



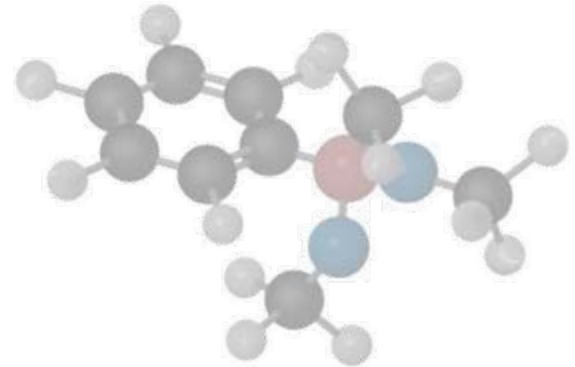
A Chemical and Electrical Analysis of Aged CableCURE Rejuvenated Cables

ICC November 5th, 2007 Scottsdale, AZ

Wayne Chatterton Ph.D.

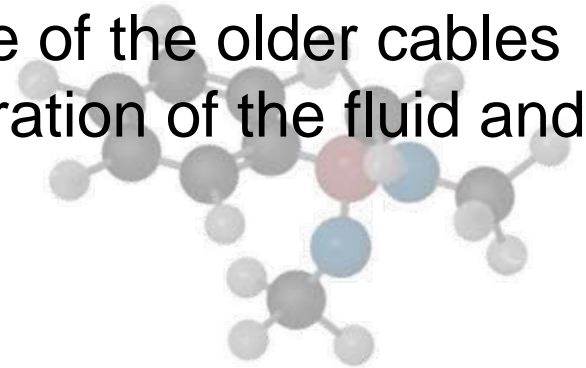
James Steele

Utilix Corporation



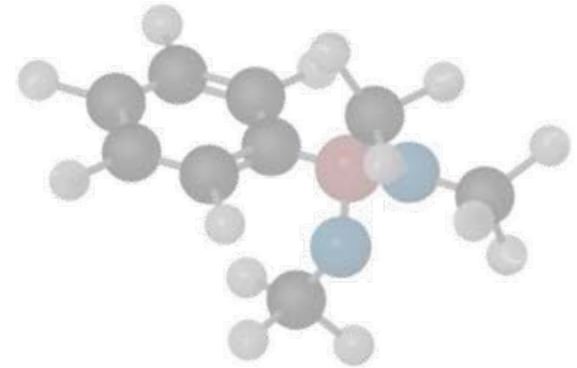
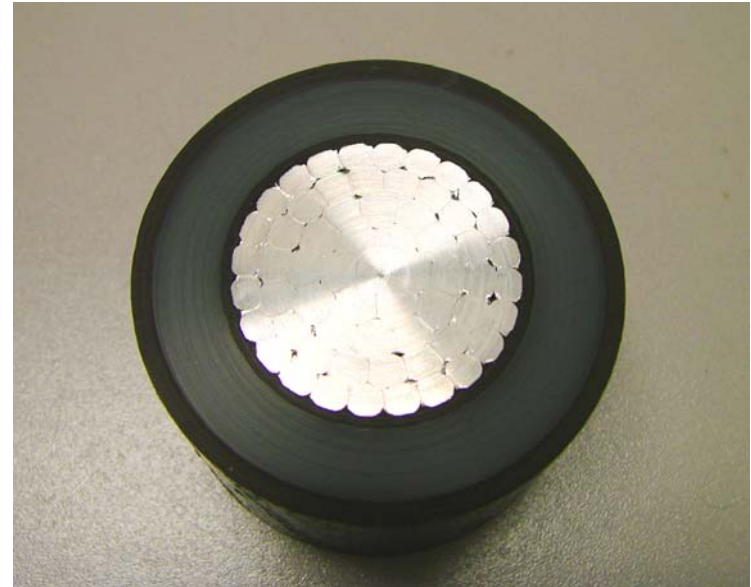
A Brief History

- Dow Corning started Silicone injection and chemical studies in 1985
- The material of interest after much lab experimentation was phenylmethyldimethoxysilane
- Full scale commercial trials and injections began in January 1989
- There is now a long history of injections with over 80 million feet of cable treated so far
- This presentation will look at a couple of the older cables with an emphasis on chemical penetration of the fluid and electrical properties of the cable



