

AFML-TR-78-63

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ISOTHERMAL WEIGHT LOSS AND LIFE EXPECTANCY CURVES OF
POLYMERS IN AIR

Polymer Branch
Nonmetallic Materials Division

June 1978

TECHNICAL REPORT AFML-TR-78-63

Final Report for Period May 1976 to January 1978

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AIR FORCE MATERIALS LABORATORY
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FOREWORD

This report was prepared by the Polymer Branch, Nonmetallic Materials Division. The work was initiated under WUD #43, "Structural Resins". It was administered under the direction of the Air Force Materials Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, with Dr. G. F. L. Ehlers (AFML/MBP) as Project Scientist.

This report covers work conducted from May 1974 to January 1978. It was submitted for publication by the author in February 1978.

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SECTION I
INTRODUCTION

The development of an automatic multisample isothermal aging apparatus (AFML-TR-74-163) allowed the simultaneous thermal aging of up to four polymer samples in duplicate.

Since then, a representative variety of polymers has been subjected to isothermal aging at different temperatures. The weight loss plots and some life expectancy curves derived from these plots are presented in this report.

SECTION II
DISCUSSION

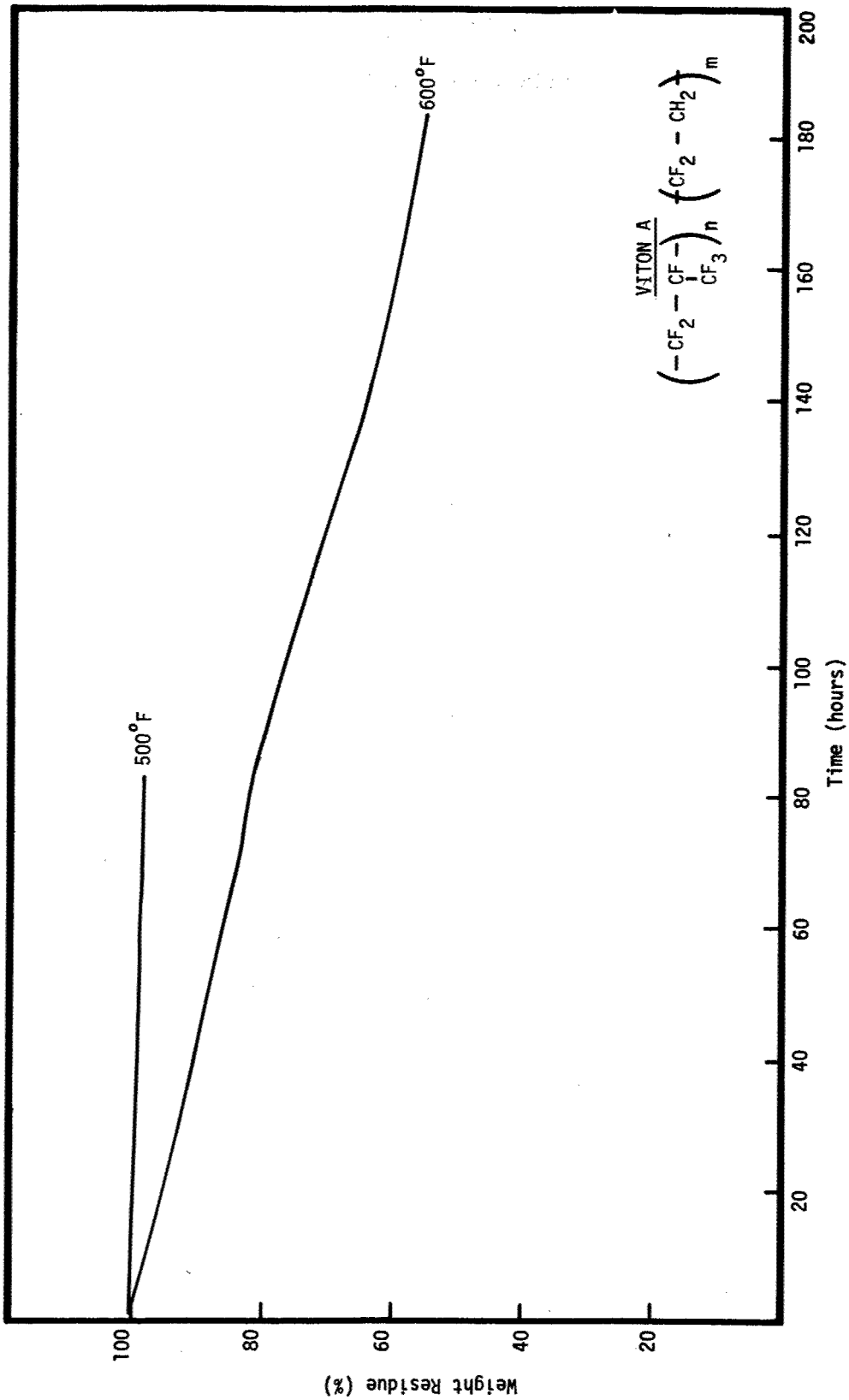
Sixty-five polymers have been subjected to isothermal aging in air at one or several temperatures of 500, 550, 600, 650, 700, and 750°F for up to 200 hours, in one case (BBB) up to 600 hours. Aging was performed in a Multisample Isothermal Aging Apparatus designed and built by the Systems Research Laboratories in cooperation with Polymer Branch personnel. Sample sizes of about 20 mg, in aluminum boats, were heated in an air flow of 40 CC/min. The curves shown in this report are average plots from two or more samples. Many of the polymers show an inhibition period of several hours up to 150 (BBB) after which the decomposition accelerates.

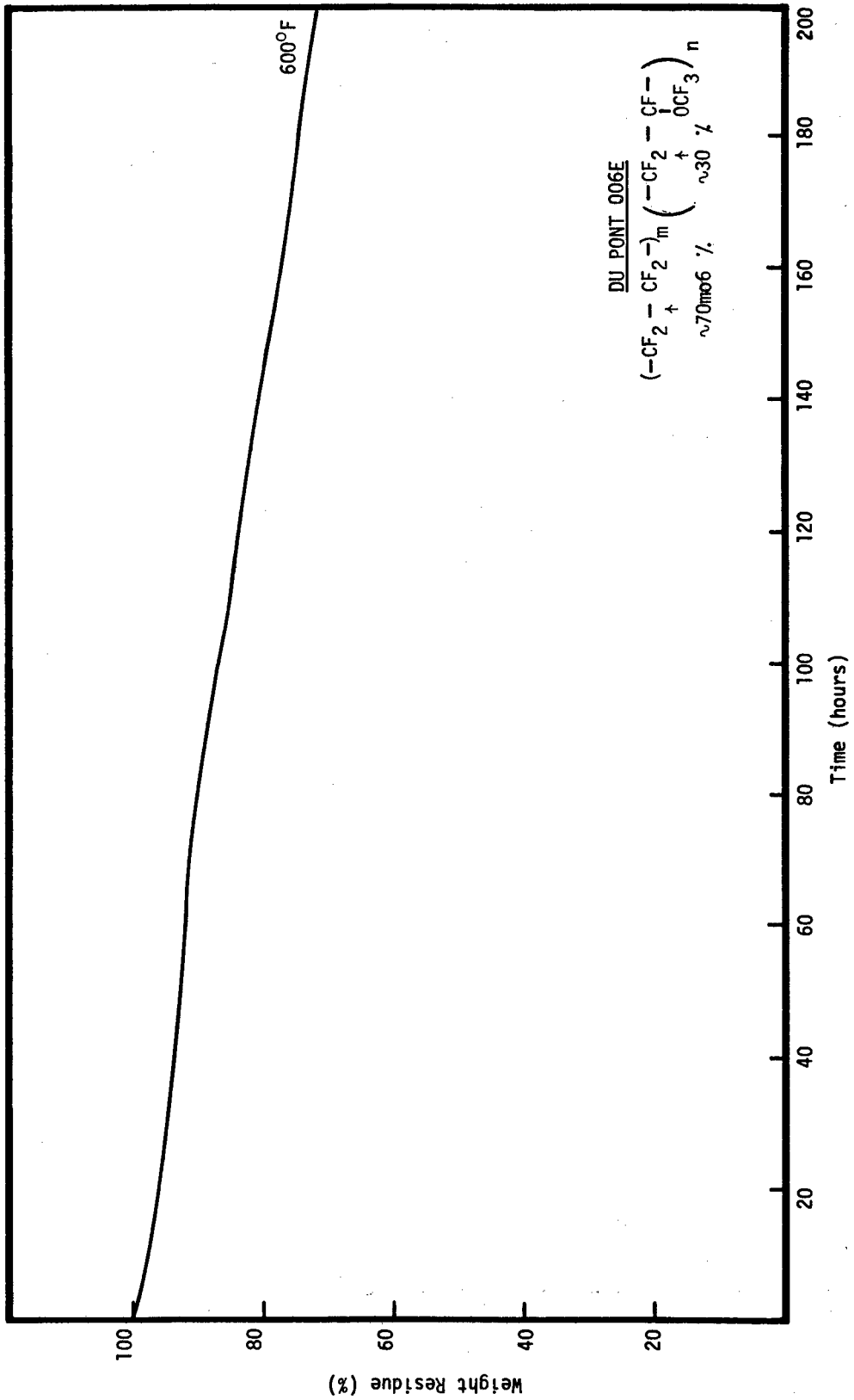
For 31 of these polymers, life expectancy plots were made. Basis for these plots was the elapsed time after the samples reached weight losses of 20 and 30%. Weight losses in this order would still be acceptable in cases where, for example, laminates are being used as separators, dielectric barriers, etc. In a laminate based on glass fabric and a resin content of 35%, a 30% weight loss would mean a reduction of the resin content to 25%.

