

# **PROTECTION OF STRUCTURAL CONCRETE SUBSTRUCTURES**

**FINAL REPORT  
IOWA HIGHWAY RESEARCH BOARD  
PROJECT HR-220**

**DECEMBER 1992**

Highway Division



**Iowa Department  
of Transportation**

Protection of Structural Concrete Substructures

Final Report  
for  
Iowa Highway Research Board  
Research Project HR-220

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8. ABSTRACT

The corrosion of reinforcing steel within concrete has always been a problem in construction of bridge decks. With low slump concrete and epoxy rebar, progress has been made in controlling the corrosion.

There is concern, however, that the chloride also attacks the substructures, specifically the pier columns. They are subject to chloride attack by chemical deicers in the drainage from the bridge deck. Piers supporting grade separation bridges are also subject to chlorides contained in the direct splash from the lower level traffic.

In this project, a field evaluation was conducted to evaluate the effectiveness of commercially available products in preventing chloride intrusion.

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Corrosion, reinforcing steel, chloride penetration, deicing salt, concrete sealers, concrete coatings	16

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DISCLAIMER

The contents of this report reflect the views of the author and do not necessarily reflect the official views of the Iowa Department of Transportation. This report does not constitute any standard, specification or regulation.

## INTRODUCTION

In the past, many pier columns were deteriorating due to attack by chlorides. The chloride (from deicers) has attacked the substructures by drainage from the superstructure. Piers supporting grade separation bridges are also subject to chlorides contained in the direct splash from lower level traffic. Repairs of these piers are both difficult and costly.

In this project, four different sealants were applied to piers to evaluate their use in the protection of the concrete against chloride-ions. One pier was left untreated to use as a control pier with which to compare the protected piers.

This project began in 1980 and was to be completed in 1985, but at that time it was determined further testing was needed to make a more conclusive evaluation.

## PROJECT OBJECTIVE

The objective of this project was to conduct field tests to determine the long-term effectiveness of several available products or procedures as to their ability to protect concrete surfaces against the intrusion of chloride-ions.

**PROJECT LOCATION**

This project was located on I-380 in Cedar Rapids. The research was done on two pier columns at 27th Avenue Southwest and three pier columns at Wilson Avenue Southwest.

**MATERIALS**

Four of the five columns tested had been coated with different sealants. One column received no treatment and was used as a control column. The five columns, locations and their treatment are listed below:

Column No. 1 - 27th Avenue, one coat of PE50 penetrating epoxy sealer manufactured by Steelcote Manufacturing Company.

Column No. 2 - 27th Avenue, two coats of TE 3008 penetrating epoxy sealer manufactured by Technical Sealants and Adhesives, Inc.

Column No. 3 - Wilson Avenue, one coat of Niklepoxy penetrating epoxy sealer manufactured by Rocky Mountain Chemical Company.

Column No. 4 - Wilson Avenue, received no treatment. It was the control column.

Column No. 5 - Wilson Avenue, one coat of Chem Trete Silane, a product imported from Germany and distributed by Dynamit Nobel of America, Inc.

**TESTING**

Tests were conducted on cores from the lowest elevation available at each column and at three foot intervals above the lowest core obtained. The concrete cores were cut into samples, each representing one-half inch of depth of the concrete from which the core was extracted.

Cores were taken and testing was conducted when the project was constructed and again in 1981, 1982, 1984 and 1991.

Graphs are located in the appendix showing the chloride content at different levels in the pier columns for each treatment. Two graphs were also made showing how the different treatments compared at the 3 ft. and 0 ft. elevations at 3/4" depth of the core.

**EVALUATION**

The control column did show slightly higher chloride content in most cases, especially at the 1/4" and 3/4" depths. This was not true compared with all the sealants and there were no major differences in any of the readings. In most cases, the 0 ft. and 3 ft. levels showed more chloride content than the higher levels but again the difference was only slight.

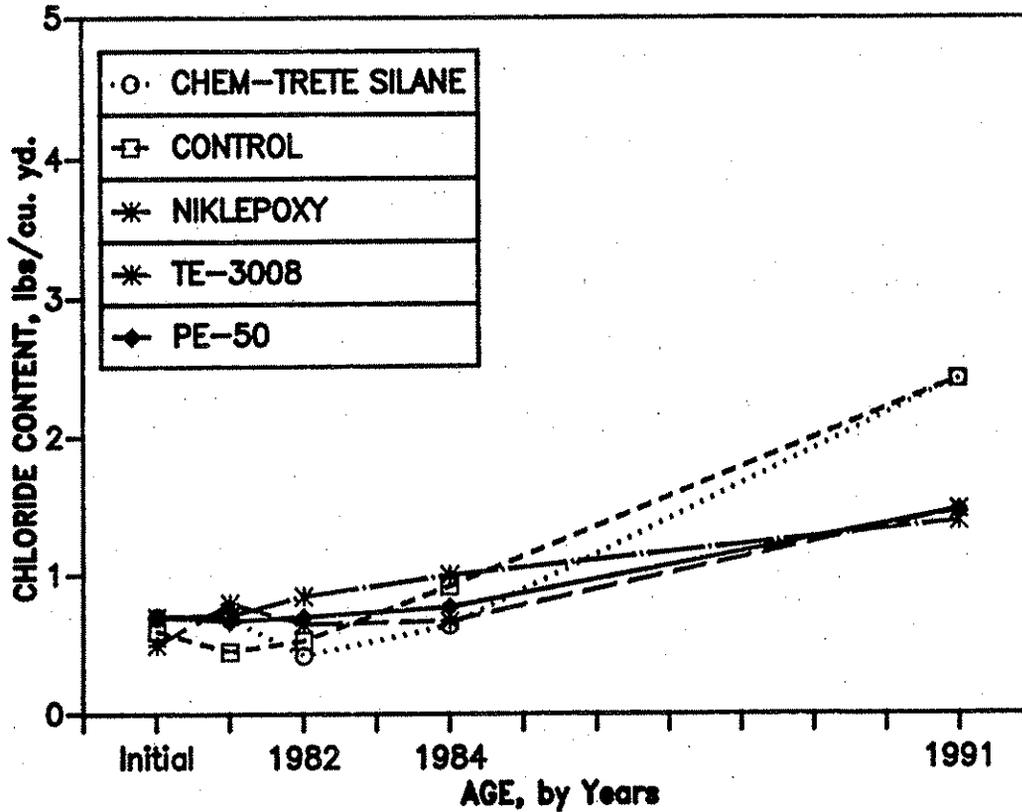
**CONCLUSIONS**

1. Intrusion of chloride-ions does occur in column piers that are subject to splash from adjacent roadway traffic. This appears worse at lower elevations.
2. The sealants did not prevent the penetration of chloride-ion, but did retard the penetration of chloride-ion.

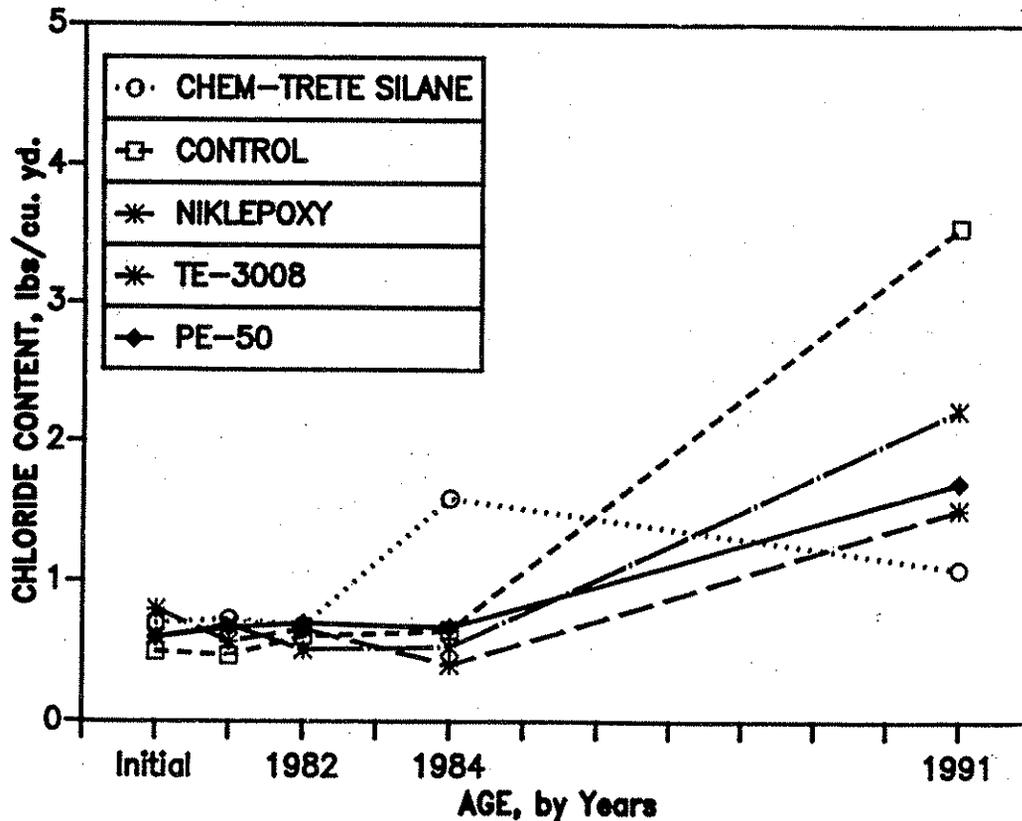
Appendix A  
Chloride Penetration of  
Pier Columns by Age  
and Sealer

