, ALTEMP Q NB 50 has shown a superior performance over the years. These special solutions have been tried and tested, approved and used by major ropeway OEMs.

Roller batteries

On any tower of a ropeway there are generally roller batteries. The roller batteries guide the hauling rope along the line. Each roller battery is made up of a system of rollers. The number of rollers depends on the load that the rope is carrying. For the lubrication of these elements reliability and long-term lubrication is a must. There are many elements in a roller battery that need maintenance. Thus, efficient and long-lasting lubrication is needed to reduce the amount of maintenance and save time and costs.

For this special application, lubricants like Klübersynth EM 94-102 or Klüberplex BEM 41-132 can be used successfully on rolling bearings. For the lubrication of pin bushings, ALTEMP Q NB 50 is the best choice.

Rope support saddles: effective and safe lubrication

Ropeways that have separate carrying ropes possess specific support saddles on the towers. Lubrication of these units can be as frequent as once a week. These saddles are mounted at the top of the towers and often in an overhanging position. This, and the weather that is often adverse, makes the relubrication procedure of the rope support saddles inconvenient and risky.

In order to minimise the risks for operation, while keeping the saddle reliably lubricated, Klüber Lubrication has developed a specific solution, namely the speciality lubricant STABURAGS NBU 12 ALTEMP supplied in automatic dispensers. The use of this lubricant has proven effective for the lubrication of rope saddles even with small quantities. It can be applied by a Klübermatic NOVA lubricator and requires no further maintenance intervention over 1 or 2 "seasons", depending on the individual situation, reducing dramatically the risk associated with manual relubrication of these elements, which are placed so high up on the pylons.

Main gearbox: PAO-based lubricants preferred

The gearbox, as part of the drive system, can be installed either at the bottom or top station of the ropeway. During winter, operation gearboxes in ski areas can experience very low ambient temperatures when operation of the ski lift starts.

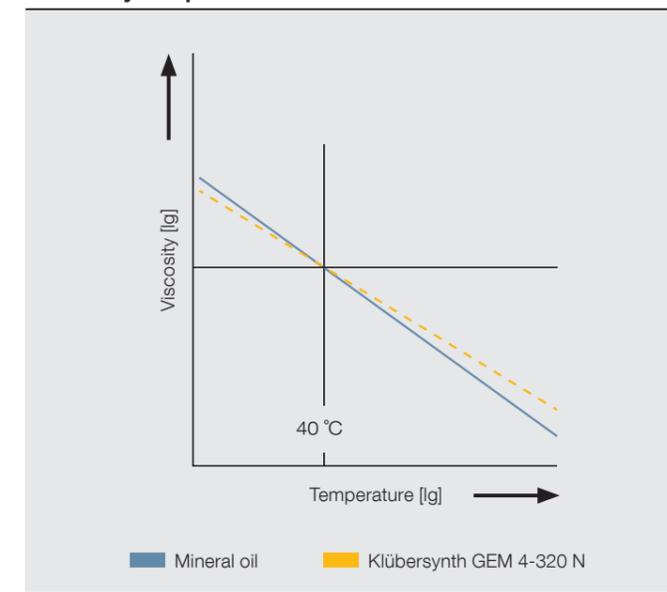
Ropeways operating in ski areas are a classic example of why synthetic oils outperform mineral oils in operation. Still many mineral oils are used to lubricate gearboxes. Normal mineral oils have a very strong viscosity increase at low temperatures, so the possible solutions can be:

- Use of a lower-viscosity oil to decrease the starting torque. But when operating, the oil sump reaches temperatures that would require higher oil viscosity for operational safety of the gearbox.
- Use of heating elements: despite the effectiveness of these elements, they often lead to an early ageing of the lubricating oil, and sometimes to oil failure due to overheating.

The use of a proper synthetic gear oil, mainly based on PAOs, can allow the use of the correct viscosity without the risk of using heating elements, thanks to the natural high viscosity index of synthetic hydrocarbon solutions.

Klübersynth GEM 4 N is the preferred PAO-based gear oil from Klüber Lubrication, confirmed by specific experience in the field, and numerous approvals from OEMs.

Viscosity-temperature behaviour of oils



A high viscosity index makes for easier start-up at low outside temperatures, reduces power loss to a minimum and ensures the formation of a load-carrying lubricant film also at high temperatures.

Toothed joints

Toothed joints are often considered a minor application for a lubricant. In the field, various greases or even non-adhesive oils are used for mounting these connection systems, but with these lubricants problems such as corrosion, tooth wear and ultimately frequent joint replacement can arise.

A special lubricating paste can offer a safe and long operation of these components. STABURAGS NBU 30 PTM has proven in the field to be an extremely well performing solution extending the useful life of these components as long as possible.

Open gears in particular in the rescue/recovery device

For the lubrication of these elements, particular attention should be given to the adhesiveness of the lubricant used to prevent dripping down, especially in applications where people are transported. In the rescue / recovery device, there is a multitude of open gears that can be quite noisy.

In order to reduce wear and hence extend the gears' lifetime, and to minimise the noise, a special grease can be used. Klüberplex AG 11-462 has proven to be performing well in this application, thanks to its adhesion and thanks to its availability in special packagings like spray cans or automatic dispensers.



Rolling bearings in electric motors and pulleys

The lubrication of rolling bearings in components like electric motors and pulleys for the wire rope can be done with speciality lubricants so as to minimise maintenance during operation. Generally speaking, standard mineral-based greases can be used, but without the benefit of having long relubrication intervals combined with reliable operation.

Klüberplex BEM 41-132, a semi-synthetic grease, works at temperatures as low as -40 °C and as high as 150 °C. Its special formulation enables long-life lubrication and it is approved or used by many electric motor OEMs.

As Klüberplex BEM 41-132 is available in automatic lubricators, it is the optimum solution for the lubrication of rolling bearings in electric motors and pulleys in ropeways

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