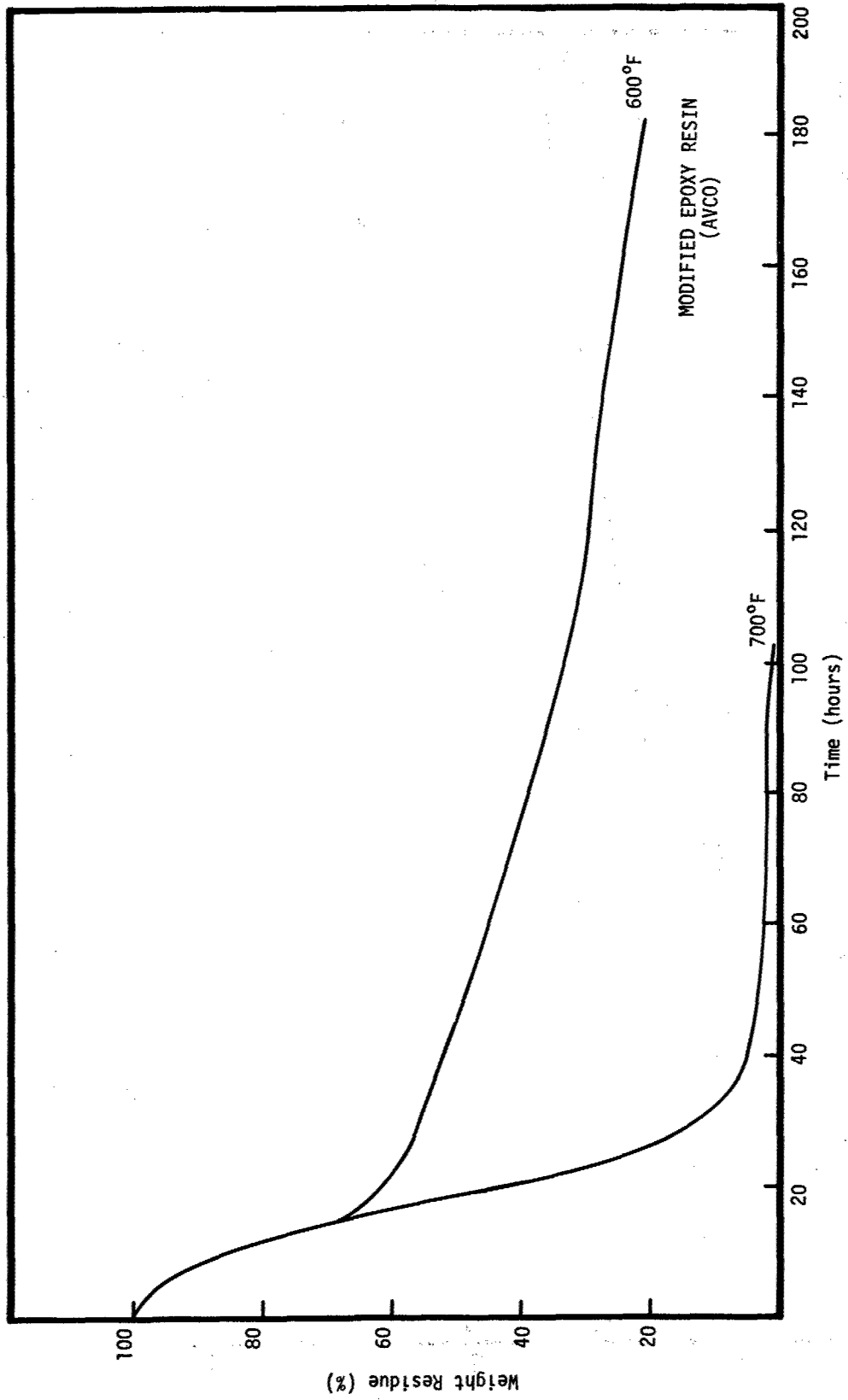
Some of the life expectancy plots are of a convex, others of a concave shape. A satisfactory explanation, why these differences occur, has not been found. As it turns out, structurally related polymers have differently shaped life curves; ATQ-s and ATQ-p have convex life expectancy curves, the one of ATQ-m.p. appears to be a straight line, and the ATQ-o curve is concave.

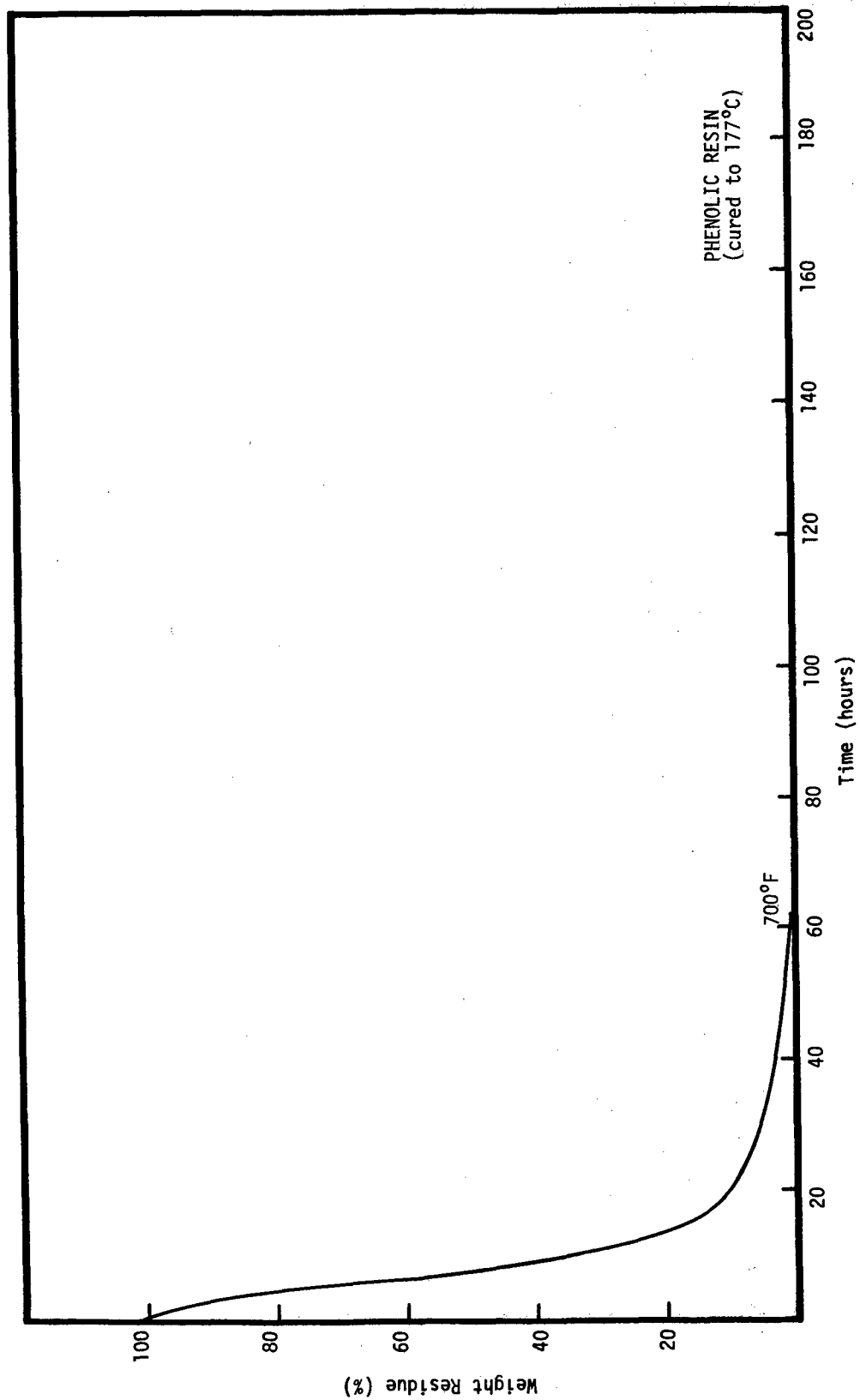
Composite plots of all of the life expectancy curves have been made, separately for 20 and for 30% weight loss. The composite plots indicate that most of the curves (all of these are from aromatic or aromatic-heterocyclic polymers) fall in the same range.