# 3\4" at ZERO ELEVATION

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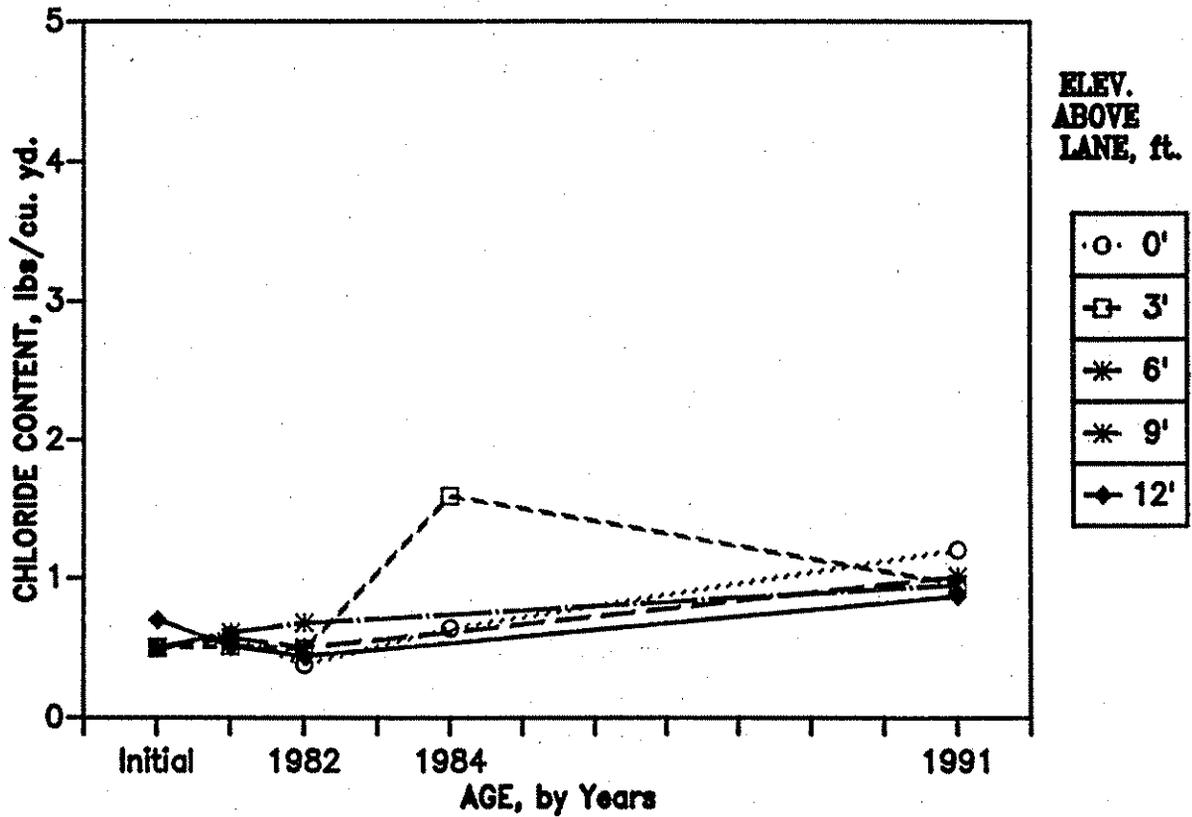


