

## RODENT PROTECTION FOR OPTICAL FIBER CABLES

### BACKGROUND

Optical cables may be attacked by several species of rodents e.g. rats (*Rattus norvegicus*), water voles (*Arvicola terrestris*) (in Northern Europe) or gophers (in North America). Also other animals may attack cables e.g. termites, woodpeckers (aerial cables) or arctic foxes (in Greenland).

In most cases cables with a Standard PE sheath may be installed without any damage. In other cases the local conditions are so that unprotected cables may be attacked and damaged.

Due to their relatively small diameter, optical cables are more exposed to rodent attack than traditional telecommunication cables.

Internationally a vast number of rodent tests have been made on optical cables with different grades and types of rodent protections. Three main conclusions can be drawn from those investigations:

- If the rodent tests are organised under aggravating circumstances only cables with steel armouring gives 100 % protection, this is because these materials are much harder than the teeth of the rodents.
- Also dielectric armour composed of rigid elements (FRP/GRP) with physical and dimensional characteristics carefully selected have proved to be effective under severe conditions.
- Under more relaxed circumstances other means of rodent protection are sufficient, included just to keep the diameter of the cable above a certain figure.

### TYPES OF RODENT PROTECTION

#### **PA 12 (POLYAMIDE 12) OUTER SHEATH**

A thin (0.5 mm) outer sheath of PA 12 has been used for more than 10 years: almost 10.000 km of cable has been installed using this type of rodent protection, experiences show that this protection is effective under normal conditions in Northern Europe.

The PA 12 outer sheath gives the cables, in addition the rodent protection, a termite protection and a hard smooth surface. Optionally this sheath is available in the following colours: orange, black, blue, red, green, yellow.

The hardness of the PA12 grade used is above 70 Shore D.

#### **PP (POLYPROPYLENE OUTER SHEATH)**

A thin (0.5 mm) outer sheath of PP has been used in the recent years. This rodent protection method has been found effective. The effectiveness of the PP sheath is due to its hard surface; it is almost as hard as PA 12. The hardness of the PP grade used is 66 Shore D.

### **STEEL**

Steel tape or wires are the rodent protection remedy, which is regarded %100 effective.

#### **CORROSION PROTECTED AND COATED STEEL TAPE**

The tape is corrosion protected and with a polymer coating

During the cable manufacturing process the tape is corrugated in order to give the cable better bending performance. The corrugated tape is folded around the cable core with an overlap.

This rodent protection gives a 100 % effective protection. The cable is of relatively lightweight, and has a good flexibility.

As Standard the tape is 0.155 mm thick. The corrosion protection is a surface layer of chromium and chromium oxide. The chromium and chromium oxide makes the surface very corrosion resistant. On both sides of the tape it is further coated with a 0.055 mm thick polymer coating.

#### **STEEL WIRES**

This is a metallic armour made of galvanized soft steel wires, applied between inners and outer sheath.

A steel wire armour is often used for heavy duty applications when high crush and pulling force is required.

The steel wire armour provides 100% rodent protection like steel tape and FRP elements.

## GLASS YARNS

In recent years the use of glass yarns for rodent protection has become more and more popular.

FOC producers developed cables with glass yarns as rodent protection. These cables have been proven to be effective against attacks from small rodents in a test carried out by an independent laboratory.

The function of glass yarns differs from the other rodent protection principles. The glass yarns protects because the rodents, although they can easily penetrate the glass yarns, they don't do it because they find it unpleasant to gnaw the glass yarns

## GLASS FIBER REINFORCED PLASTIC ELEMENTS ( GRP / FRP )

This is dielectric armour composed of rigid elements (FRP/GRP) with physical and dimensional characteristics carefully selected.

Flat FRP elements are stranded around the cable core, typically in a construction with double sheathing and the armour between the sheaths.

This means of rodent protection provides the same 100 % protection as steel tape, and in addition the cables becomes dielectric (non-metallic), an advantage because the cable becomes immune towards lightning and towards induced voltage e.g. along electric railways

In order to qualify the rodent protection test has been made in order to investigate the merits of different protection means. The figure shows a result of such a test. Only the 3 cables to the right have survived the test, cables with steel armour or dielectric rigid elements (FRP/GRP).

### N° and cable structures that have been tested

- 1 : duct cable, glass yarns armour, 226300 dTex, single sheath HDPE 1.5mm, Ø 13.4 mm
- 2 : duct cable, aramid yarns armour, 82100 dTex, single outer sheath HDPE 1.5mm, Ø 12.7 mm
- 3 : direct buried cable, glass yarns armour, 226300 dTex, inner sheath PE, outer sheath HDPE 2mm, Ø 17.5 mm
- 4 : direct buried cable, aramid yarns armour, 38800 dTex, inner sheath Polyamide, outer sheath HDPE 2mm, Ø 14.5 mm
- 5 : direct buried cable, glass yarns armour, 86400 dTex, inner sheath PE, outer sheath HDPE 2mm, Ø 17.5 mm
- 6 : direct buried cable, aramid yarns armour, 28800 dTex, inner sheath PE, outer sheath HDPE 1.8mm orange, Ø 17.5 mm
- 7 : direct buried cable, glass yarns armour, 12000 dTex, inner sheath PE, outer sheath HDPE 2mm, Ø 17.5 mm
- 8 : direct buried cable, steel tape 0.25mm armour, inner sheath PE, outer sheath HDPE 2mm, polyamide over sheathing, Ø 18.2 mm
- 9 : direct buried cable, steel tape 0.15mm armour, inner sheath PE, outer sheath HDPE 2mm, , Ø 16.5 mm
- 10 : direct buried cable, flat FRP armouring, inner sheath PE, outer sheath HDPE 2mm, , Ø 15.5 mm

### Procedure

The samples of cables have been tested against 'Rattus norvegicus', wild trapped and grown in captivity rats. The tests have been performed 3 times 3 weeks per testing set and per rat group, wild or captive. Each testing set comprised three samples : the n° 2 and 9 as low and high protected reference and the cable sample to be tested.

The picture below well represents the final status of the tested samples and the cables ability to protect the optical core against the rodents. N° 1 to 10 from left to right.



### Conclusions

Whatever its thickness may be, even over sheathed with polyamide, the outer sheath can be damaged by the rodents.

When metal is allowed, a steel tape armouring is an excellent barrier against the rodents.

When the cable is required all dielectric, rigid FRP armouring is the only effective protection for the cable core.