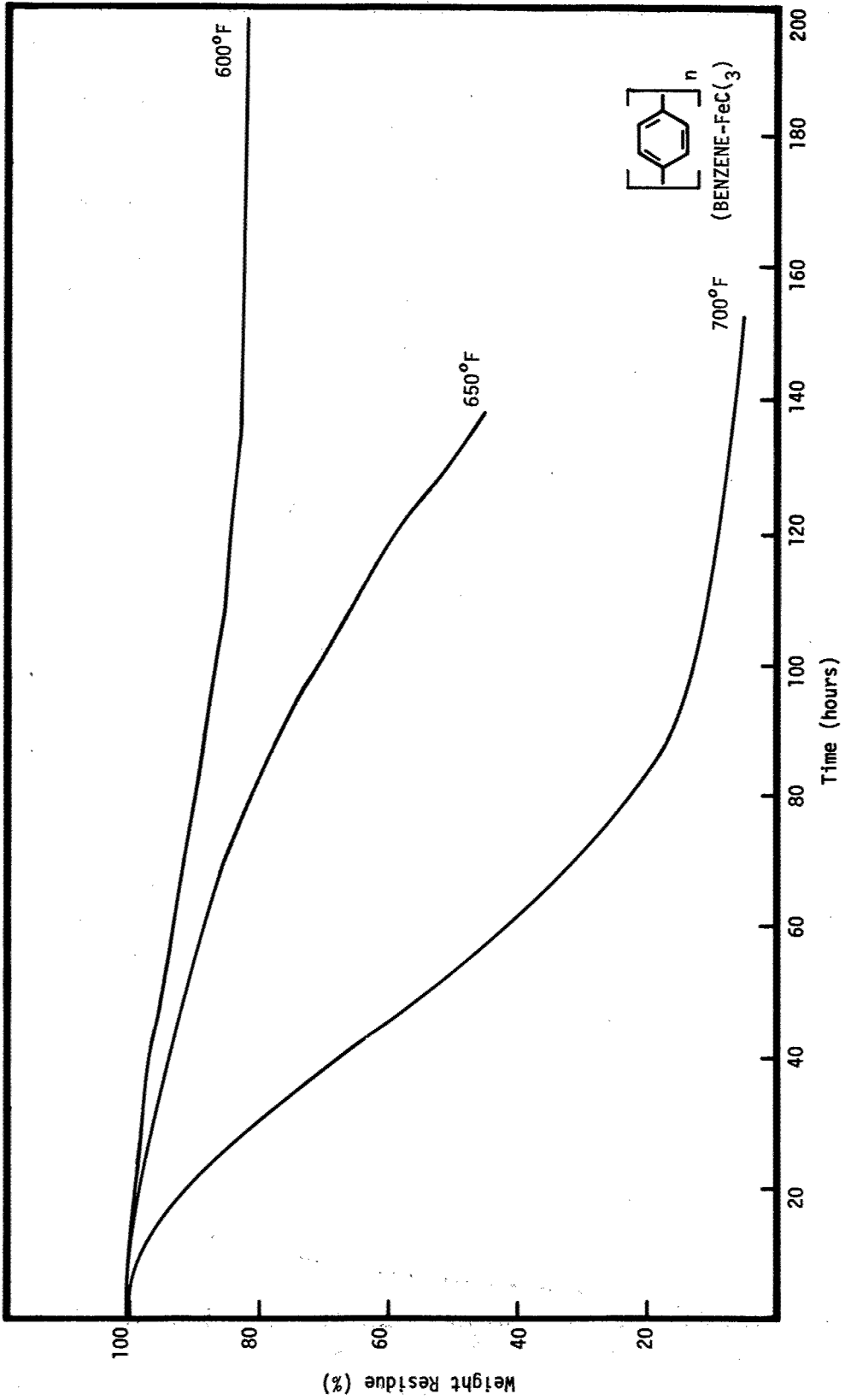
SECTION III
WEIGHT LOSS CURVES

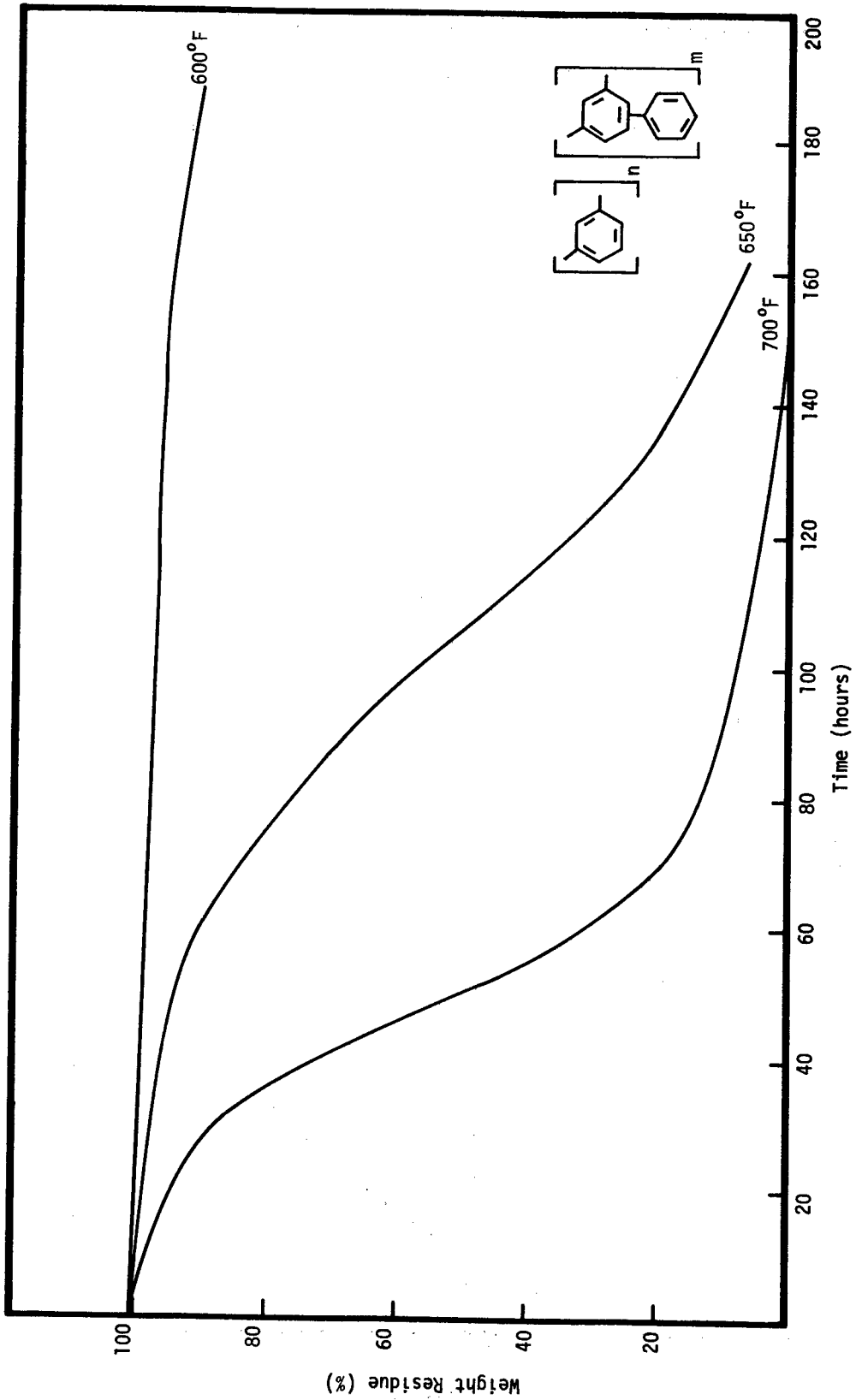