# 3\4" at 3' ELEVATION

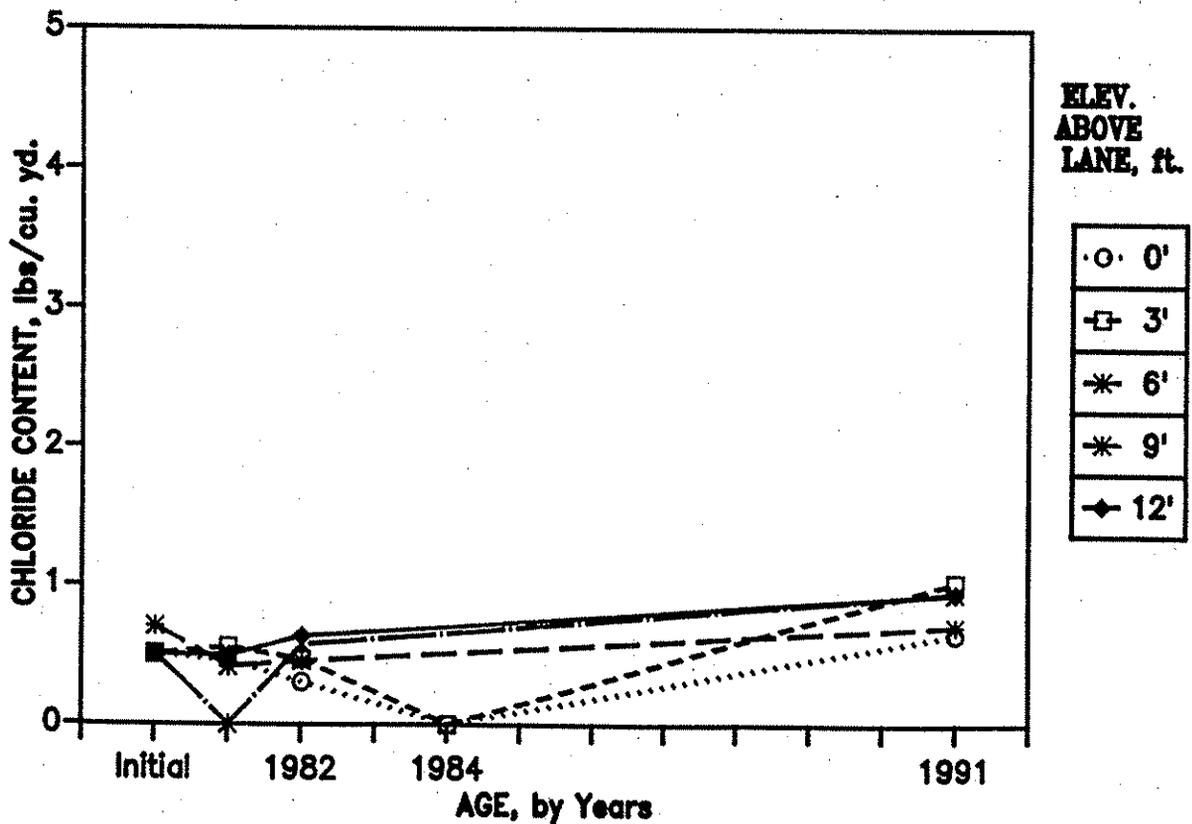


# 1-1/4 CHEM-TRETE SILANE

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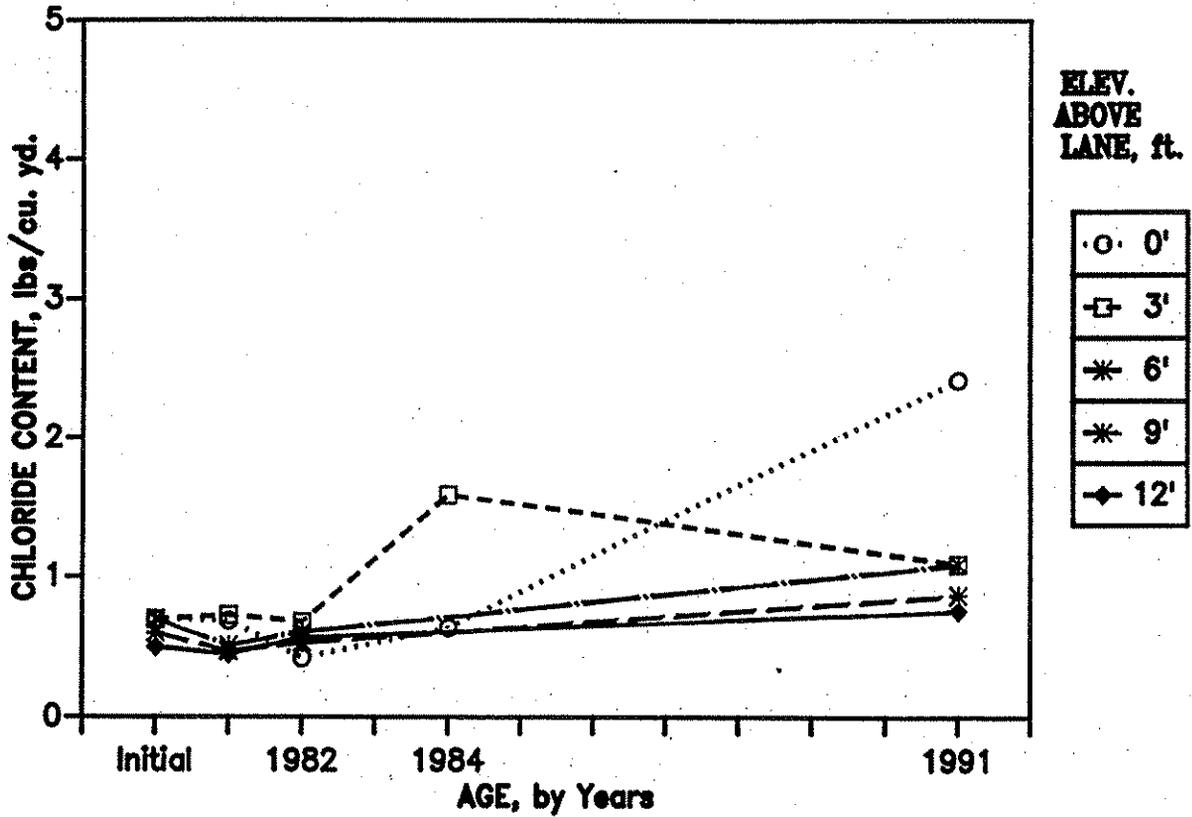


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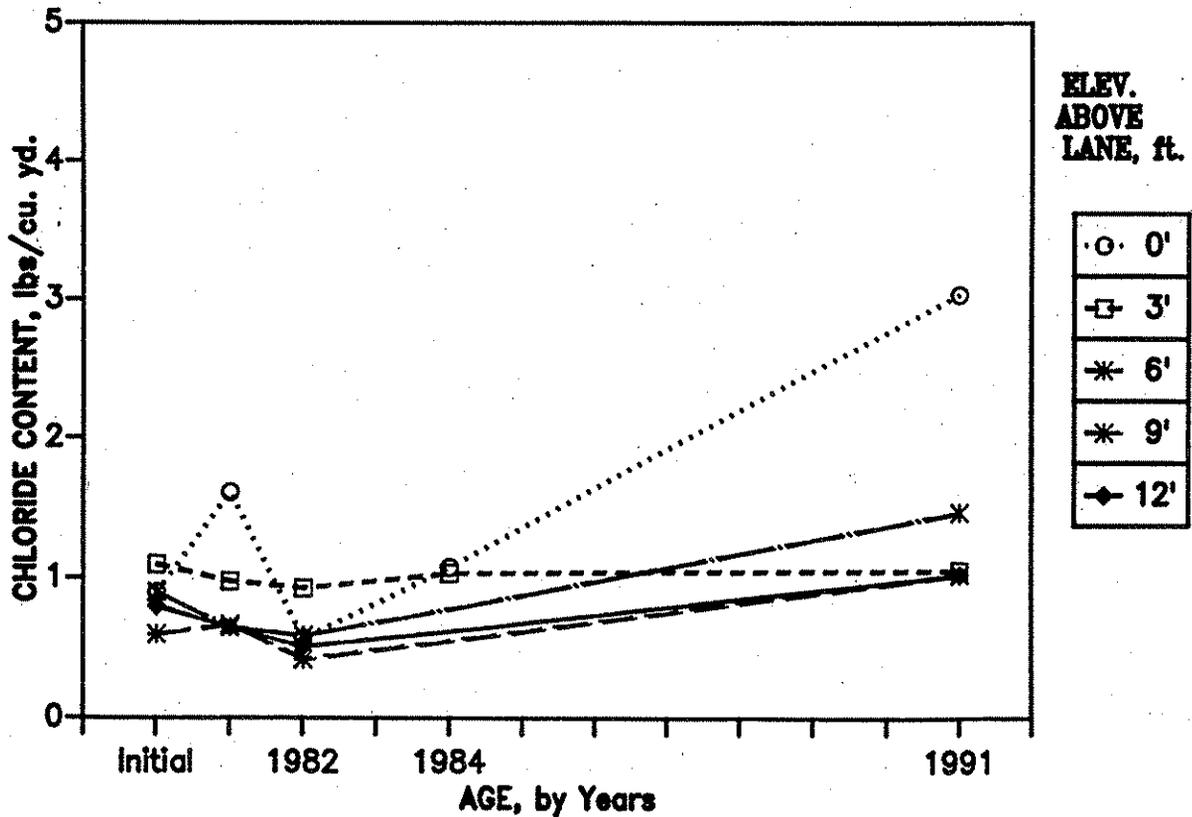


# 3\4" CHEM-TRETE SILANE

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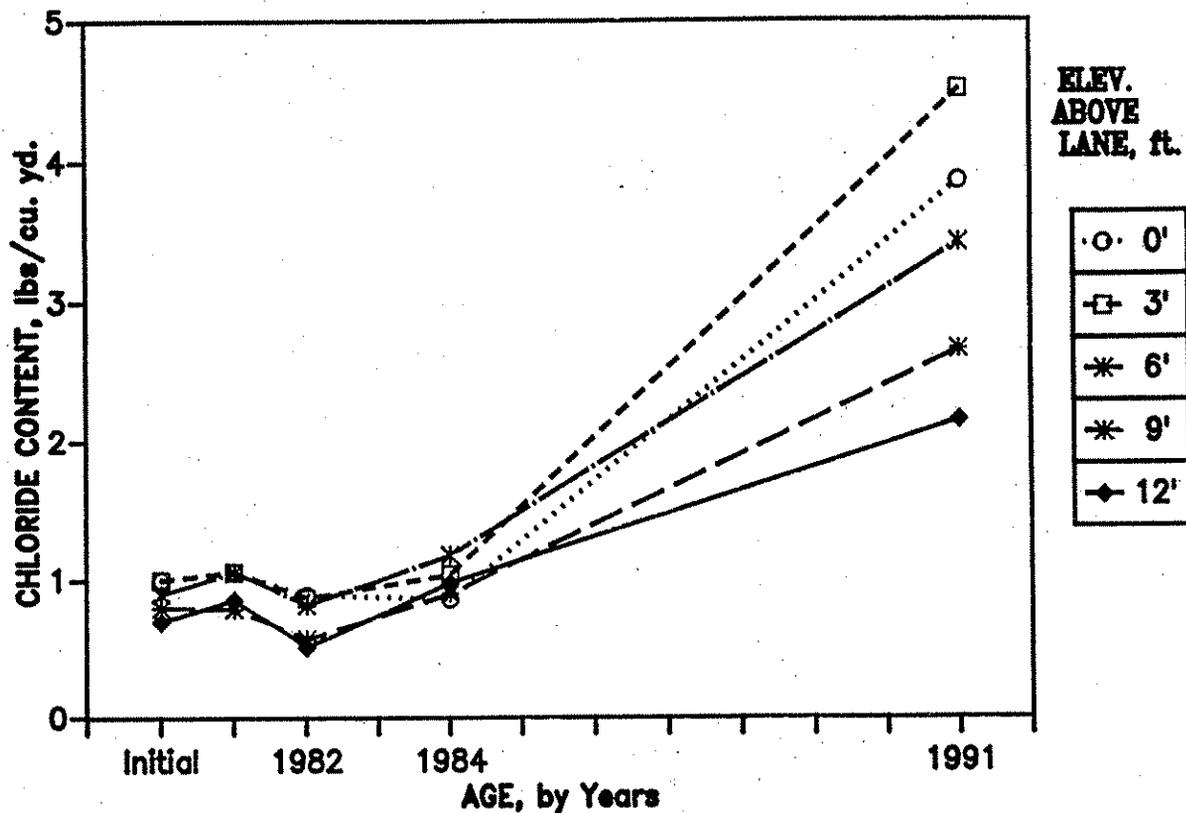