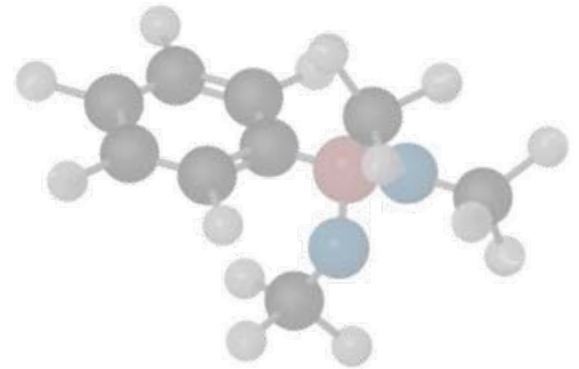
Case Study #1: Dominion Power (Formerly Virginia Power)

- 1000kcmil AL
(manufactured in 1973)
- 260mil XLPE insulation (35 kV rated)
- Fabric strand shield with extruded overlayer
- Bonded insulation shield
- Copper concentric neutrals
- Unjacketed

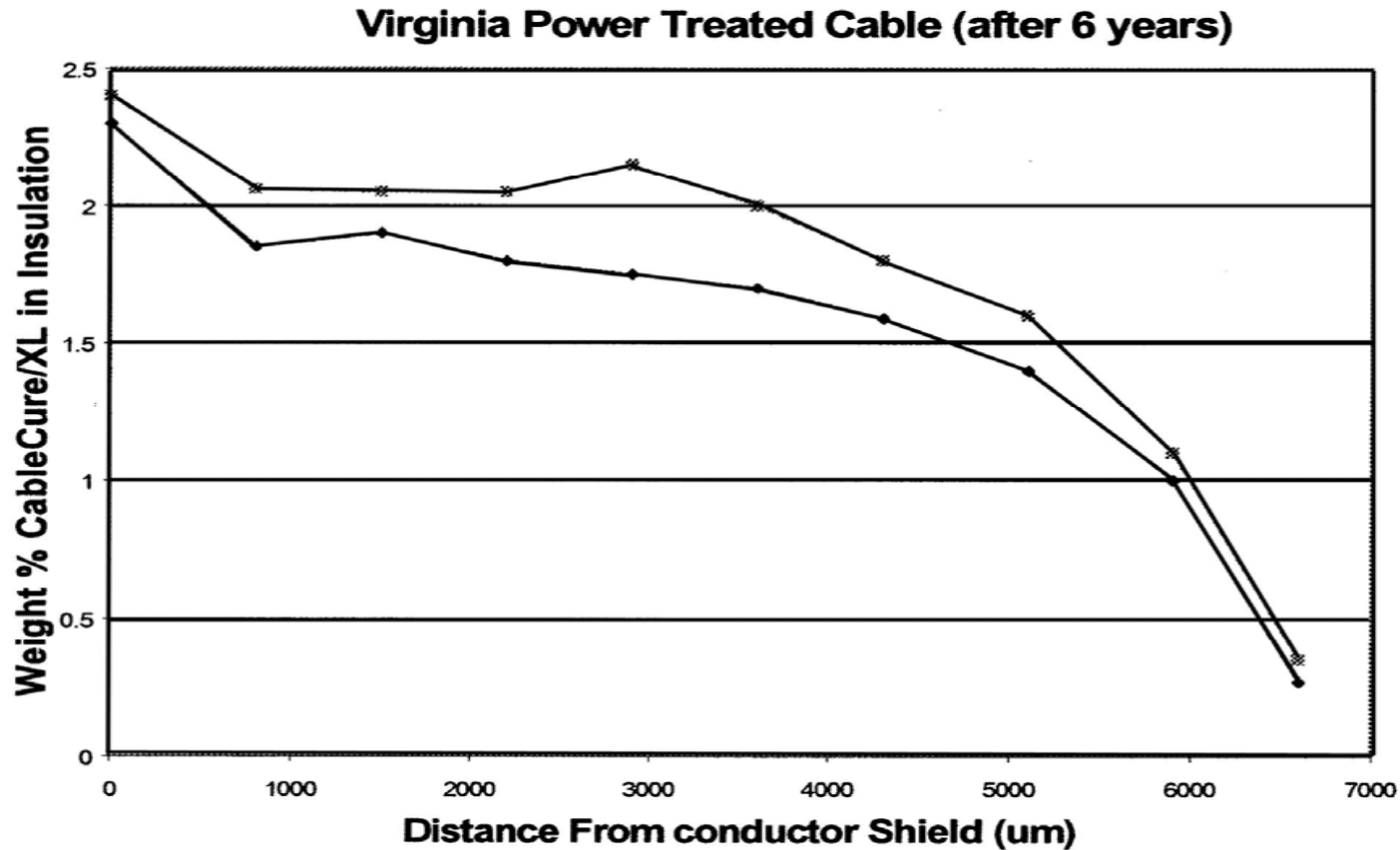