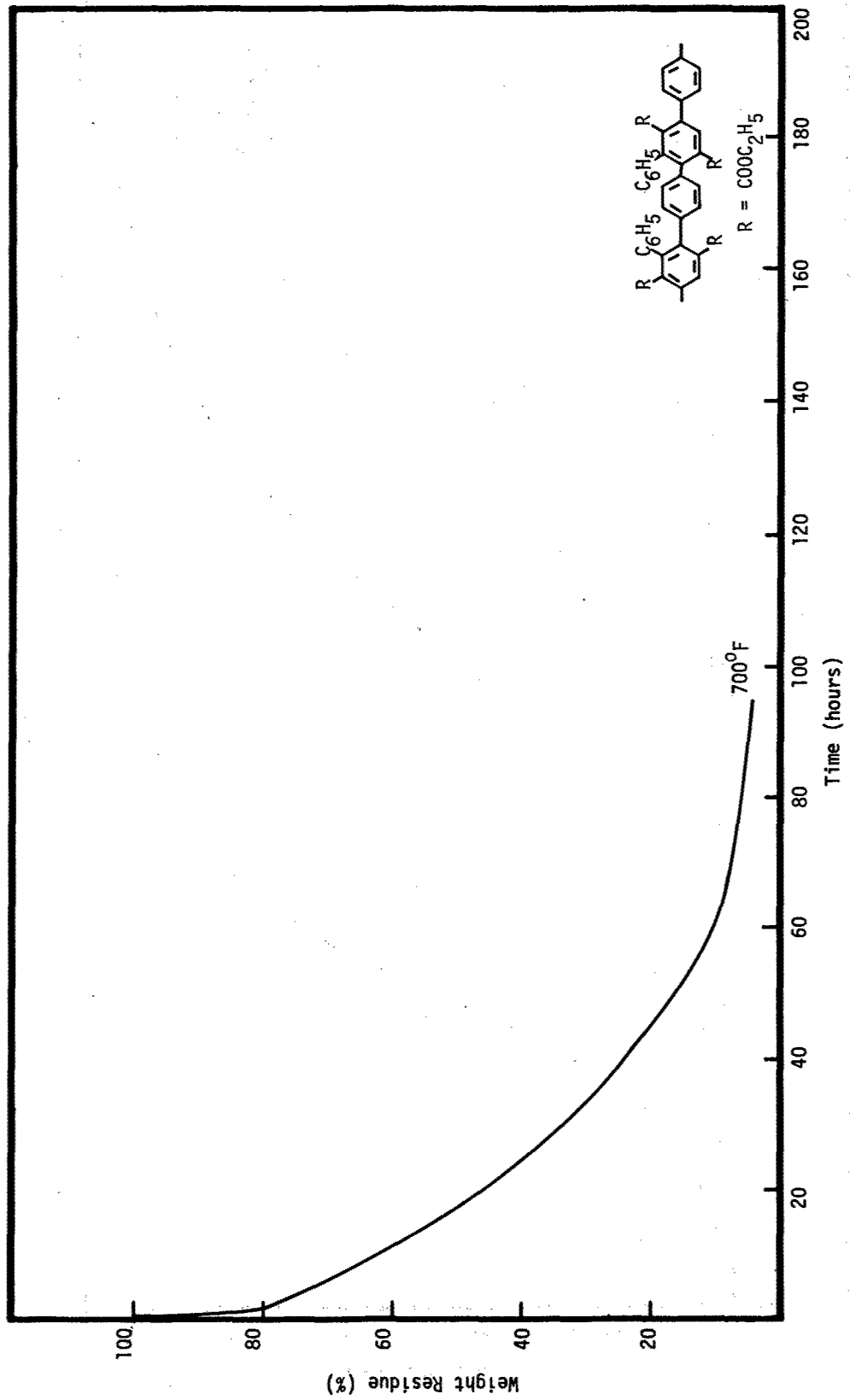


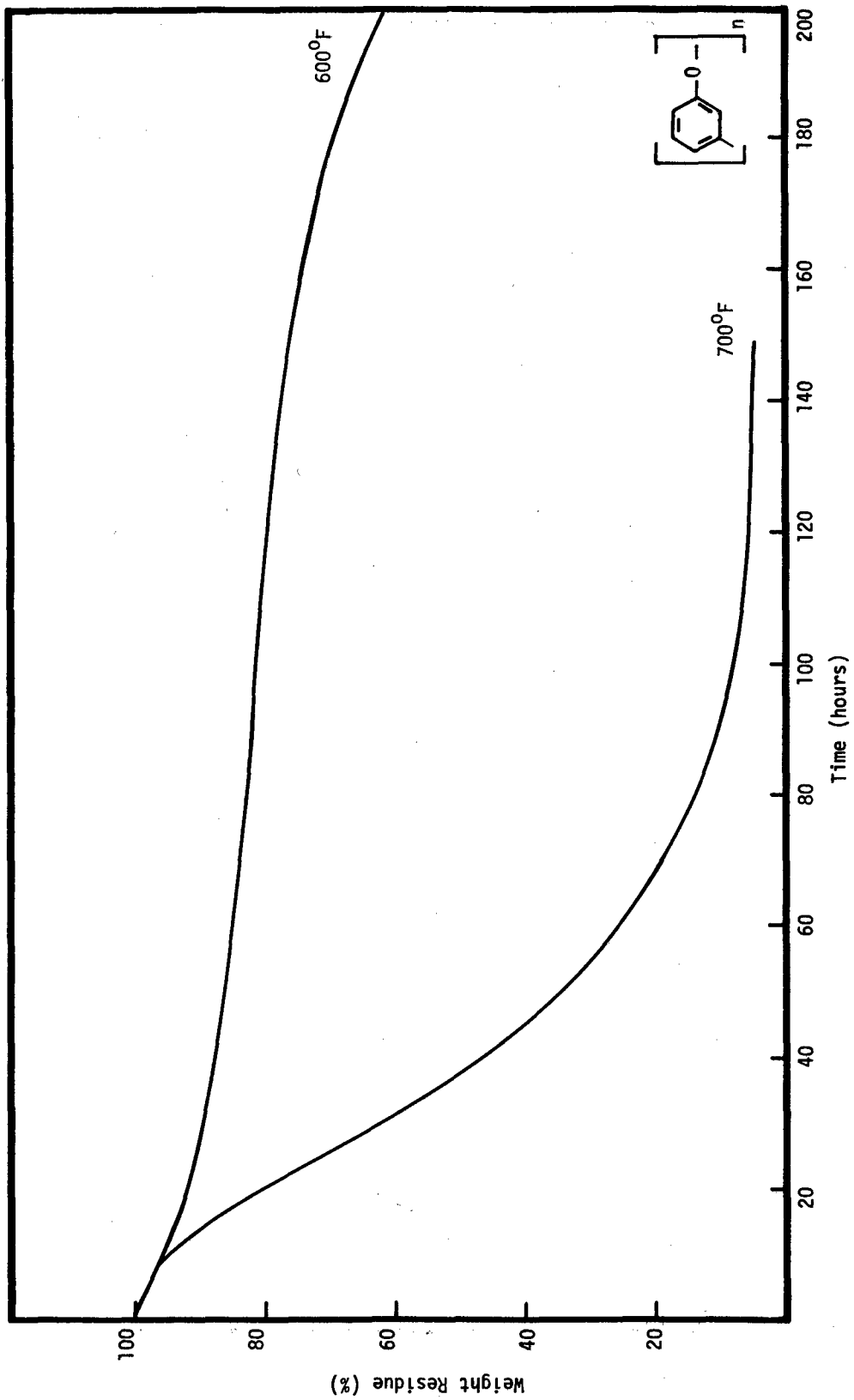


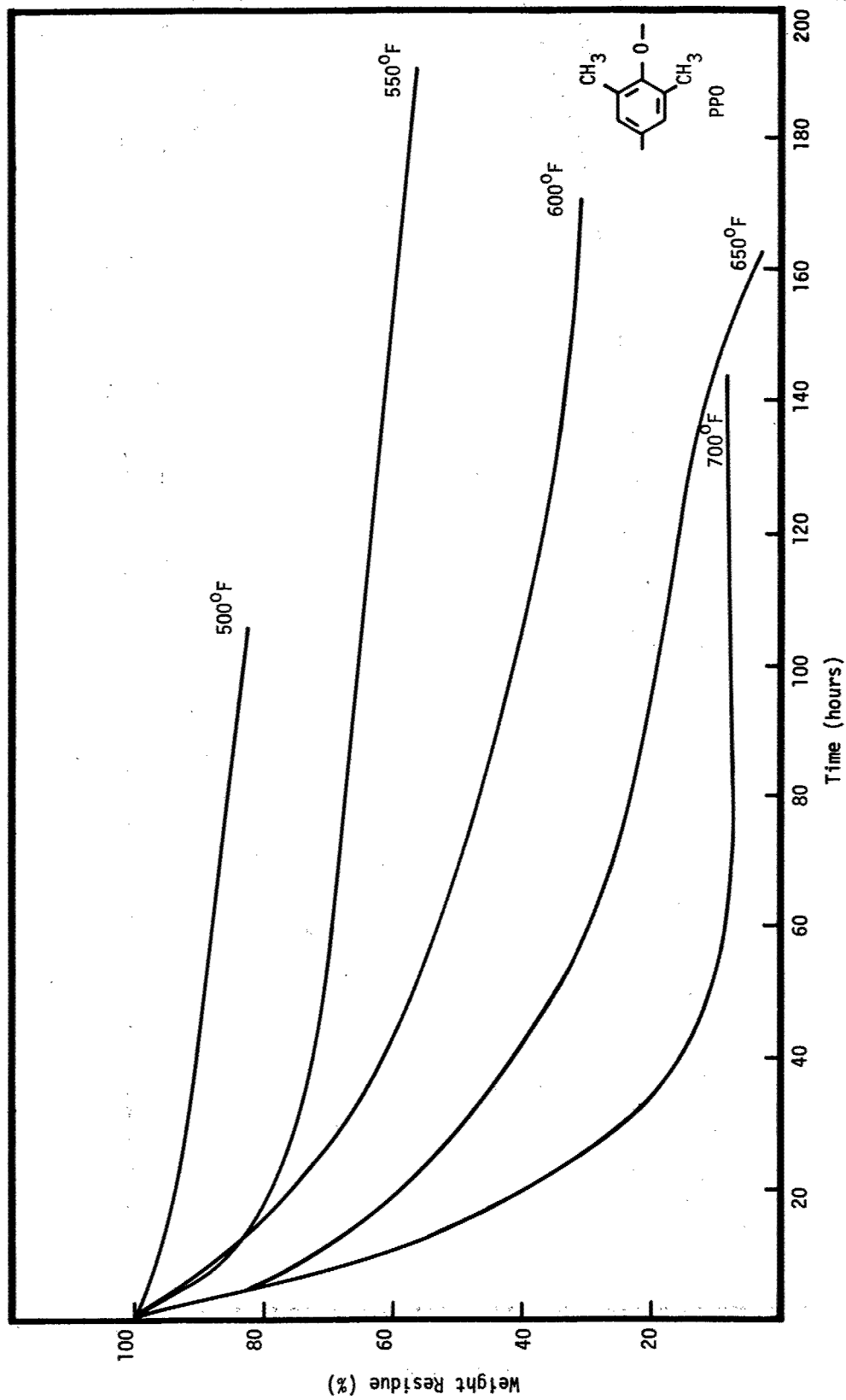