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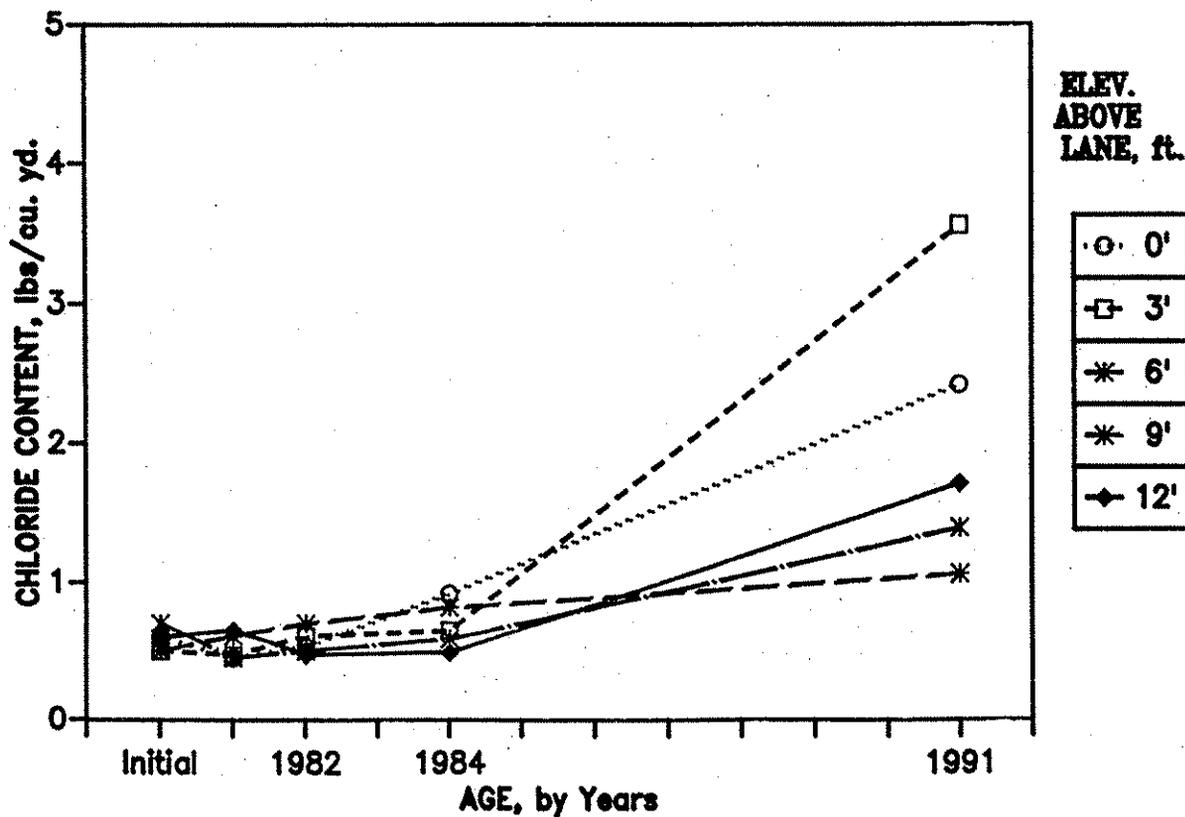


# 1/4" CONTROL

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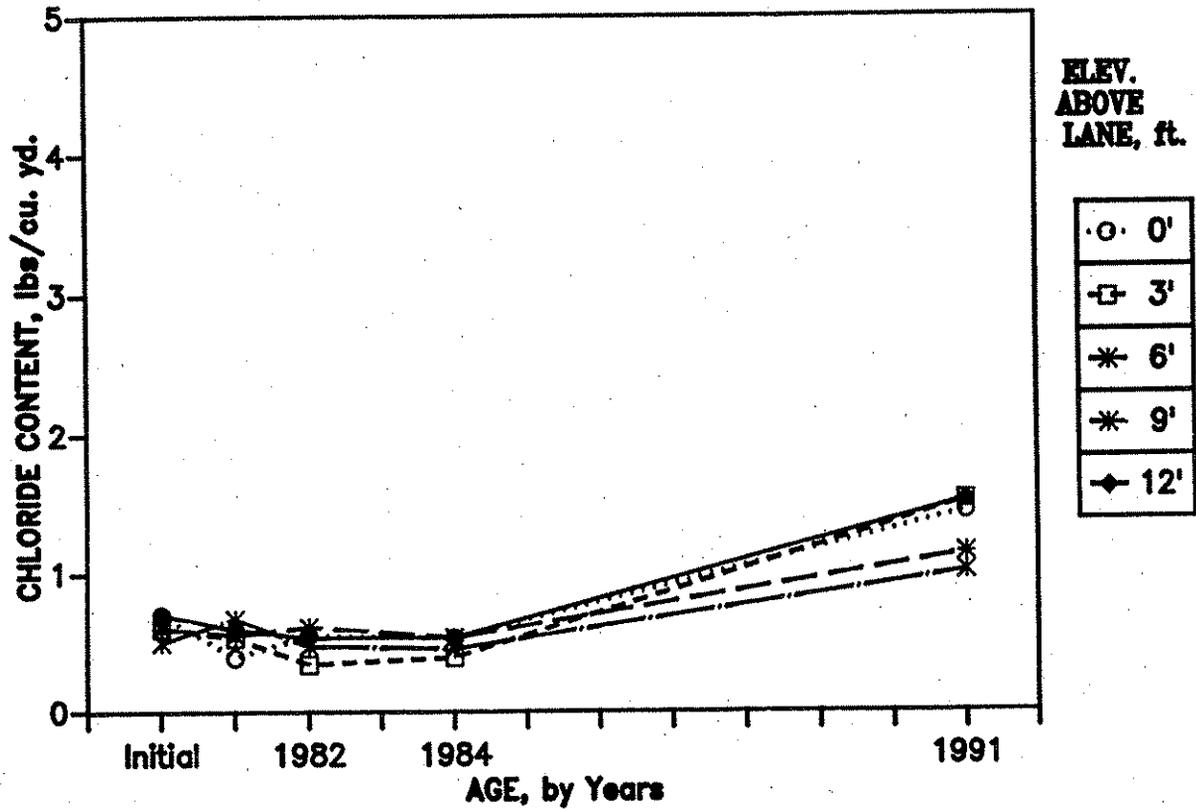