Case Study #1: Dominion Power

- Injected 13 years ago
- Total cable aging of 33 years
- Cables were unloaded but remained energized underground
- Samples Tested at 6 and 13 years after silicone injection

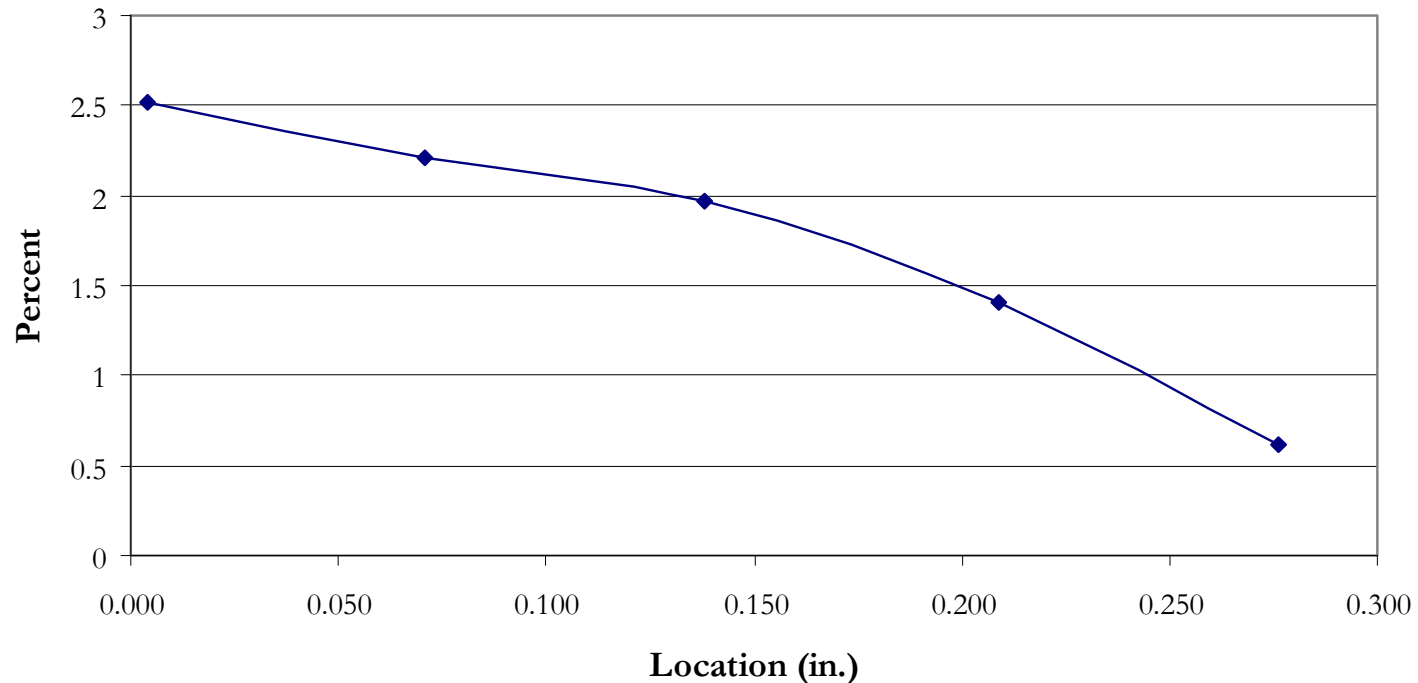


Case Study #1: Dominion Power (Micro IR 6 years after treatment)