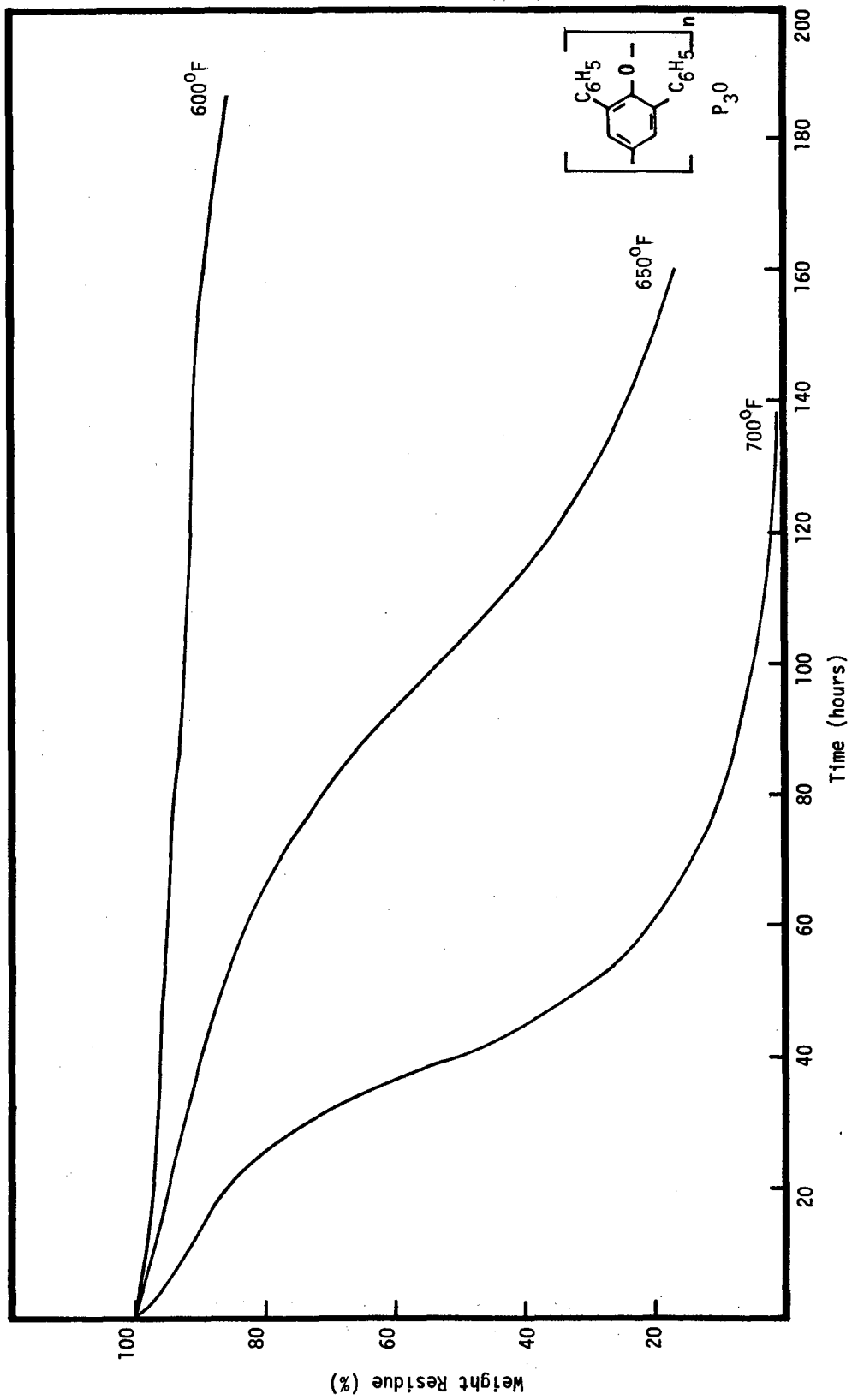


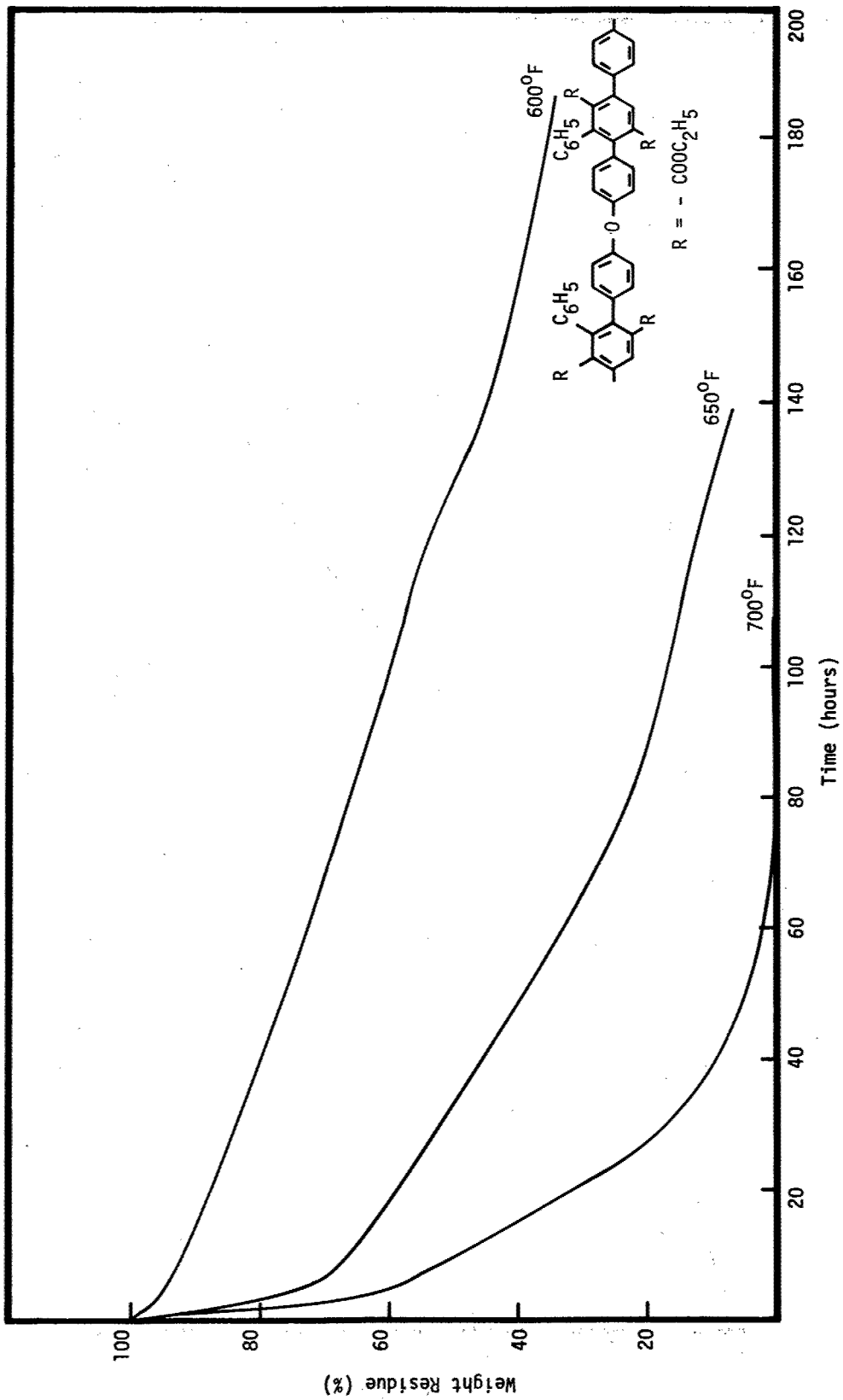


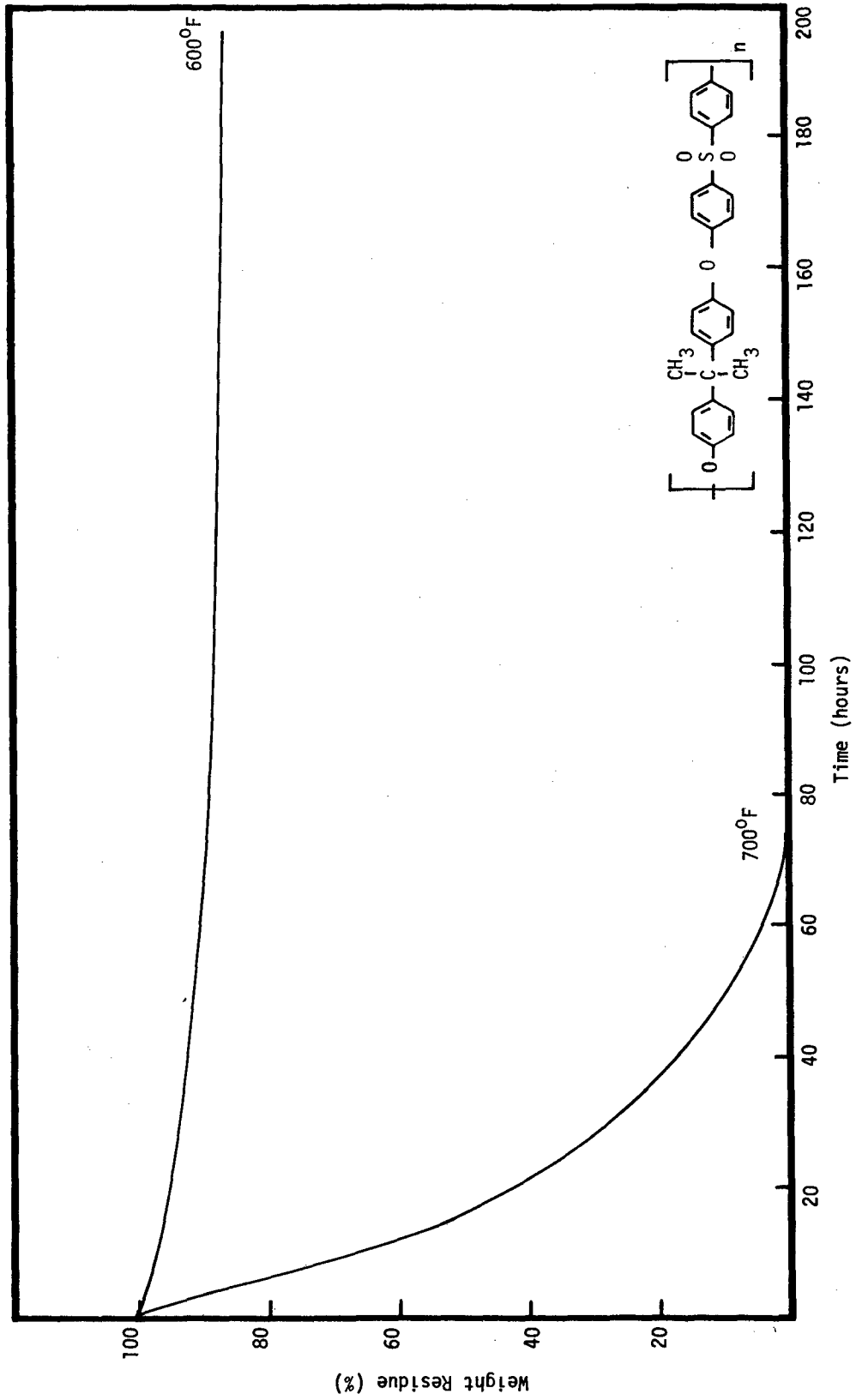