# 3/4" CONTROL

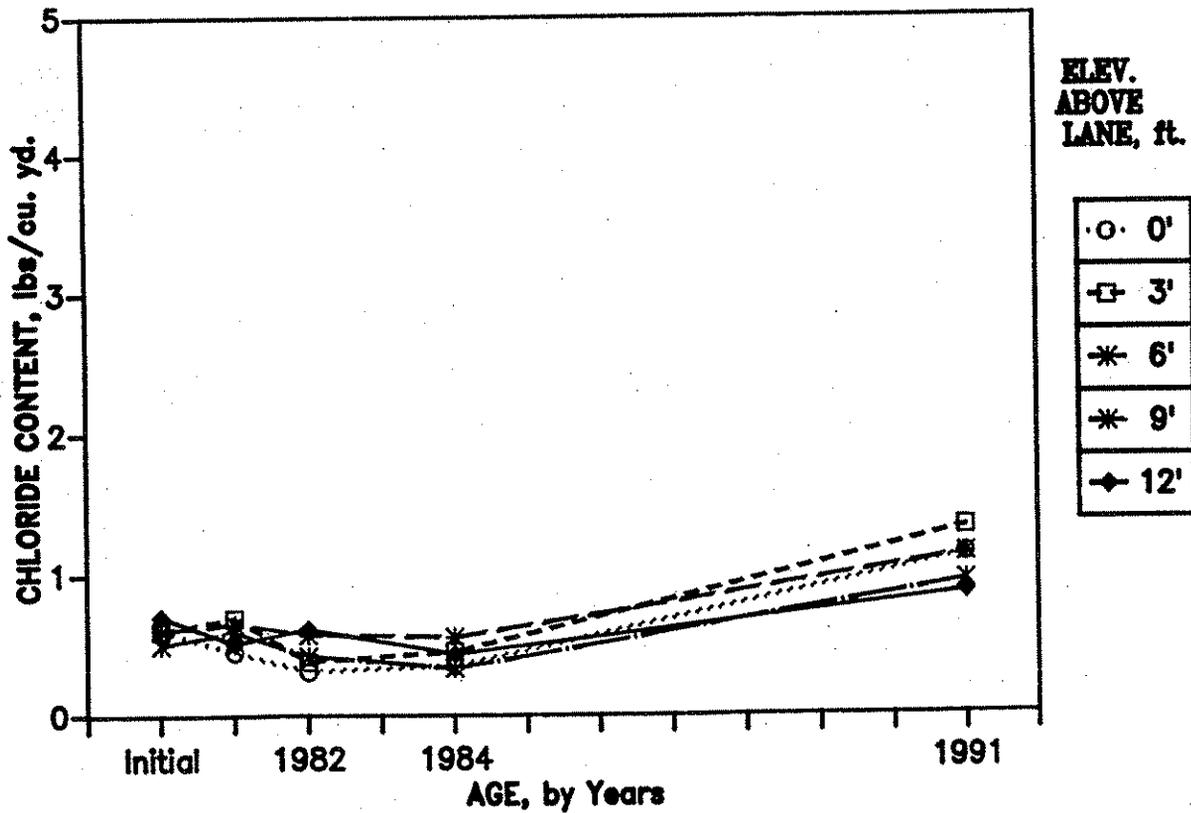


# 1-1/4" CONTROL

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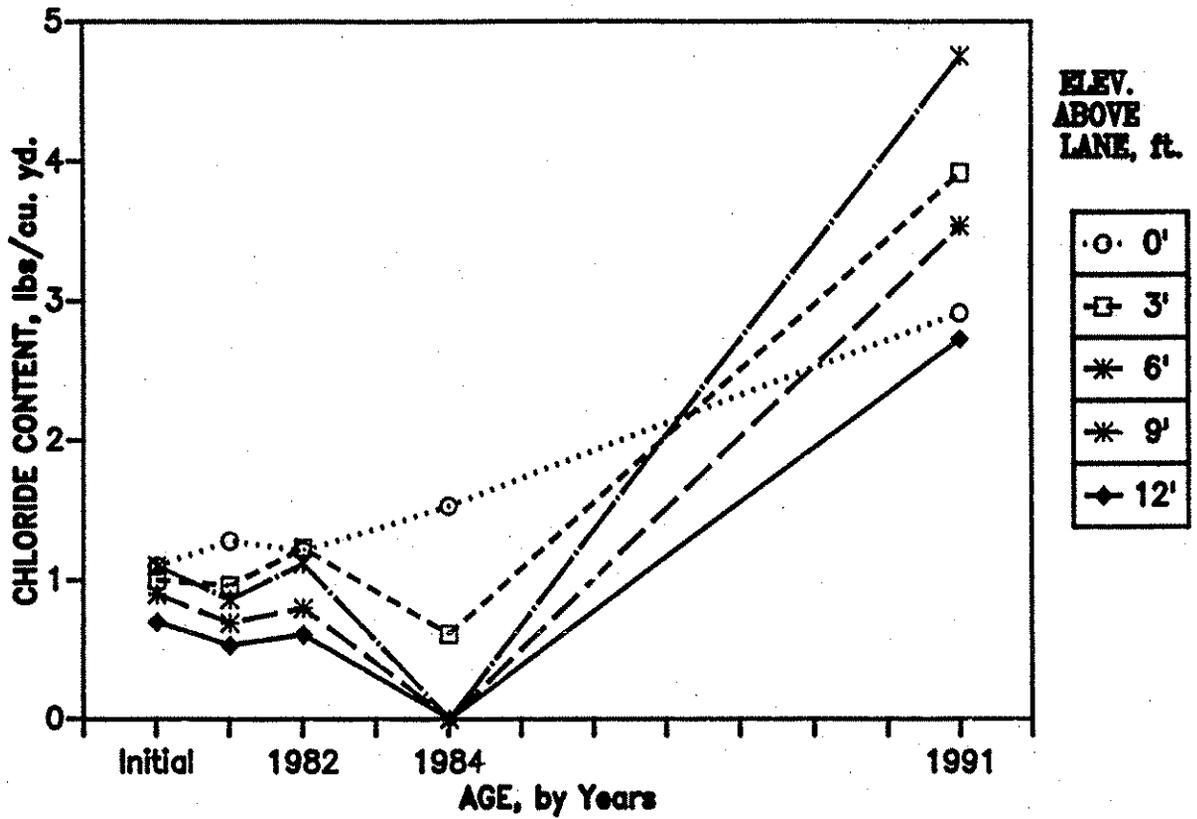


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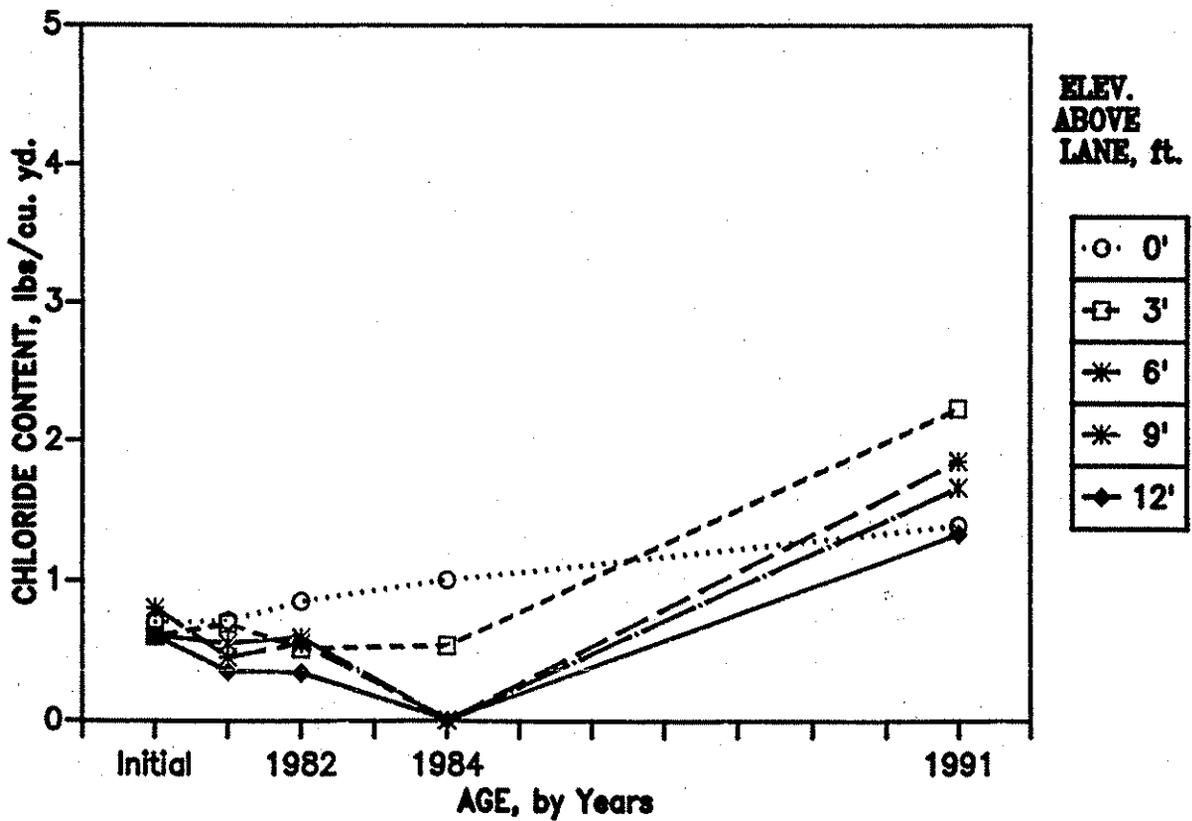


# 1/4" NIKLEPOXY

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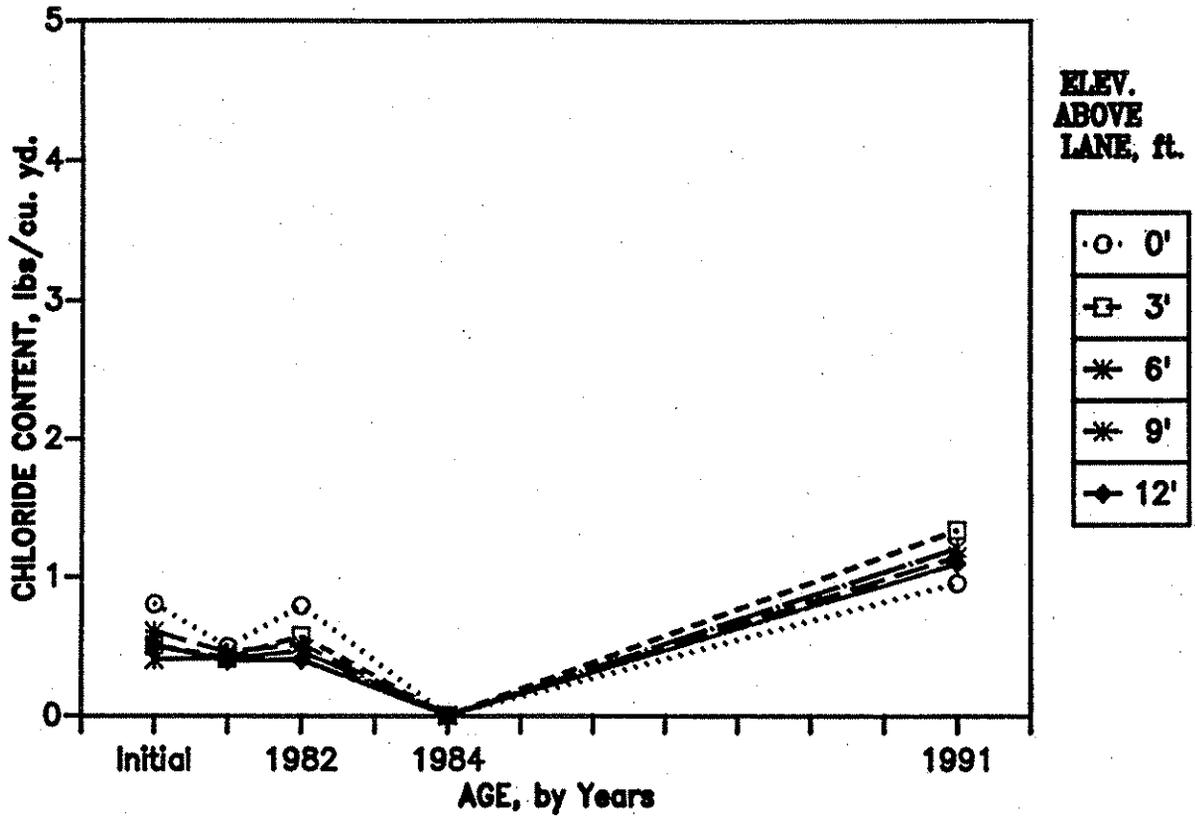