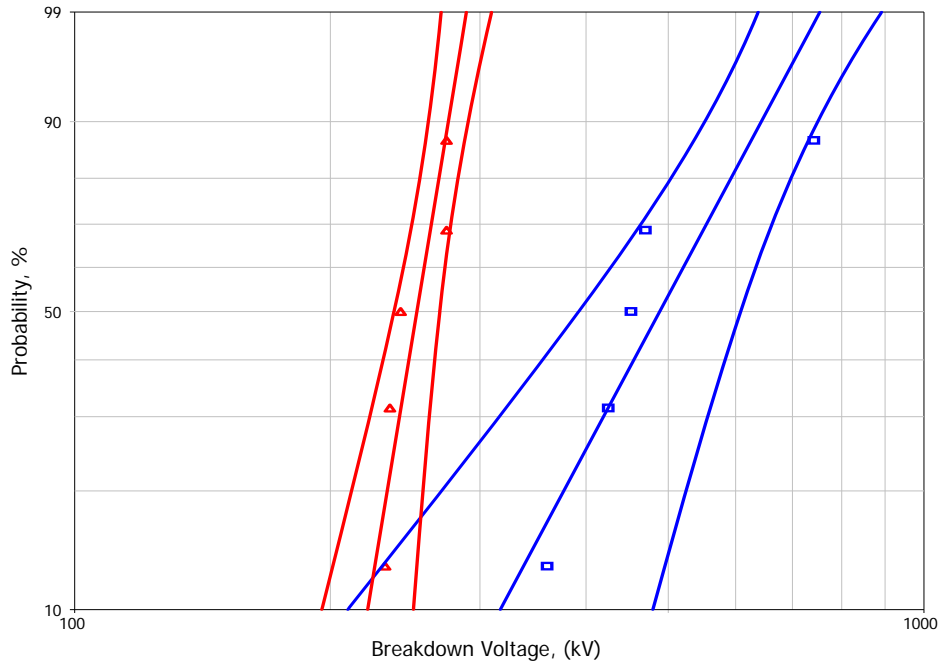


Case Study #1: Dominion Power (Micro IR 13 years after treatment)

**% PhMeSi(OMe)₂ to Polyethylene vs.
Position from I.D. to O.D.**

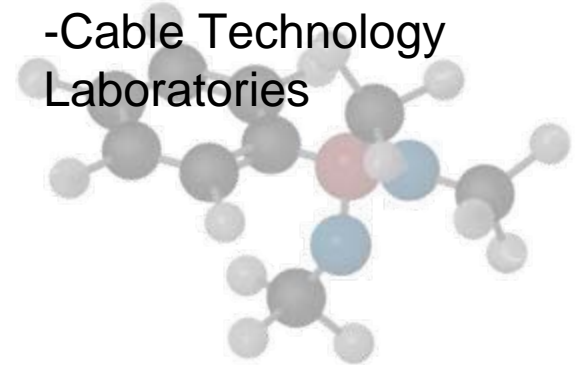


Case Study #1: Dominion Power (AC Breakdown Data after 6 years)

