

Journey through rodent resistance options in dielectric cables

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Abstract

Utilization of optical fiber cables in metro as well as long-haul networks is increasing exponentially. Duct & Direct-Buried cables has always been the mainstay for all OSP applications. Rodent attacks have been a major cause for heavy maintenance cost of such networks and is a threat to service operators in almost all geographic locations of the world. To make rodent proof, service providers are not always able to choose the steel armoured cable solution due to the disadvantages of stiffness, higher diameter, higher weight, and also difficult to install comparatively – especially as fiber proceeds from the long-haul rings to the last mile giving rise to the requirement for dielectric options.



Keywords

Rodent-Resistance, Cable, Non-Toxic

1. Introduction

Application of glass roving as a protective layer below the sheath has been in practice for quite sometime as a convenient dielectric solution for rodent resistance. However, conducting a field study as well as in a simulated condition experiment, it was found that the outer sheath, once eaten through, exposes the glass roving layer which due to its unbound and filamentous nature, has a tendency to settle or shift away when coming in contact with water percolating from rainfall or by scratching of the rodent itself, thus exposing the inner core for easy access/destruction by the rodents, etc. So, we introduced a new range of duct & drop cables having a glass roving woven tape as a protective layer. Application of the glass roving tape over the core minimizes the chances of exposure of the inner core and instead, enhances the impact/crush resistive properties thus making it very special and very robust solution from rodent protection point of view. However, gnawing rodents possess two pairs of lips, an adaptation which enables them to gnaw into material without getting any of the material into their mouths. So, glass roving based protection has still limitations. So, an additional protection in the form of a repellent additive that makes the cable emit the odour of a predator urine sensed only by such animals was worked out. This is a biological repulsion, which although non-toxic – keeps the rodents away. The performance of the above has been evaluated & analysed for discussion in this paper.

As more and more operators are preferring their cable networks to be through well-installed ductlines, steel armoring for rodent proofing becomes quite unviable for smooth installation. This paper relates to a cable which has a non-metallic armoring layer and which is effectively rodent resistant. More particularly, it relates to cables having dielectric sheath system which includes a plurality of coated, longitudinally extending members disposed about the periphery of the core of the cable and which provide excellent protection against rodents, without affecting adversely the flexibility of the cable.

One better up above physical resistance mechanism in the cable is a special repellent non-toxic additive into the sheath material that actually causes the rodents to avoid going near the cable due to instilled “fear” of predator attack. This ensures that the cable is safe from rodent attack. At the same time, unlike normal poisoning additives having dangerous/banned chemicals containing lead, etc., which are biologically harmful to the environment including humans, this kind of additive is “repellent” in its actual sense having bio-actives and are completely non-toxic.

It has been tested that thick layers made up of glass roving yarns tape itself act as rodent-resistance material for the direct buried cable. Supported by eco friendly rodent repel sheathing material. The glass roving material is glassy in nature & irritates the animal when bitten.

2. Cable Construction

The basic core design of the cable can be uni-tube or multi-tube. Over this core layer of glass roving tape is applied to protect core from rodent bits. The final sheathing material is extruded over this layer. The sheath is having properties to repel rodents.