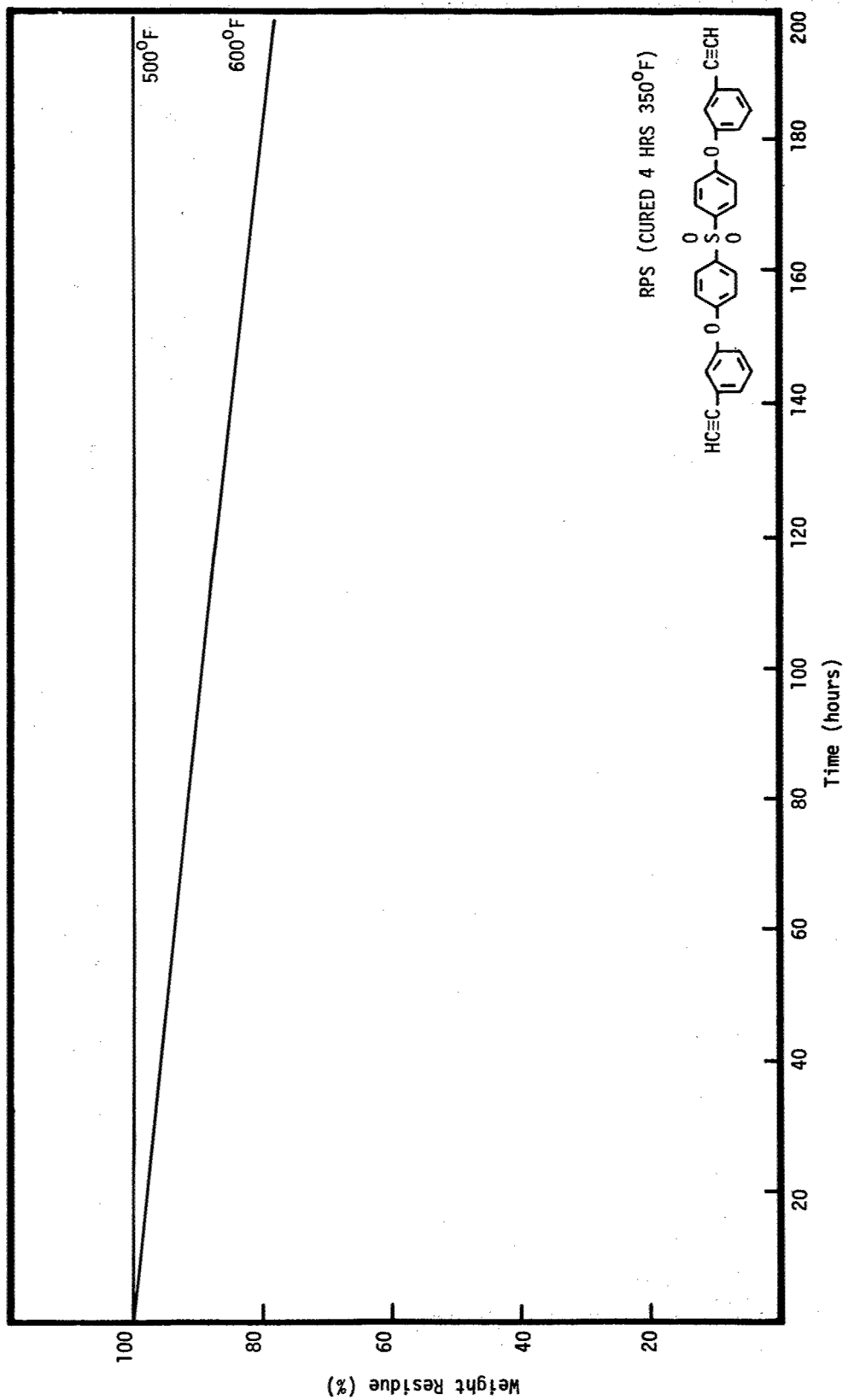


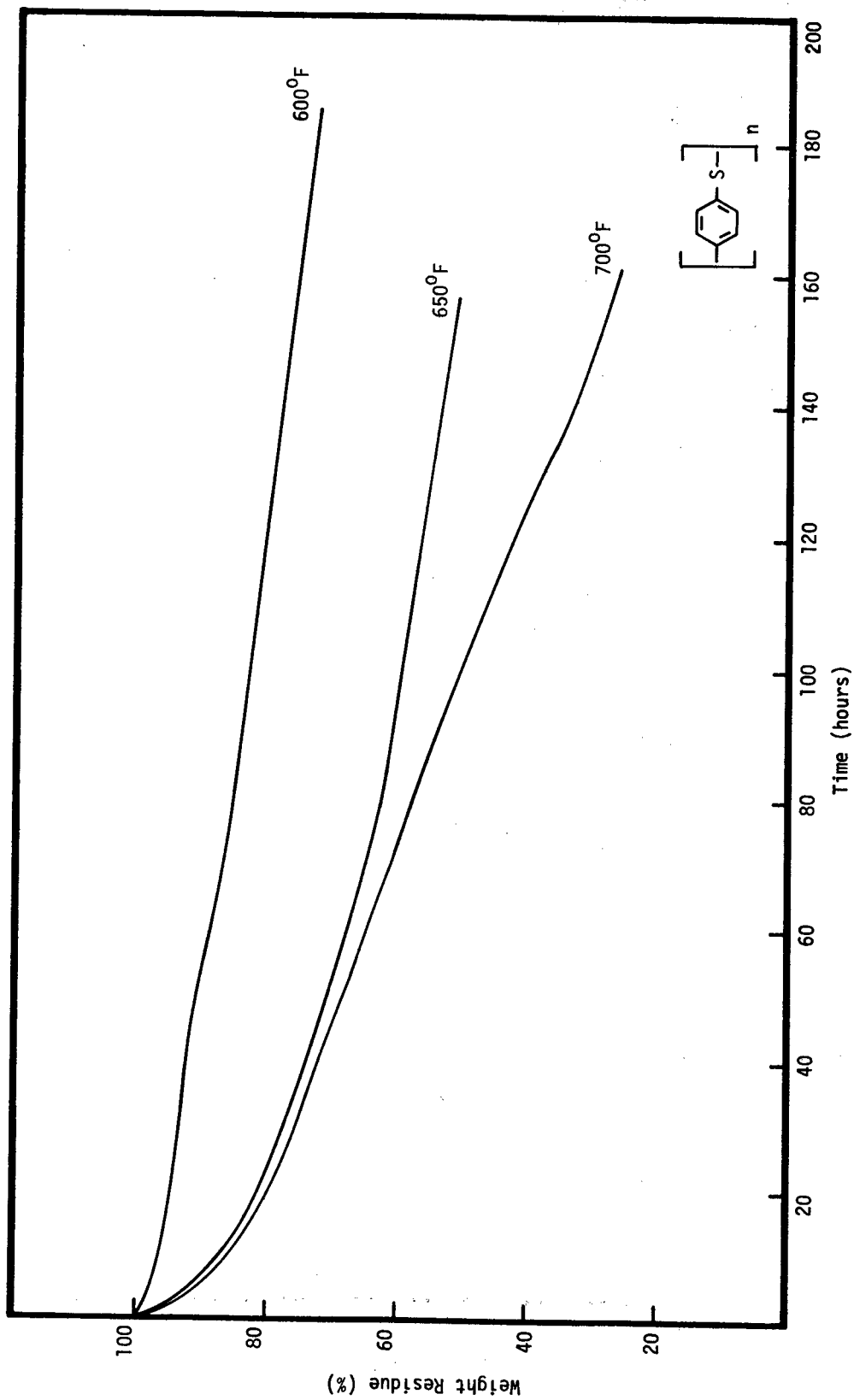