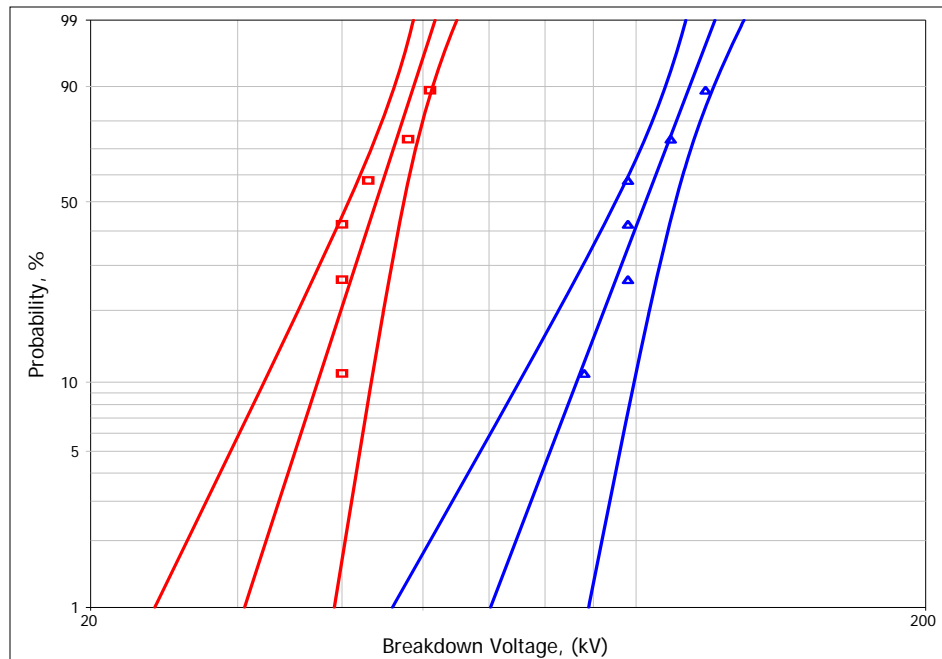


“What appears to be important is that vented trees growing from the conductor shield in the red (untreated) phase are significantly larger than those in the treated phases. This fact implies that injection reduced (or even stopped) the tree growth.”

-Cable Technology
Laboratories

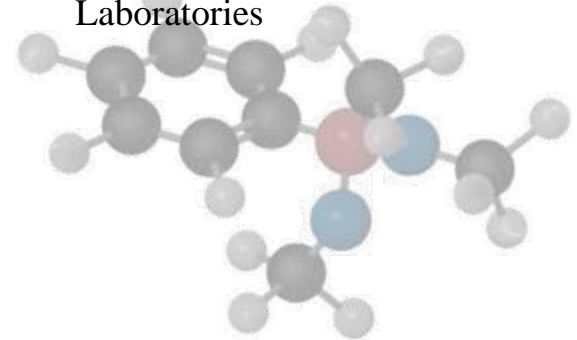


Case Study #1: Dominion Power (AC Breakdown Data after 13 years)



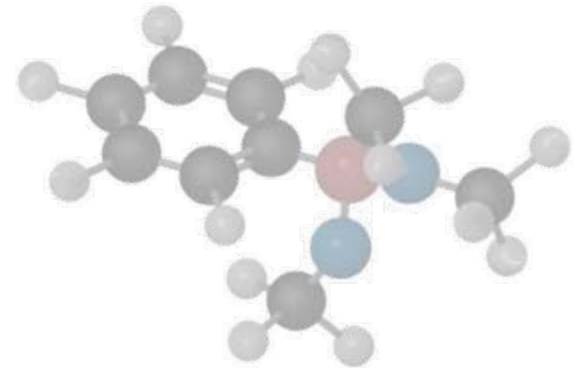
“Comparative evaluation of service aged cable sections – from the phase aged without treatment and from those impregnated... indicated significant improvement in the cable dielectric strength caused by rejuvenation. At present, this characteristic of the treated cable is still twice as good as that of the untreated cable.”