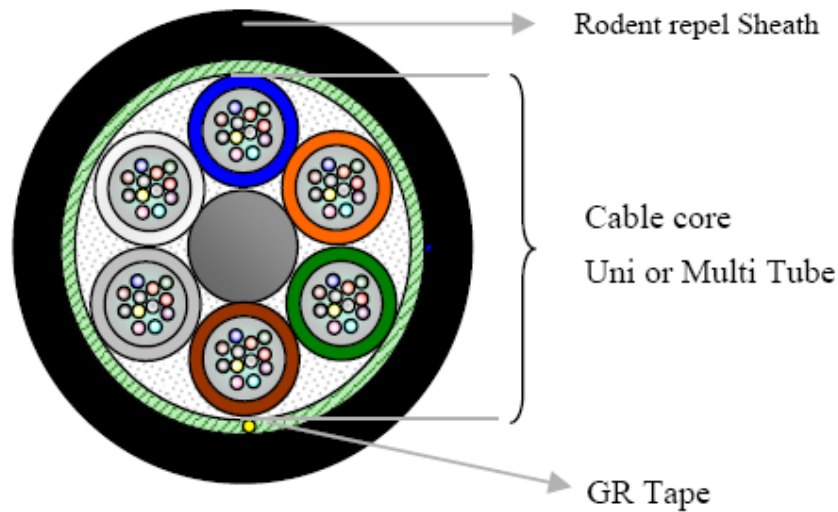


Figure 1. Cross section view of cable



Figure 3. Glass roving yarns tape

3. Applications of Cable

Flexibility during installation & detection by intruders of the armour cable is roadblocks for uses of the metallic armour cables in metropolitan networks and security purpose. Whereas metallic armored cable has good rodent resistance properties. To overcome this roadblocks eco friendly nonmetallic cable is developed. This cable is flexible & easy to bend in low spacious areas like metropolitan cities. This is non metallic cable and cannot be detected by RADAR system useful for security & military applications.

3.1 Application of Woven Tape Layer (Armour)

Below Sheath

Woven tape is made up of glass roving yarns. Tape is a powerful tool to avoid rodents because when fiber becomes broken due to a bite, immediately producing small pieces of glass. This glass is very unpleasant for these animals thus keeping them away.

3.2 Application of Non-Toxic Repellant Additive In Outer Sheath Material

The inherent property of this additive to exploit the olfactory response of animals will prevent the rodent itself from coming near the cable – thus increasing the life of the cable.

4. Cable Performance

The cable manufactured with glass roving tape & rodent propelled sheath material is tested in-house as well as out house facilities for its performance.

4.1 Optical Fiber Performance

Optical performance of the cable is evaluated by testing cable as per IEC standards for optical fiber cable.

4.1.1 Tensile Test

Cable is tested for fiber strain Vs. Load. Change in attenuation w.r.t. initial attenuation was measured after completion of test. After test cable is inspected physically. No damage is observed to the cable. Fiber strain Vs. load graph is shown in Figure 3 & test result summary in Table 2.

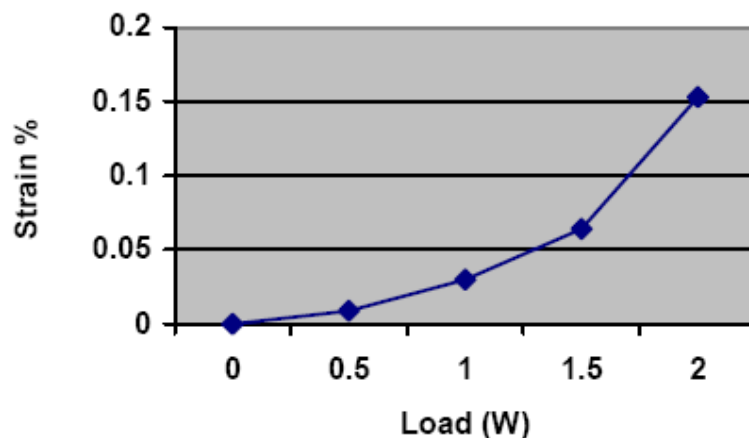


Figure 3. Strain % Vs Load W (W = Weight of cable / Km)

Table 2. Summary report for tensile test

	1310 nm	1550 nm	Fiber Strain
Change	0.010 dB/Km	0.015 dB/Km	0.153%

4.1.2 Mechanical Tests

Cable is tested as per IEC standards for mechanical tests. Test results are summarized in the Table 3.

Table 3. Summary of mechanical test report

Test	Specification	Test result
Compression test	IEC-60794-1-E3	Change in attenuation 0.010 dB/Km
Cable bend test	IEC-60794-1-E11	Change in attenuation 0.009 dB/Km

Impact test	IEC-60794-1-E4	Change in attenuation 0.015 dB/Km
Torsion test	IEC-60794-1-E7	Change in attenuation 0.010 dB/Km
Repeated bending	IEC-60794-1-E6	Change in attenuation 0.009 dB/Km

No physical damage was observed on the cable after completion of test.

