

# Design and development of uniform and continuous lubrication system for wire rope

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**Abstract**—The main aim of the project is to provide proper lubrication to the wire which are used worldwide in various industrial applications such as cranes, hoists, Lifts, etc. Also, project focuses on reducing overall cost of the lubrication system which includes lubricant cost, maintenance and operational cost. When wire ropes are made on stranding machine, at the time of stranding lubricant is sprayed which does not penetrate into the core which results into improper lubrication inside the core and failure of wire from core. Insufficient lubrication increases corrosion and fretting wear of rope. As lubricant is sprayed on wire rope, lot of lubricant is wasted and spread on floor which increases chances of accidents and also increases overall cost of lubricant. Our project describes a pressurized lubrication system which provides lubricant inside the core and maintain uniform thickness over the outer surface of wire rope. This is automatic lubrication using hydraulic system which saves human efforts and saves time as speed of lubrication is also increased. Unique design of seal provides better penetration of lubricant inside the core of wire rope. Wastage of lubricant is reduced as there is outlet port which carries extra lubricant back to the reservoir. Thus, proposed lubrication system reduces overall operational and maintenance cost and improves life of wire rope by reducing failure.

**Keywords**— *Lubricant, Stranding Machine, Pressurized Lubrication, Wire Rope.*

## I. INTRODUCTION

Wire ropes are widely used in various industrial applications such as mines, cranes, ship hoist, navy applications, remote operated crane etc. Main element of wire rope is wire which is wound about core to form strand and when number of strands wound together, it forms wire rope. There are four types of wire rope according to lay of the wire. The lay of wire is the direction along which strands in rope twists. The different kind of lays are right lay, left lay, regular lay, lang lay. Lubrication is the process of applying grease or oil

on contacting surfaces to reduce friction, wear and tear which results into smooth movement. Strands in wire rope are continuously in contact with each other during motion, which results into friction and wear of wire rope. Due to this, wire rope fails. In order to avoid this failure lubricant is applied on wire rope.

Various works in the field of wire rope lubrication are explained further. Ignatio Madanhire and Tawanda Mushiri [1] mainly focused on wire rope lubrication where wire rope passes over pulley and spreads out so that strands allow grease to penetrate rope upto core. Hence, in this setup pulley bends the rope to lubricate wire in lubricant pressurised casing where inlet and outlet ports are given. Ms. Bhushan Patil, Prof. H. D. Chaudhari [2] worked on the setup consisting of greasing housing, greasing seal set, scrapper guide and groove cleaner assembly that used for specific wire size. This device is clamped around rope and rope is pulled through ring.

S. Shankarnarayanan, D. David, T. Naresh Kumar [3] investigated different methods for lubrication system that is centralised lubrication system, gravity lubrication system, oil-mist lubrication system. They aim to provide automated lubrication system using hydraulic or pneumatic system.

Demont G. Millerg, San Marine, John C. [4] found a line wiping device and more particularly accommodating line wiping element to various sized cables, ropes for increasing life of line wiping elements. Glen J. Bertini, Glen S. Jessen [5] studied about wire rope construction. The wire strands are wound around core. The conduits radial flow of lubricating oil. The lubricant is injected into conduit through channel and lubricant migrates in conduit through orifices.

The aim of the study is to standardise lubrication system to achieve proper wiping and superior protection to the rope against fretting and corrosion by forcing

lubricating oil into core. Also, avoid spreading of lubricant on floor area to minimise wastage of lubricant.

## II. DESIGN DETAILS AND MEASUREMENT

The design of lubrication system consists of main parts as scraper plate, casing, seal. Also, this system is operated by hydraulic system which consists of following parts.

- 1) Pump
- 2) Reservoir
- 3) Direction control valve
- 4) Pressure gauge
- 5) Temperature indicator
- 6) Delivery hose
- 7) Grease flow control valve

Using gear pump lubricant is pumped into oil nozzle from reservoir in which it is filtered using oil strainer to avoid any contaminants in the arrangement. In accumulator, certain level of lubricant is maintained to have continuous supply of lubricant. To direct lubricant into oil nozzle direction control valve is used. Pressure and temperature of lubricant is indicated by temperature indicator and pressure gauge respectively. Piping arrangement is used to supply lubricant.

**Casing** -The casing is the most important part of lubrication system. It is aluminium alloy casing which is robust in construction and having good corrosion resistance coating. It has two ports i.e. inlet port and outlet port located at  $\frac{1}{3}$ rd and  $\frac{2}{3}$ rd of casing length. Casing allows lubrication of 8mm to 100mm of wire rope diameter. It also consists of one locking system to connect two halves of casing.

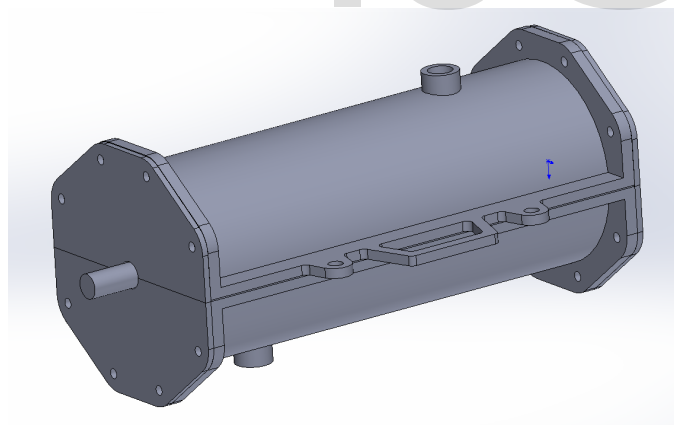


Fig 1. Casing

**Scraper Plate** - It is located at both the ends of casing to provide support and also to clean wire rope before entering to casing. At outer end, it maintains certain thickness of lubricant on wire rope. It is made of Aluminium alloy material.