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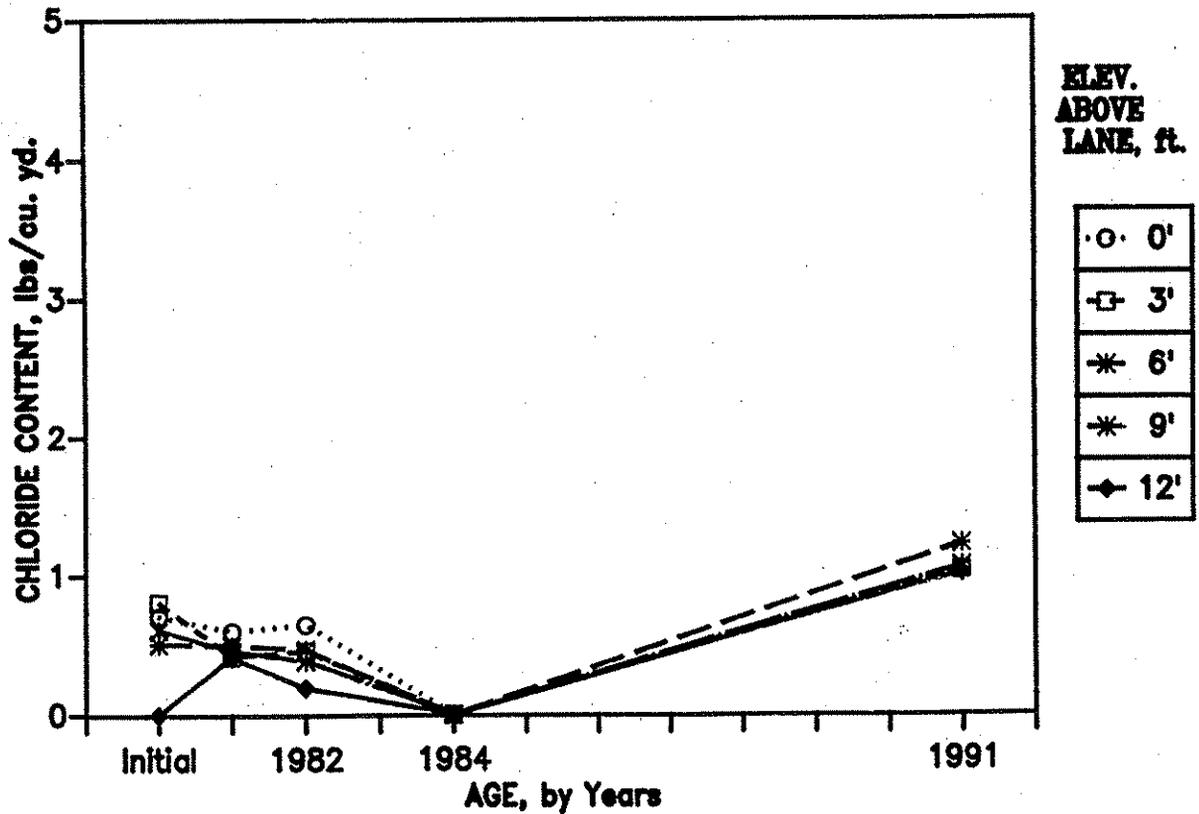


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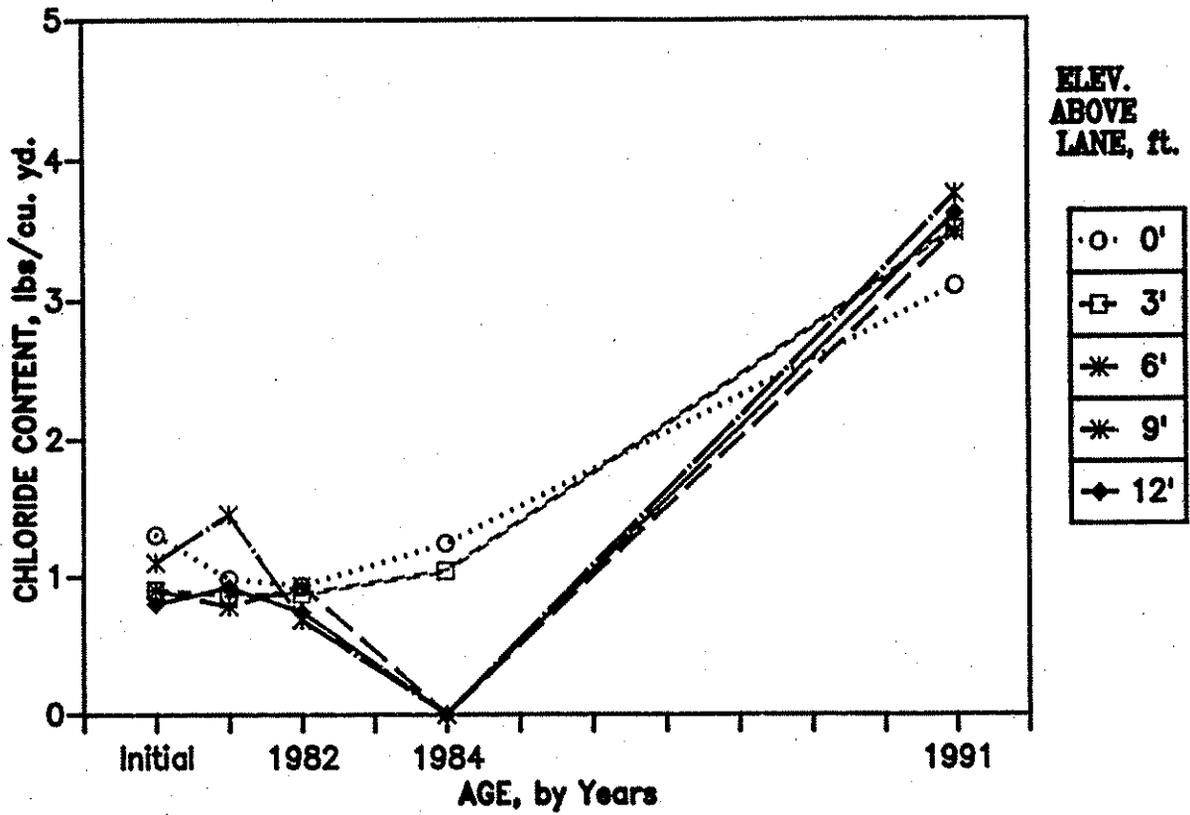