4.1.3 Environmental Test

Cable is conditioned in walk-in type chamber for different temperatures. Temperature cycle is as shown in the figure 4.

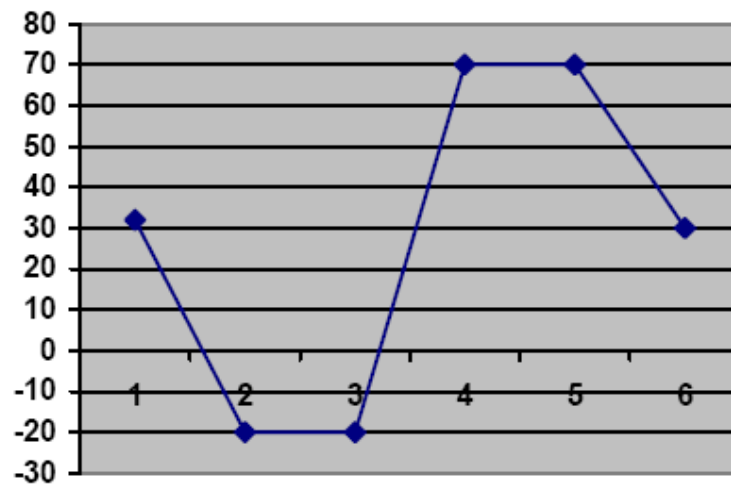


Figure 4. Temperature cycle set for environmental test performance

Attenuation readings are taken after condition of cable for 12 hours at each temperature. Change in loss is calculated with respect to the initial attenuation is as shown in figure 5.

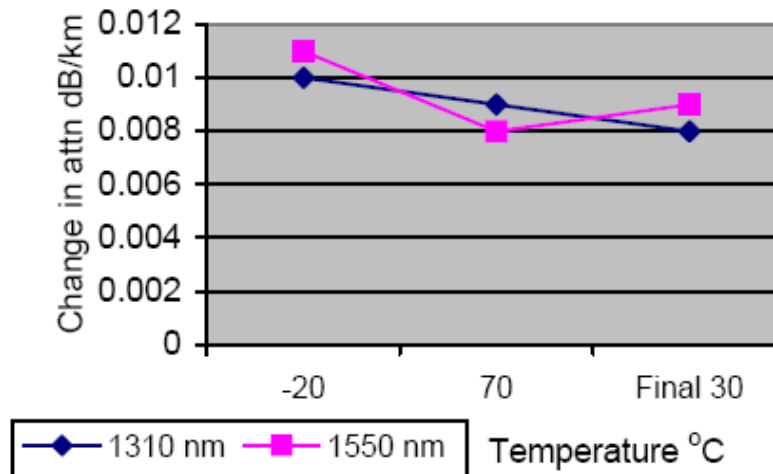


Figure 5. Change in attenuation during temperature cycle

4.2 Evaluation Report Of Anti-Rodent Testing Of Rodent Proof Cable Using Repellant Additive:

Cable is tested for anti-rodent testing at all India network project on rodent control Central Arid Zone Research Institute [1]

Rodent species used for trial were

- i. The house rat, *Rattus rattus*
- ii. The lesser bandicoot rat, *Bandicota bengalensis*
- iii. The soft furred field rat, *Millardia meltda*
- iv. The Indian gerbil, *Tatera indica*

These are essentially field rodent species distributed in various parts of the country.

4.2.1 Test Method

The test cables were exposed to these rodent species housed individually in iron mesh cages under laboratory conditions. The freshly captured rodents were first acclimatized in laboratory cages for ten days and then used in the trials. For each trial, a set of 3 animals of uniform body weight was exposed to the test cables under following test conditions.

No choice test: The rodents were starved for 24 hours before exposure to the cables and no food was given to the rodents during the period of the trial. The test cables (one sample each of treated and control sample) were exposed to all the test rodents. This trial was run for 5-6 days depending upon the health status of starved test rodents. Tap water was provided ad libitum to the rodents. In all there were twelve (3 replications X 4 species) exposure trials in this test.