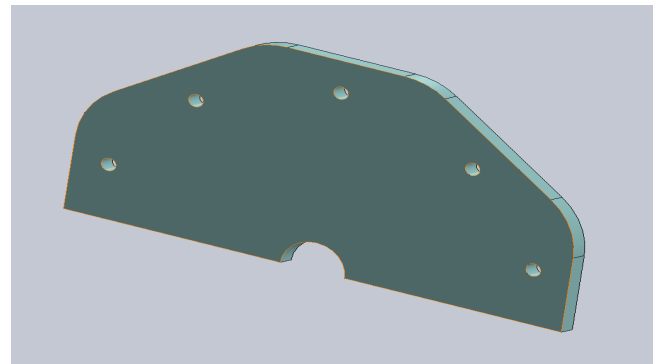


Fig 2. Scraper Plate

**Seals** - Material used for seal is Polyurethane which is wear resistant & durable. Also, being flexible material provides better sealing when operating under pressure. According to size of wire rope different seals are used.

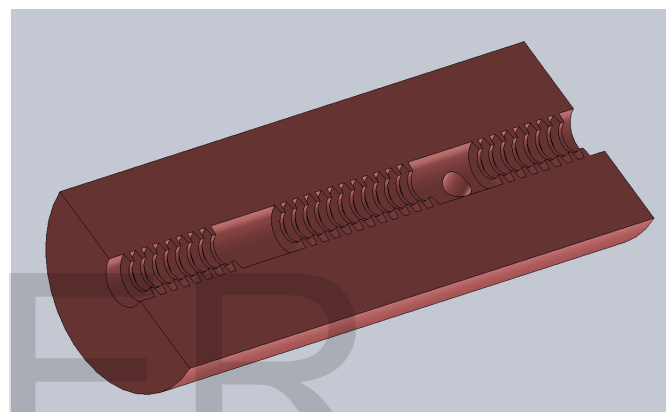


Fig 3. Seal

## III. Lubrication method

The lubrication system for Rope are basically following type grease drop lubrication, oil dipping lubrication, grease conical lubrication, spray lubrication, pressurised lubrication.

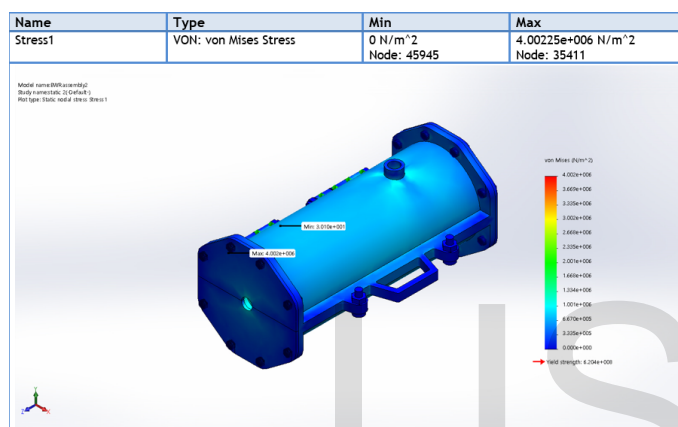
Using pressurised lubrication system for wire rope produces great results in increasing life of rope. Pressurised lubrication has reservoir containing lubricant. The lubricant is selected as per application of rope. The pump is used to pump the lubricant at pressure of 120 psi into the casing. The non-conductive hoses are used to transfer pressure into the casing. The lubricant then penetrates into the core of the rope. The seals have specific area to provide space for lubricant to rest and penetrate. The seals having circular tooth get positive interference with the Rope and provide proper pressure as well no leaking of the lubricant. The remaining Lubricant is collected back to reservoir by second outlet where pressure decreases the lubricant is passed through filter before sending back to reservoir. The

scraper plate at inlet does not let the dust and rust particles to let in by scrapping them out because the diameter of scraper plate is same as rope. Scraper plate at outlet provide uniform thickness of lubricant over the rope. The system can be assembled anywhere & chain is used to restrict the motion of casing. The rope is wounded on bobbin after lubrication.

#### IV. RESULTS

The proposed design is made in Solidworks CAD and simulated in Solidworks simulation. The Casing has assigned Aluminium alloy and also, Scrapper plate has assigned Aluminium alloy material. Each part is assembled correctly and Nut & bolt to clamp them. The pressure force of 120 psi is applied on internal walls of the casing and found this stress contour and displacement contour.

Max Displacement: 0.0014192mm.



**Fig 4. Static Analysis of Lubrication System**

#### V. CONCLUSIONS

The proposed design provides proper lubrication to the wire rope into the core which reduces corrosion, fretting wear & other failures. This system reduces overall operation & maintenance cost. Also, life of wire rope is improved. As pressurized lubrication is used, wastage of lubricant reduced and accident due to slippery floor are avoided. As this is automatic process, less labour efforts are required. This is very fast process with speed of 1200 m/hr. so time required for lubrication is less.

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