

RODENT REPELLENT CABLE COATING DEVELOPMENT

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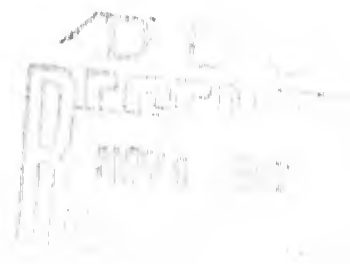
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DEVELOPMENT OF A RODENT REPELLENT CABLE COATING

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One of the unpredictable factors that can shorten the life of communication wire in the field is the gnawing by rodents. In some parts of the world, losses incurred in this way total hundreds of thousands of dollars and, in some cases, human lives are at stake. Under a contract with the U. S. Department of Interior, Bureau of Sport Fisheries & Wildlife, Denver Wildlife Research Center, M&T Chemicals, Inc. developed a rodent repellent coating for field telephone cable. This coating is designated by M&T as bioMeT[®] 12. In this joint program development, it was the responsibility of M&T to develop the coating and of the Denver Center to test it. This paper will discuss briefly our progress in the development of the coating and the laboratory and field testing of the resulting coated wire.

Coating Development

The objective of the contract was to develop a coating for WF-16 field telephone wire that would keep rodents from attacking it. Moreover, this coating needed to be effective for at least 6 months under field conditions and not interfere with the operation or functional use of the wire. The coating was to be able to withstand normal temperatures and handling, be suitable for machine application to the high-density polyethylene surface of the finished wire, and not exceed 15 pounds per mile at the thickness used.

M&T and the Denver Center had previously established that many organotin chemicals were effective rodent repellents, and a group of these compounds was selected for further testing. In developing a coating, it was necessary to determine whether combining them in coating formulations reduced their repellency. In addition, film-forming materials for the coating had to be selected not only for physical and mechanical properties, but also for chemical compatibility with the repellents. Many candidate coatings were dropped because they interfered with the repellency of the organotin compounds.

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We tested many formulations of repellents and film-forming materials to find the coating with the best repellency, adhesion to polyethylene, curing cycle, flexibility, etc. We found that the additives and the compounding sequence were very critical parts of the system, but eventually reached a formulation that, once properly compounded, was stable and trouble-free.

The final selection was a coating, plastic-based with modifiers and additives, which contained the active repellent ingredient. This coating has very good adhesion to untreated high-density polyethylene, produces a hard durable finish with enough flexibility to withstand bending around a mandrel 1 inch in diameter or smaller without spalling and, finally, does not interfere with the activity or effective life of the repellent. The properties of the film as deposited on the WF-16 wire are described below:

Appearance - Clear, transparent, pale yellow.

Thickness - Variable as desired. As used on wire, approximately 0.007-0.010 inch.

Concentration of Active Ingredient - Depending on level needed.

Adhesion - Good to untreated polyethylene.

Solubility - Insoluble in water; soluble in ketones, chlorinated hydrocarbons, and aromatics.

Weight/Mile - Less than 15 pounds on double stranded WF-16.

We used a crude hand coating device to coat about 2300 feet of double stranded WF-16 wire for field tests in the United States. An additional 3000 feet, coated by a machine process developed under this contract by the Alpha Wire Company of Elizabeth, New Jersey, was distributed for field evaluation in Panama. Electrical characteristics of the control wire were measured and accepted by Electronics Command personnel at Fort Monmouth.

Laboratory Tests

Initially, candidate repellents were compounded in different base stocks and tested on burlap bags. Candidate formulations were applied at various concentrations onto 4 x 4 inch burlap bags that were filled with standard rodent rations. Similar untreated bags were used as controls. Ten bags of each formulation were placed overnight with 10 individually caged house

to feed on the yuccas. The animals make definite trails from which they rarely deviate. When a wire, cable, or anything else crosses these trails, the rat attempts to move it, thereby inflicting the damage. Forty active wood rat nests were selected from a group known to contain active wire cutters. We distributed the wire treatments randomly among these nests and placed the wires around their perimeters, making certain that one or more rat trails were intercepted.

Fort Devens - The test site at Fort Devens is an abandoned field with a heavy growth of native grasses. The field is heavily populated with meadow mice (Microtus). Forty wires were placed in the field, threaded through matted grass to intercept the Microtus trails. The cables are being checked by personnel of the Division of Wildlife Services, also of the Bureau of Sport Fisheries & Wildlife, who were instructed in the method of recording damage.

Panama - Because of our current military action in Vietnam, protection of communication wire in regions of tropical flora and fauna has become important. The nearest test facility with environmental conditions approximating those found in Vietnam is Panama, where the U. S. Army maintains the Tropic Test Center. Species of rodents are undoubtedly different in the two areas, but the Electronics Command was experiencing mammal damage on their facilities in Panama and requested that a repellent test be set up there. A path was hacked through the jungle and the line of wires was laid on the ground when possible, or partially suspended by grass. Since monthly travel to Panama is impractical, personnel of the Tropic Test Center are making the monthly examinations and taking the wire samples.

Ten months' data on animal attack are available for the three tests in the United States and 6 months' data for the Canal Zone. The results through September 1967 are shown in Table 1. Animal attack is judged by two categories of damage:

Category 1 - Slight to moderate damage. The conductors are exposed but undamaged.