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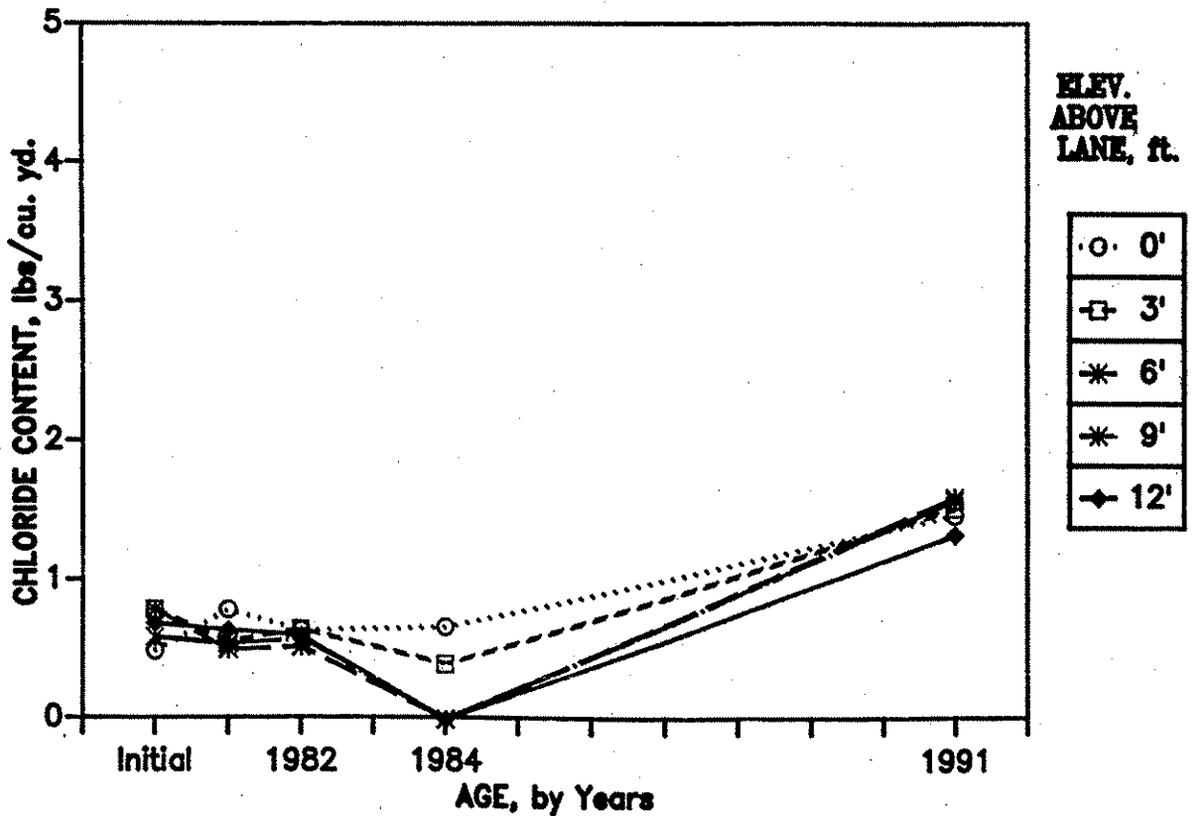


# 1/4" TE-3008

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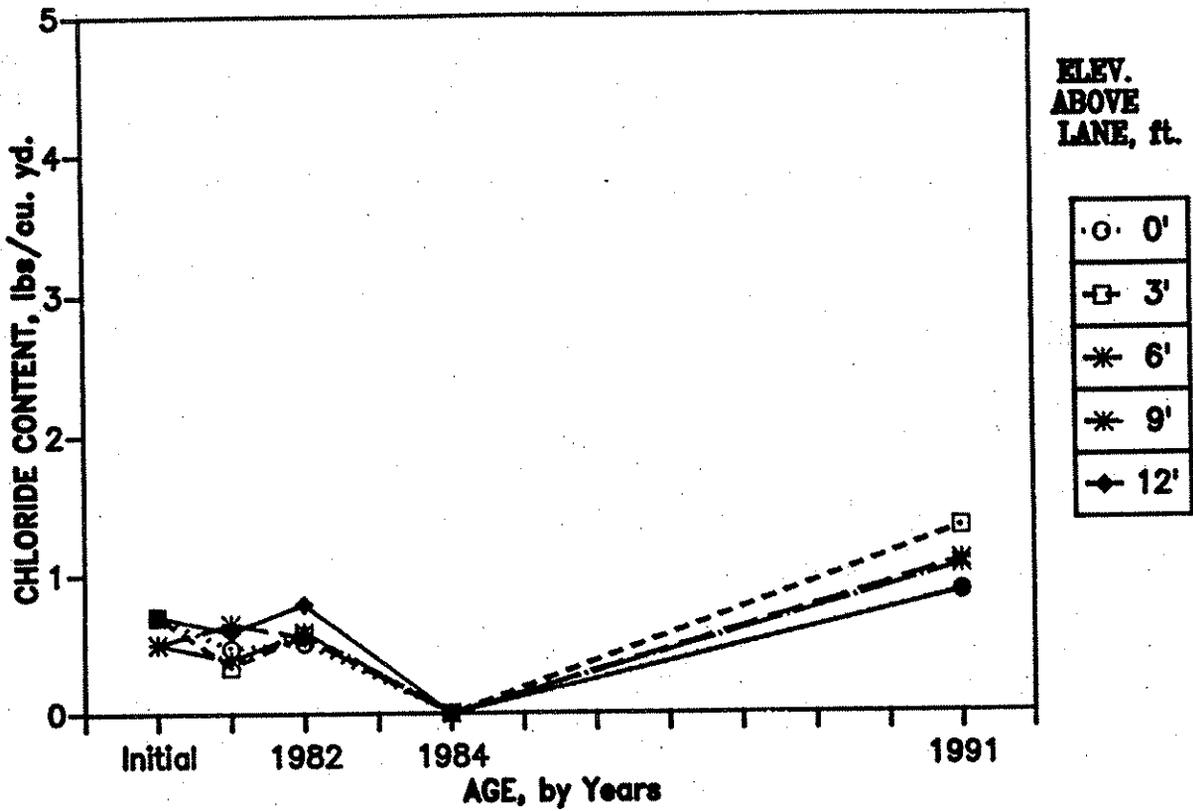


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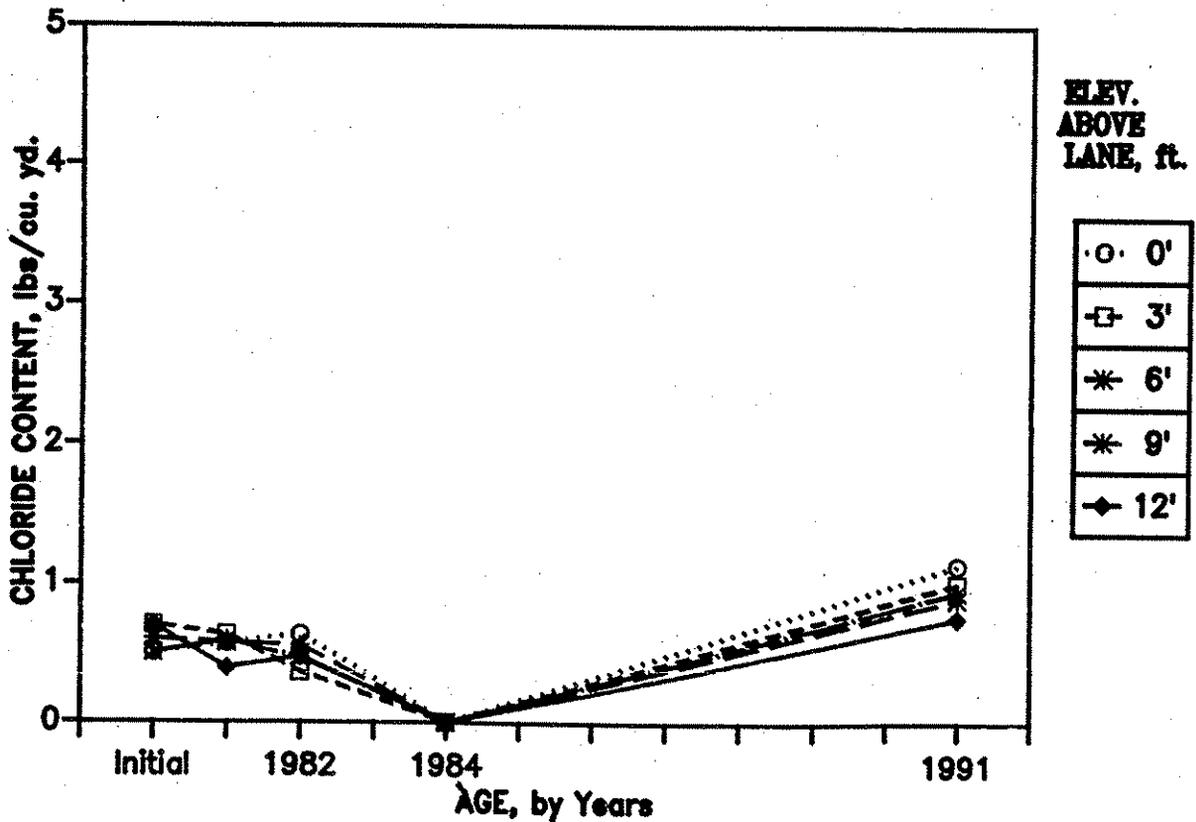