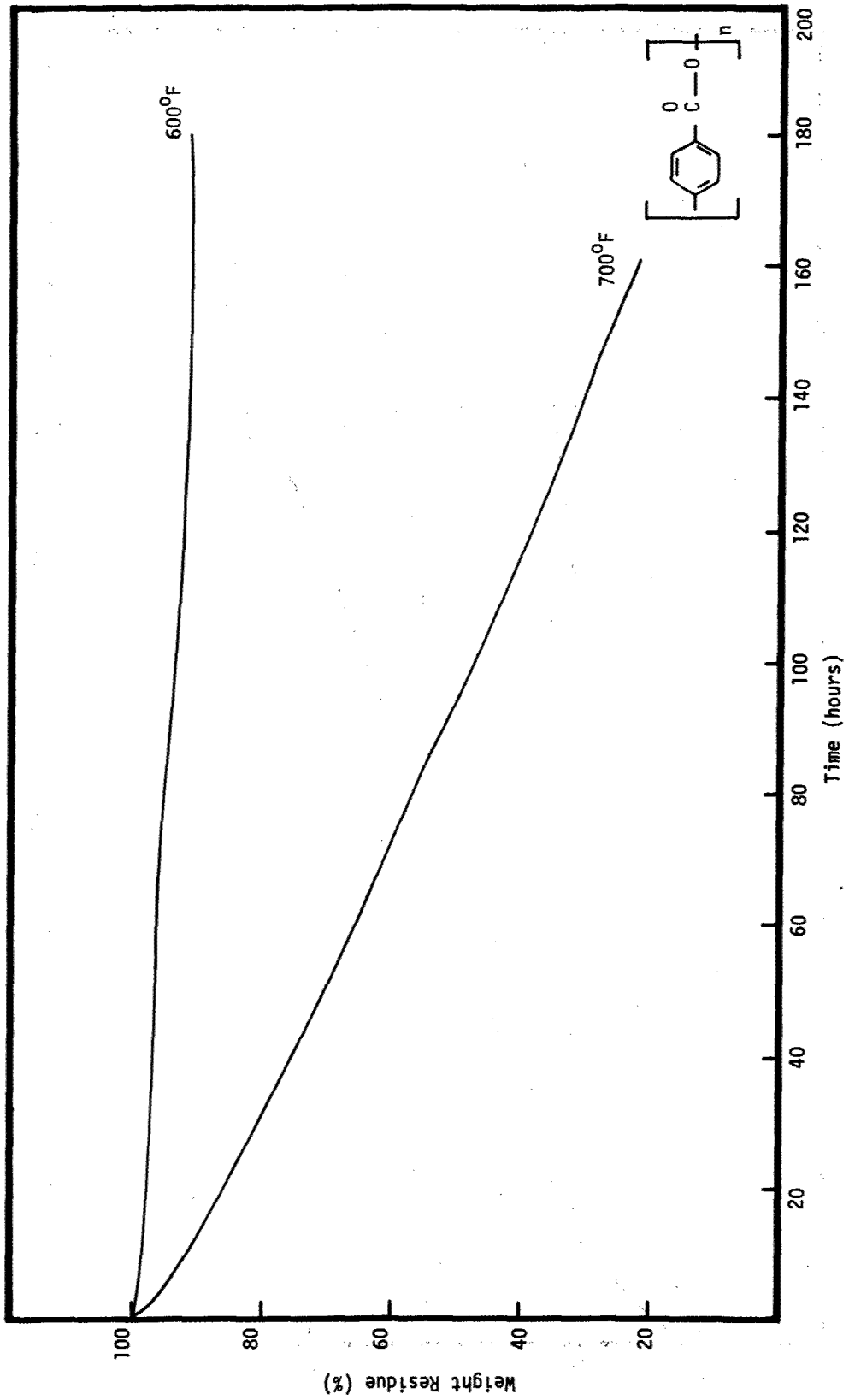


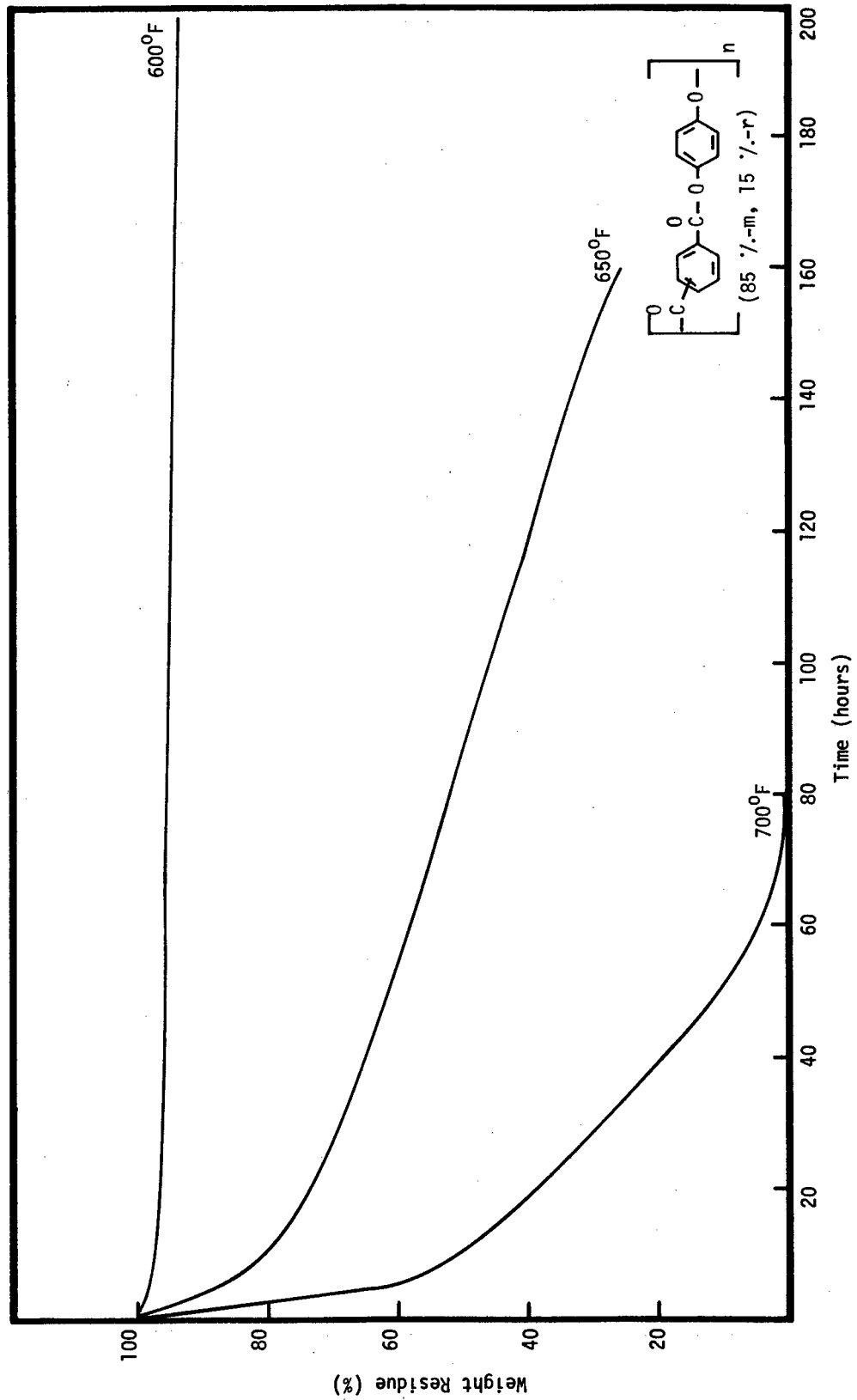


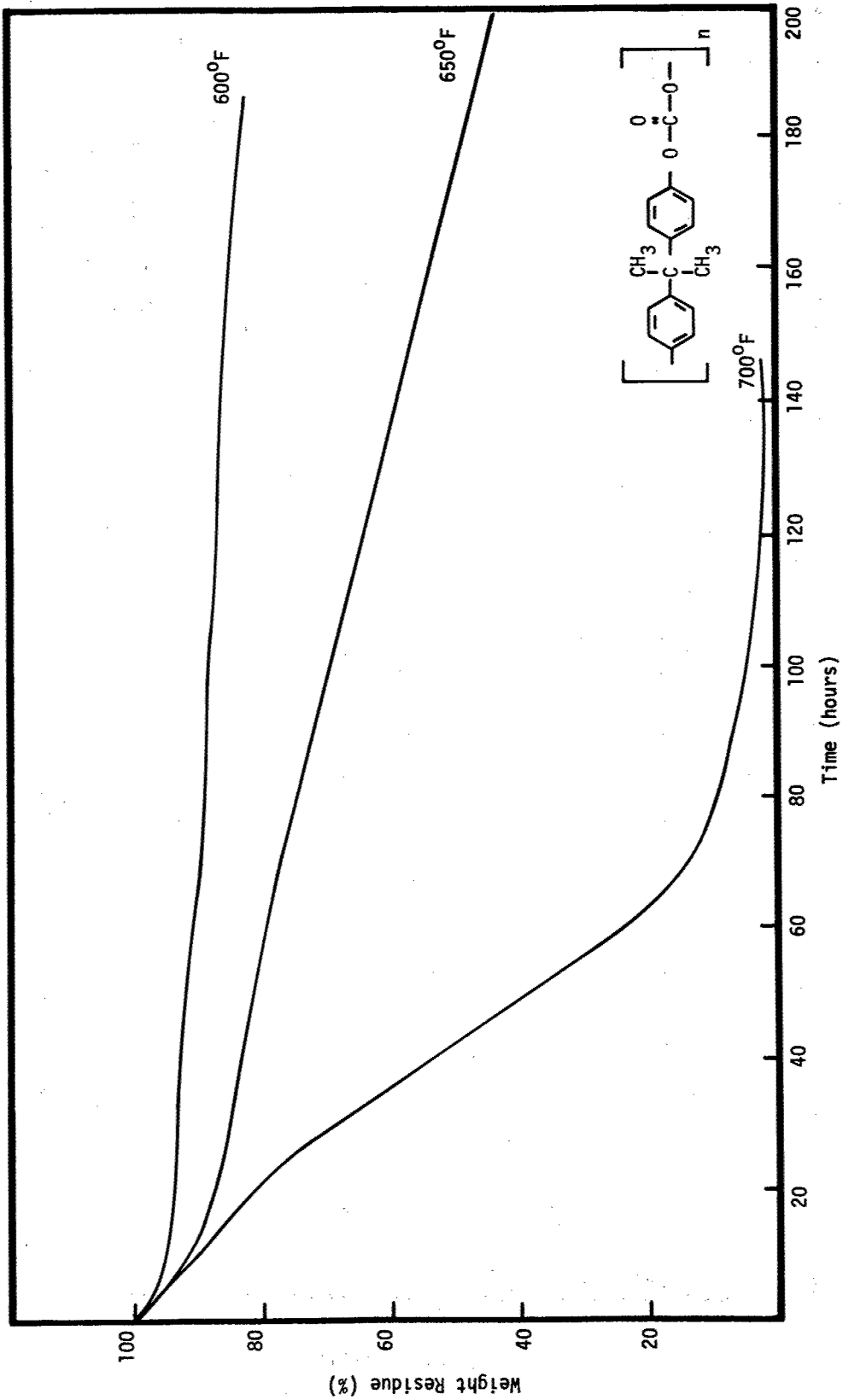