Category 2 - Severe to complete cut. Conductors are damaged or completely severed and a splice is required.

In addition, wire samples were analyzed monthly to determine if exposure to weather caused loss of the active ingredient. In Table 2, the tabulation of these data shows erratic results for all locations except Panama. The probable explanation of this

is quite simple. Because of schedule demands, the wire used at Fort Devens, Strauss, and Fort Huachuca was hand coated with a crude applicator and air dried only. It was later determined that the coating was rather uneven and that a considerable amount of solvent was retained in the air dried film, reducing its adhesion to the wire. Consequently, small amounts of the film were sometimes mechanically removed by handling and exposure, and the results of analyzing any given length would vary according to the amount of original coating. In two cases, unusually thick coatings on the samples resulted in apparent increases in active ingredient. In contrast, the wire sent to Panama was coated mechanically and oven cured, thereby ensuring a more even coating. This wire has full adhesion strength, and has not exhibited handling or service losses. Therefore, as expected, loss of active ingredient due to environmental exposure has been very low. In spite of considerable mechanical loss of repellent from the hand coated cable, both it and the machine coated cable have maintained very effective repellency.

Conclusions

From these tests we learned that certain organotin chemicals when properly and carefully compounded into a suitable coating are very useful in reducing rodent attack on field telephone wire such as WF-16. Since the data are incomplete, no statistical analysis is available and we are making our statements from inspection only. The data indicate that about 90% reduction in category 1 is possible with this treatment and that even less serious damage occurs in category 2. Also, several species can be controlled by this treatment, and complete protection from category 2 damage may be possible for at least these species.

One puzzling feature is the effect of the coating mixture. Alone, it seems as repellent as the low concentration treatment. In the laboratory, it repelled house mice, but had little effect on Norway rats. However, it does contain a great deal of chlorine, which is known to be a mammal repellent. It remains to be seen how long the coating mixture will continue to repel rodents. However, when a more active ingredient is added to it, there appears to be a definite decrease in damage between it and the other treatments.

Obviously, not all mammals potentially harmful to wire have been tested, but it is possible that other species may be repelled as well. So far, considering the rodent repellency and the coated

wire's continued effectiveness even with environmental exposure, we expect that this treatment will be effective for at least a year and possibly longer. In any event, this work has demonstrated the feasibility of rodent repellency on polyethylene coated wire, and in addition a mechanical method for coating has proved practical.

TABLE 1

Chemically Treated and Untreated WF-16 Communication Wire Tested for Rodent Damage in Continental U.S. for 10 months and Panama for 6 months (40 wires per test area)

Location	Untreated Wires		Base Stock Mixture Only		Low Concentration bioMeT* 12		High Concentration bioMeT* 12					
	<u>No. of Cuts</u> 1 2	<u>No. Wires Damaged</u>	<u>No. of Cuts</u> 1 2	<u>No. Wires Damaged</u>	<u>No. of Cuts</u> 1 2	<u>No. Wires Damaged</u>	<u>No. of Cuts</u> 1 2	<u>No. Wires Damaged</u>				
Strauss, N.M.	604	7	52	109	0	26	80	0	19	53	0	13
Ft. Huachuca, Ariz. ²	32	0	12	54	0	19	24	0	11	5	0	2
Ft. Devens, Mass. ³	<u>322</u>	<u>9</u>	<u>18</u>	<u>32</u>	<u>0</u>	<u>6</u>	<u>57</u>	<u>17</u>	<u>6</u>	<u>21</u>	<u>0</u>	<u>4</u>
	958	16	82	195	0	51	161	17	36	79	0	19
Galeta Point, Panama Canal Zone	168	42	3	0	0	0	0	0	0	0	0	0

¹ Category 1 - Slight to moderate damage - conductors undamaged, but exposed.
² Category 2 - Severe to complete cut - conductors damaged or completely severed, requiring splice.

³ 30 wires destroyed by fire July 3, 1967.

⁴ 7 wires removed by troops May 1, 1967.

TABLE 2

Time and Temperature Effects on Concentration of Active Repellent Ingredients in Coated Wire (samples taken from different cables when possible)

Location	Temp. (°F)		Percent Decrease in Original Concentration After Months of Exposure								
	Min.	Max.	1	2	3	4	5	6	7	8	9
Strauss, N.M.	-2	128	5.5	39.6	17.5	6.5	15.9	9.5	21.6	14.8	14.8
	7	124	5.4	35.0	17.5	5.7	12.3	+23.5*	20.0	10.0	14.0
	2	103	29.5	23.5	12.5	6.4	13.9	15.5	19.7	15.9	6.4
Galeta Point, Panama Canal Zone	71	106	1.2	1.2	-	7.2	+9.2*	-	-	7.8	-
Strauss, N.M.			7.7	42.0	25.0	29.5	24.0	24.4	24.4	21.7	33.4
			17.3	40.0	25.0	29.0	24.0	22.7	22.7	34.0	27.5
			38.5	28.8	18.4	17.0	25.6	18.5	23.2	31.5	20.0
Galeta Point, Panama Canal Zone			1.8	0.3	-	5.0	5.0	-	-	7.8	-

* Sample showed increase in concentration.