-Cable Technology
Laboratories



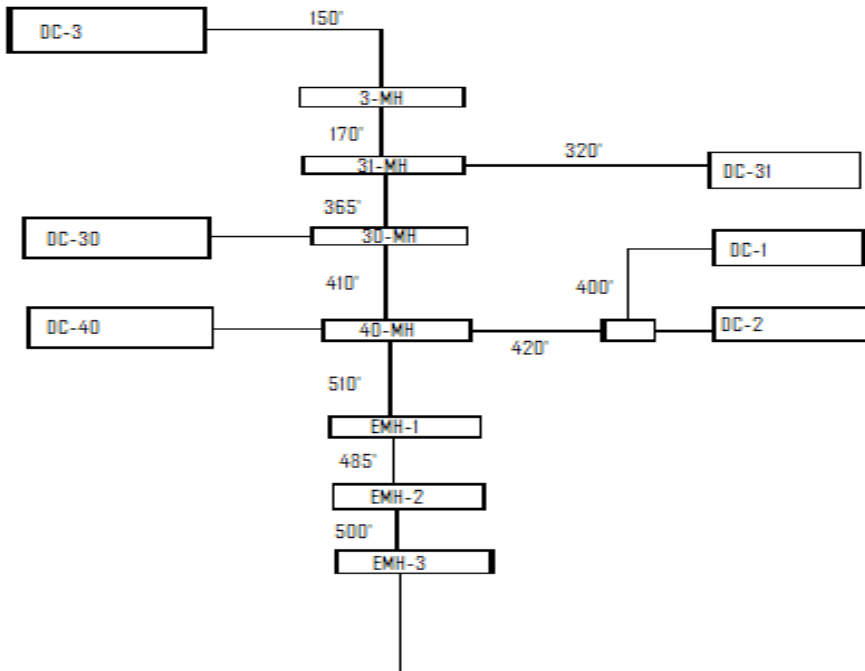
Case Study #2: Dow Corning

- 500kcmil CU
- Manufactured by Rome Cable (1968)
- 175mil XLPE, 15kV
- Extruded conductor shield
- Fabric insulation shield
- Copper drain wires
- Jacketed



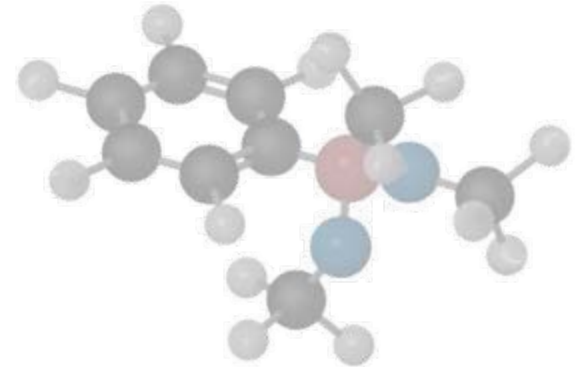
Case Study #2: Dow Corning

Dow Corning Corporate Site



4 more transformers and 2 more buildings

- Injected in January 1989
- Removed in August 2007 (18.5 years)
- 510 circuit feet (40-MH To EMH-1)
- Cable was still loaded prior to being removed

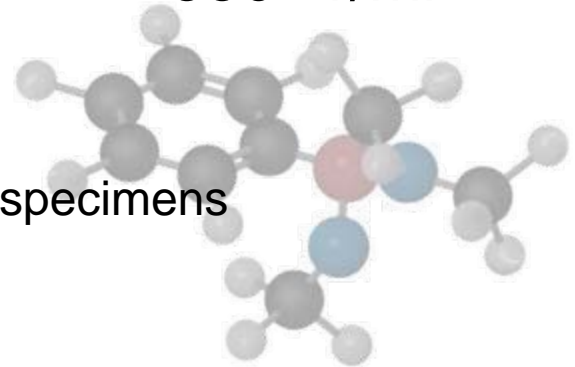


Case Study #2: Dow Corning (Early AC Breakdown Results)

A sample of this cable was tested prior to treatment and then at 1 and 2 months of aging in a water bath.