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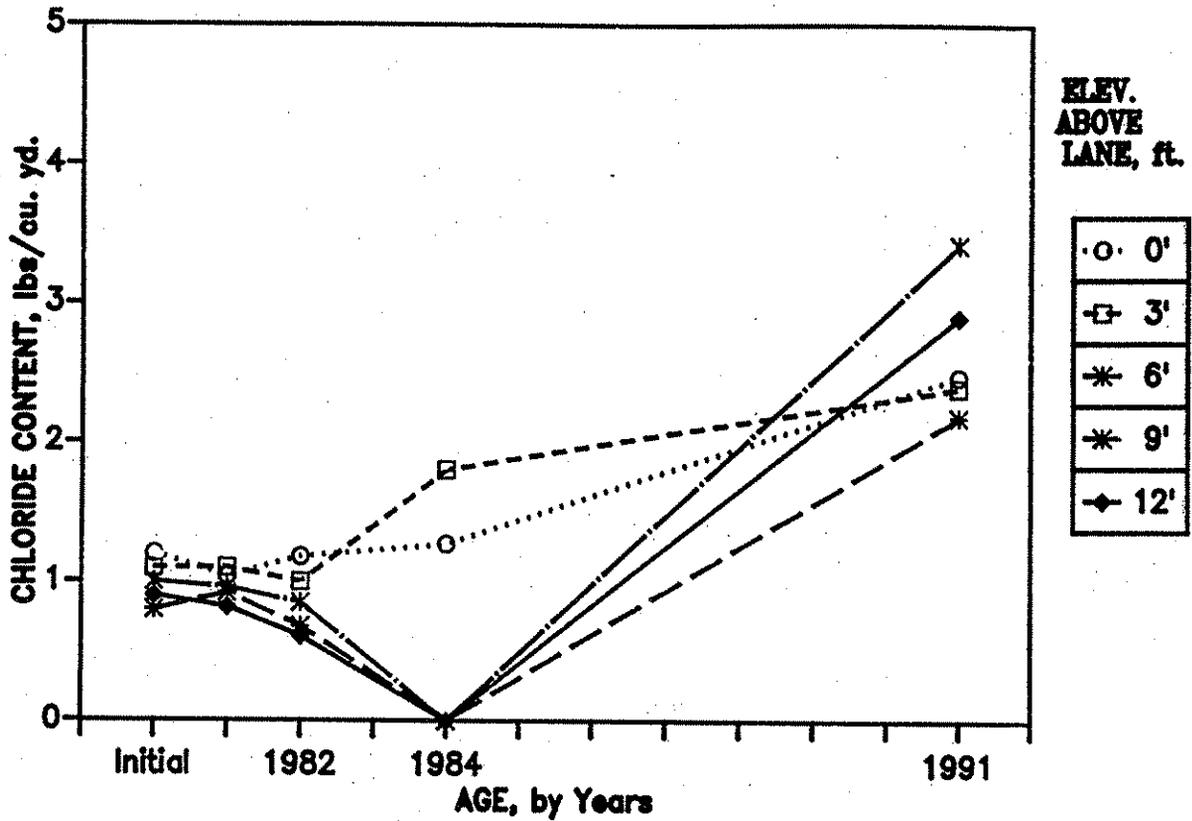


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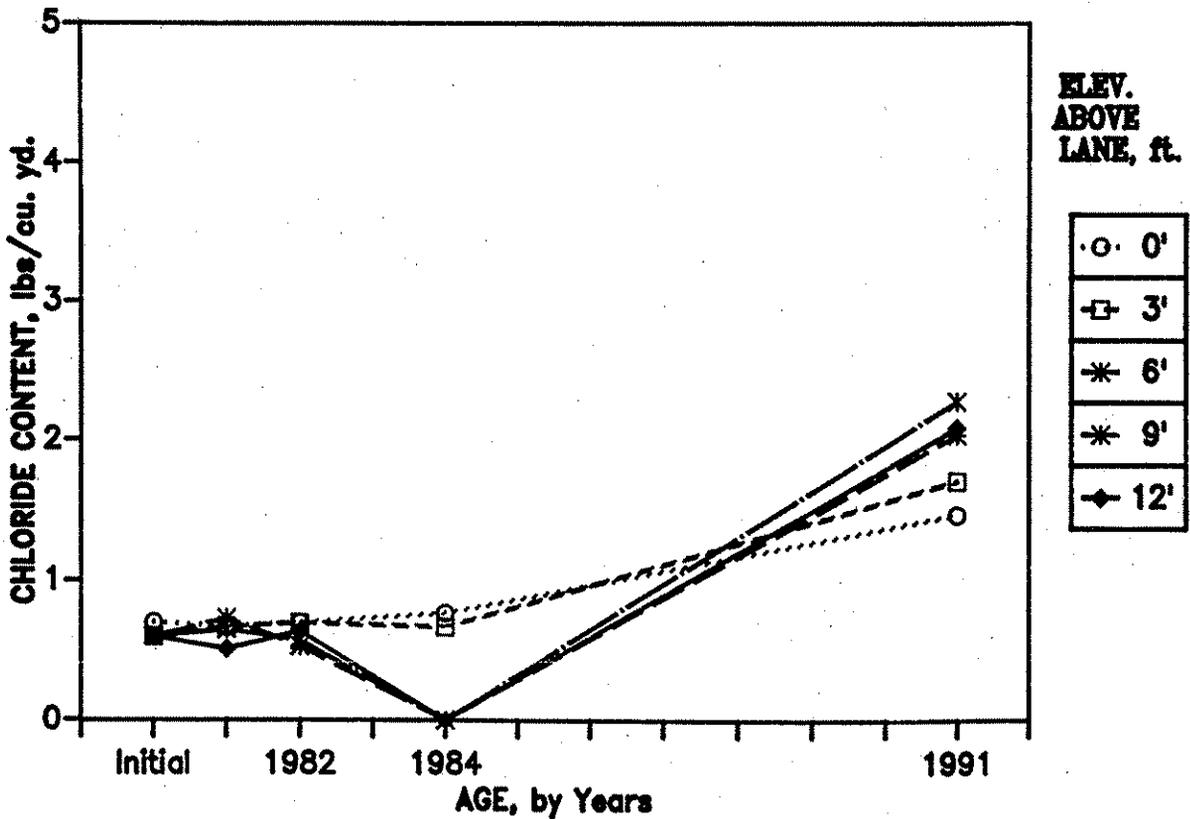


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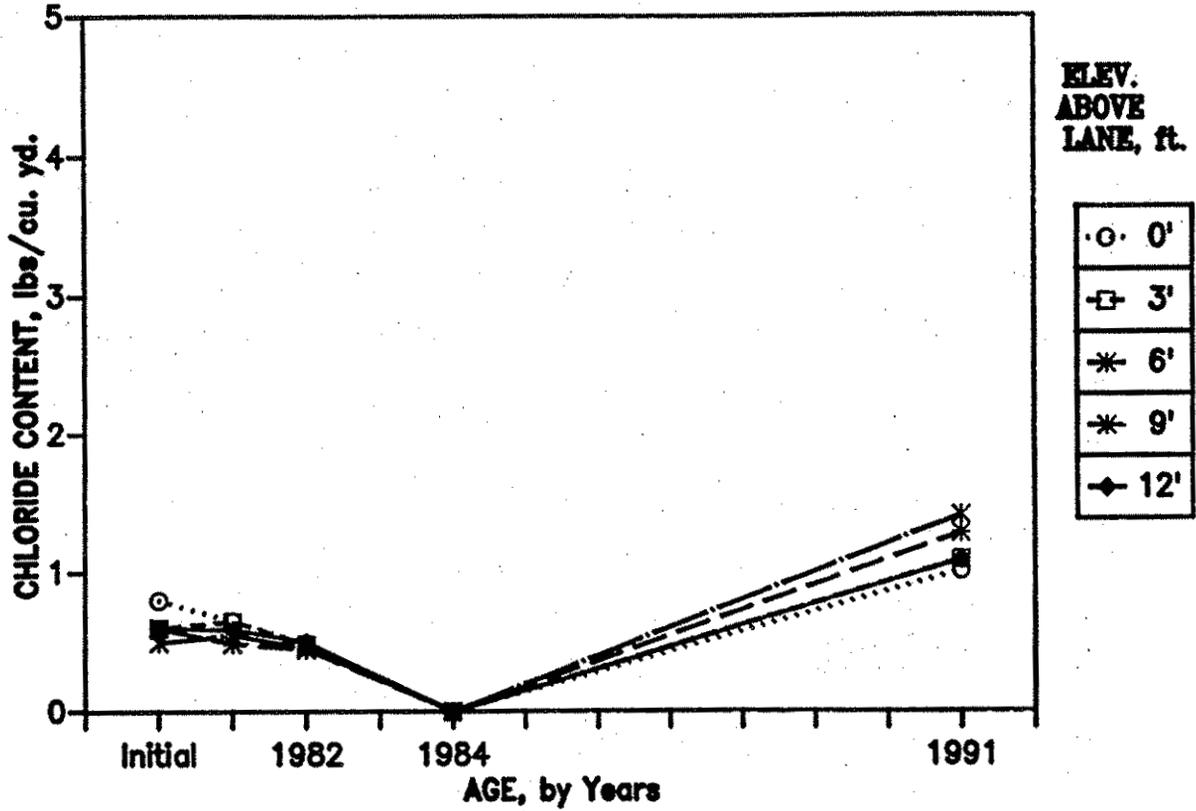


# 3/4" PE-50



# 1-1/4" PE-50

16



# 1-3/4" PE-50