Choice tests: In this trial the cables (one sample each anti rodent treated and control samples) were exposed to the test rodents along with food, thus the rodents had a choice between food and the cable. This test was run for longer periods (30 days). Tap water was provided to the test rodents ad libitum. In all there were twelve (3 replications X 4 species) exposure trials in this test.

Observation on tooth marks, rodent behaviour toward exposed cables, relative extent of damage in treated and untreated samples were recorded. Health status of test animals was also be monitored to record any ill effect of exposure of treated/control cables on these animals.

4.2.2 Result

Laboratory trials with three replications of each sample exposed to four rodent species having different habitats and distribution patterns indicate that both the anti rodent treated cables T-1 and T-2 (Shown in Figure 3) are relatively safer against rodent attack as compared to the control samples. (Shown in Figure 4&5)

The exposure of rodents to these FO cables for 5-30 days in no choice and choice conditions did not show any ill effect on test rodents, as their body weight and overall activity was not affected even after a month of completion of the trials.

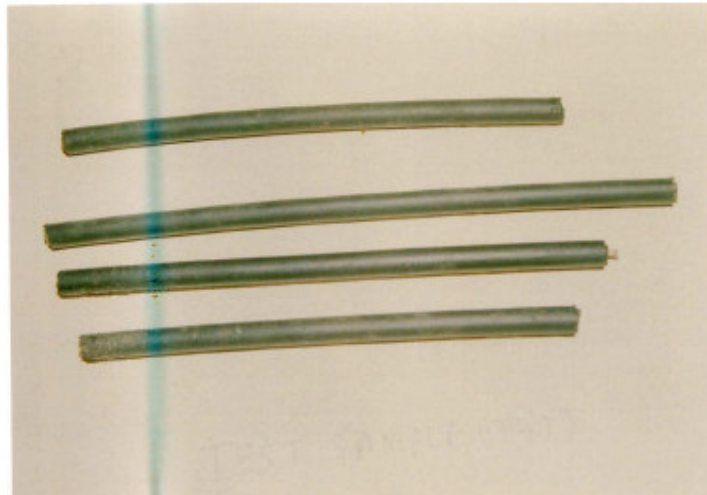


Figure 3. Test Sample for Anti-rodent testing



Figure 4. Controlled Sample for Anti-rodent testing

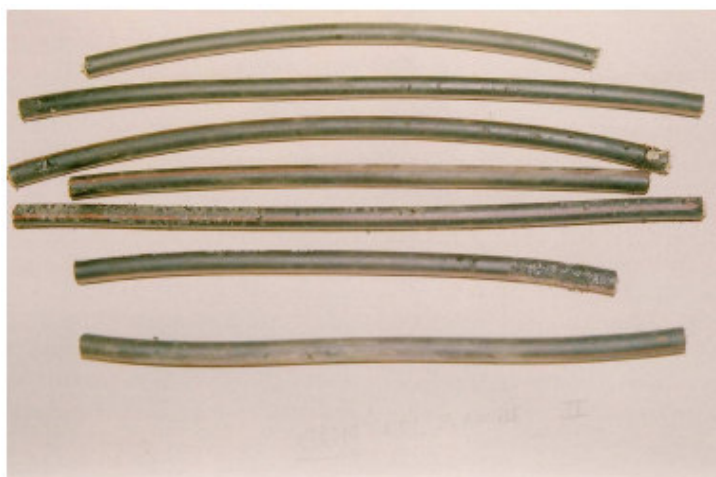


Figure 5. Controlled Sample for Anti-rodent testing

5. Conclusion

The developed eco-friendly rodent repelled optical fiber cable with extra rodent resistive protection using glass roving tape. These were extensively tested at laboratories for its Anti-rodent property, which show these cables can be used as an alternative to armored cables for easy installation & security purpose.

6. Acknowledgements

The authors gratefully acknowledge the support from “All India Network Project On Rodent Control” for conducting Anti-Rodent test at their Laboratory.

7. References

- [1] Test report: No. PC(RC)/Consult/St Op./06-07
From All India Network Project On Rodent Control.

Fiber Optic Cable

Whitepaper



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