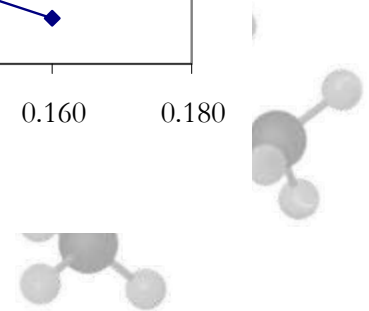
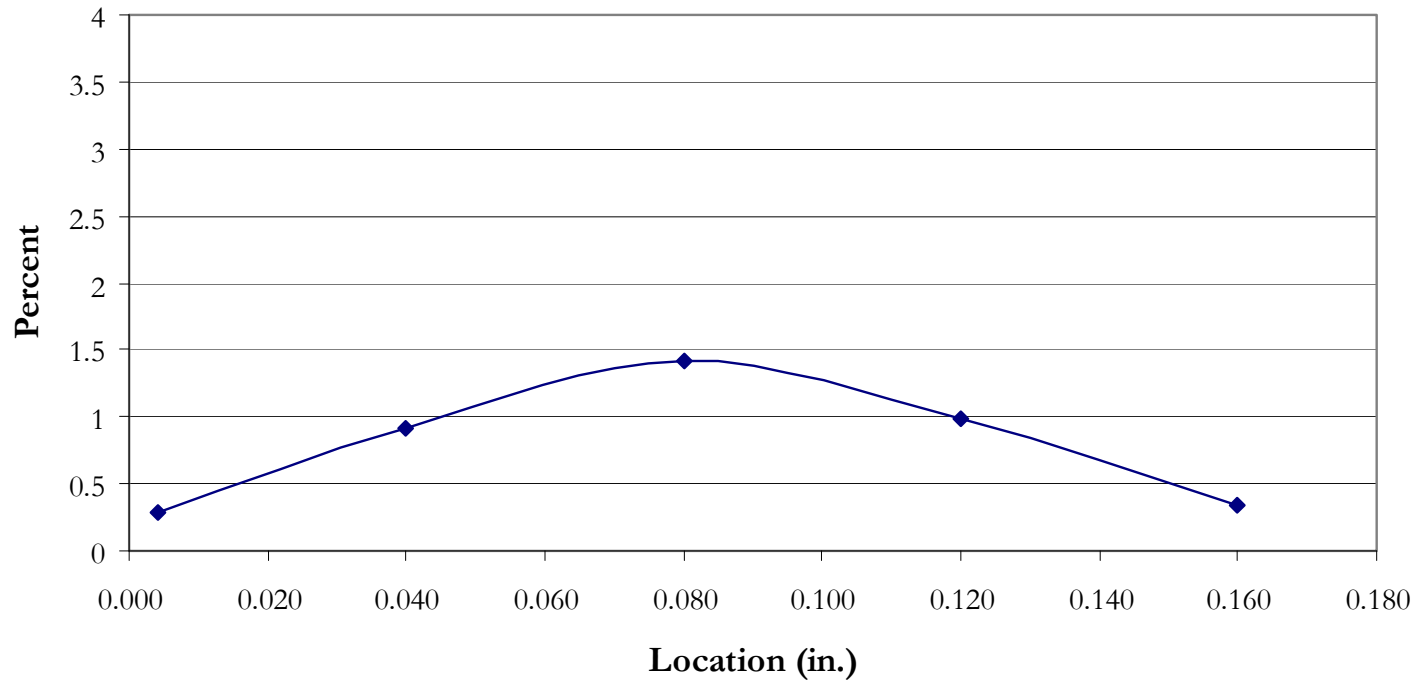
Uninjected (conditioned for 2 weeks)	210* v/mil
1 Month after treatment	310* v/mil
2 Months after treatment	350* v/mil

*All results are an average of 3 test specimens



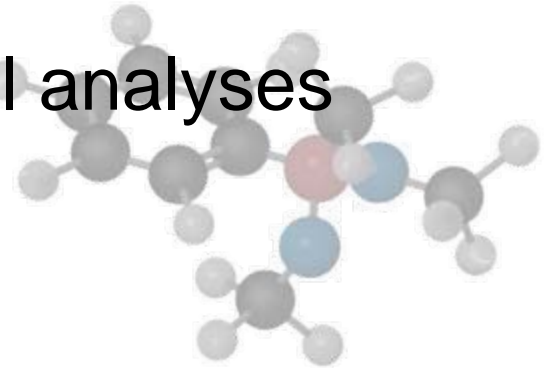
Case Study #2: Dow Corning (Micro IR 18.5 years after treatment)

% PhMeSi(OMe)₂ to Polyethylene vs.
Position from I.D. to O.D.



Case Study #2: Dow Corning (Future Work)

- Sample just recovered this summer and more extensive testing is planned
 - Full battery of electrical testing (ac breakdown, volume resistivity, tan delta, etc.)
 - Long term accelerated aging (ICEA-S-94-649-2004 Section 10.1.6)
 - Further Micro IR and chemical analyses



Conclusions

- Early historical data is starting to become available
- Early field treated cables show the presence and benefits of silicone fluid in the insulation
- These cables are still viable and it is not known how long they would have lasted had they been left in service