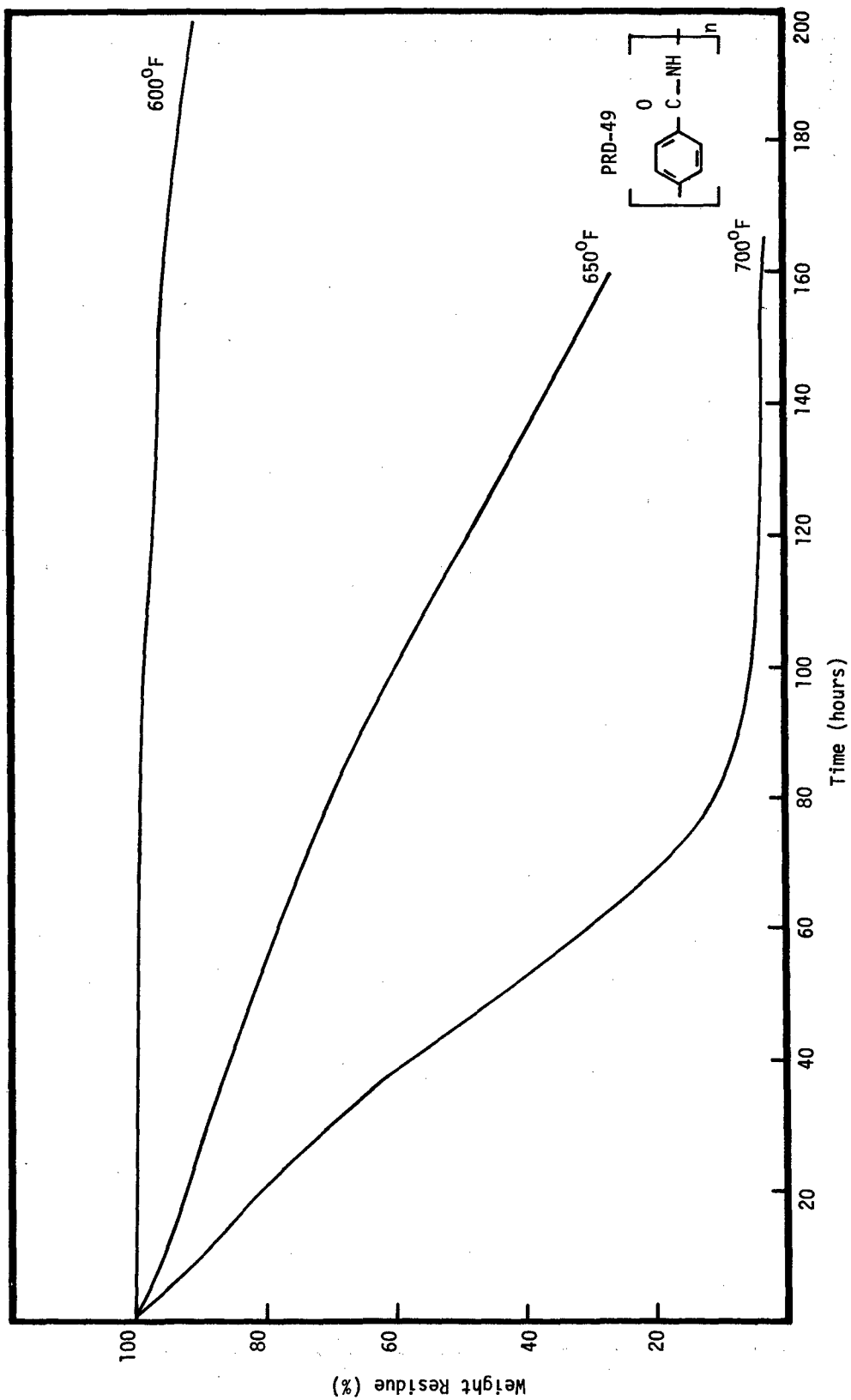


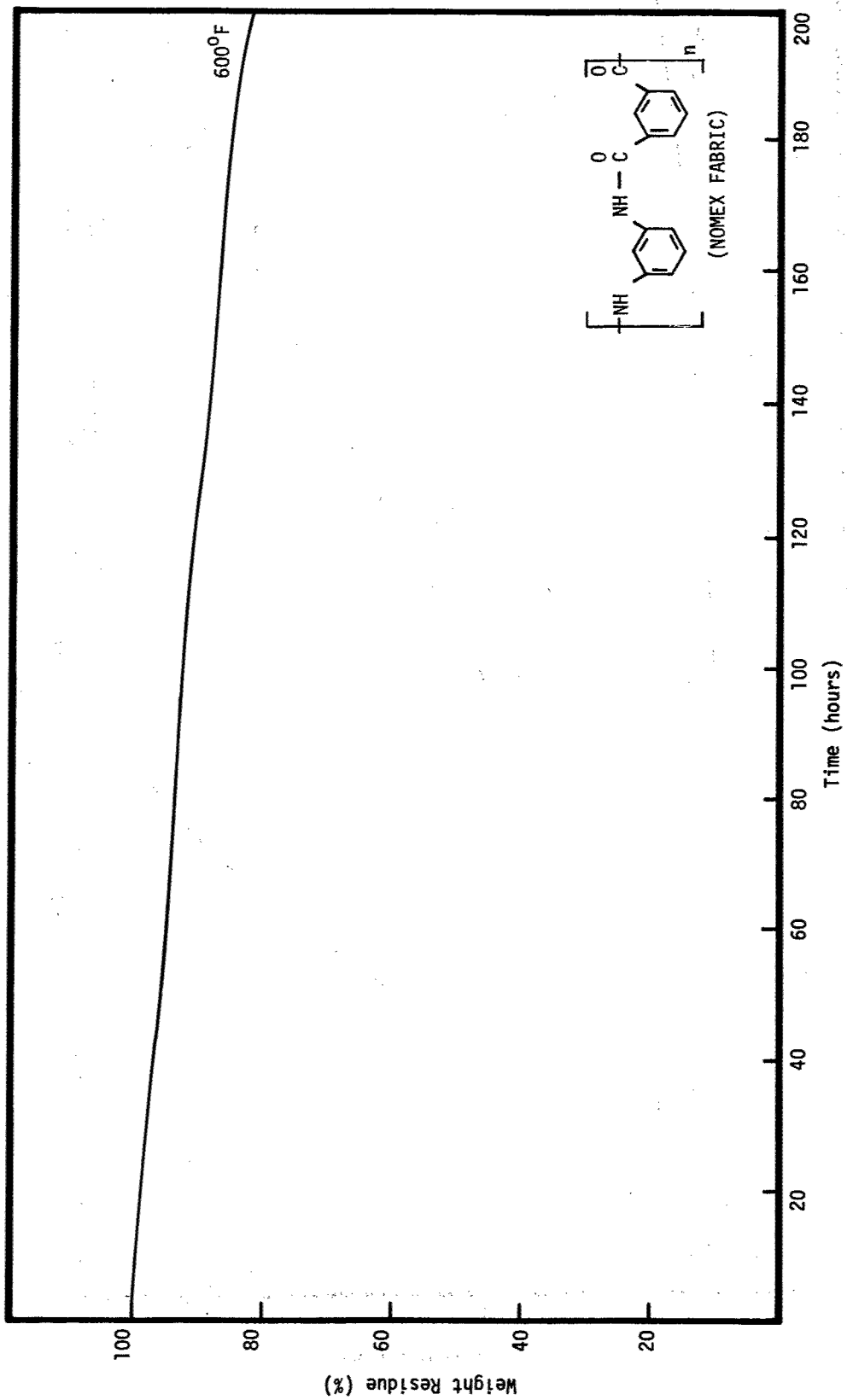


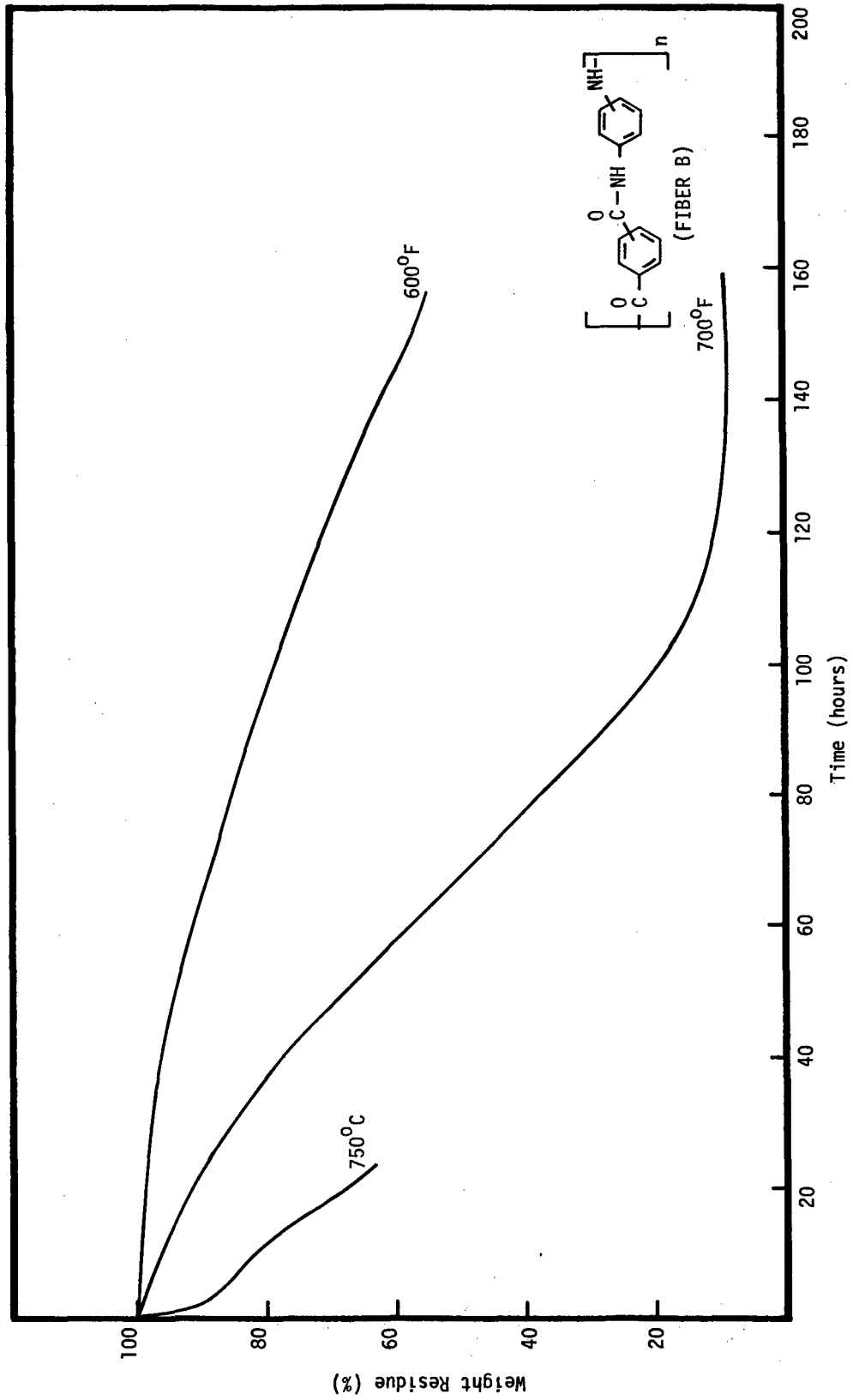


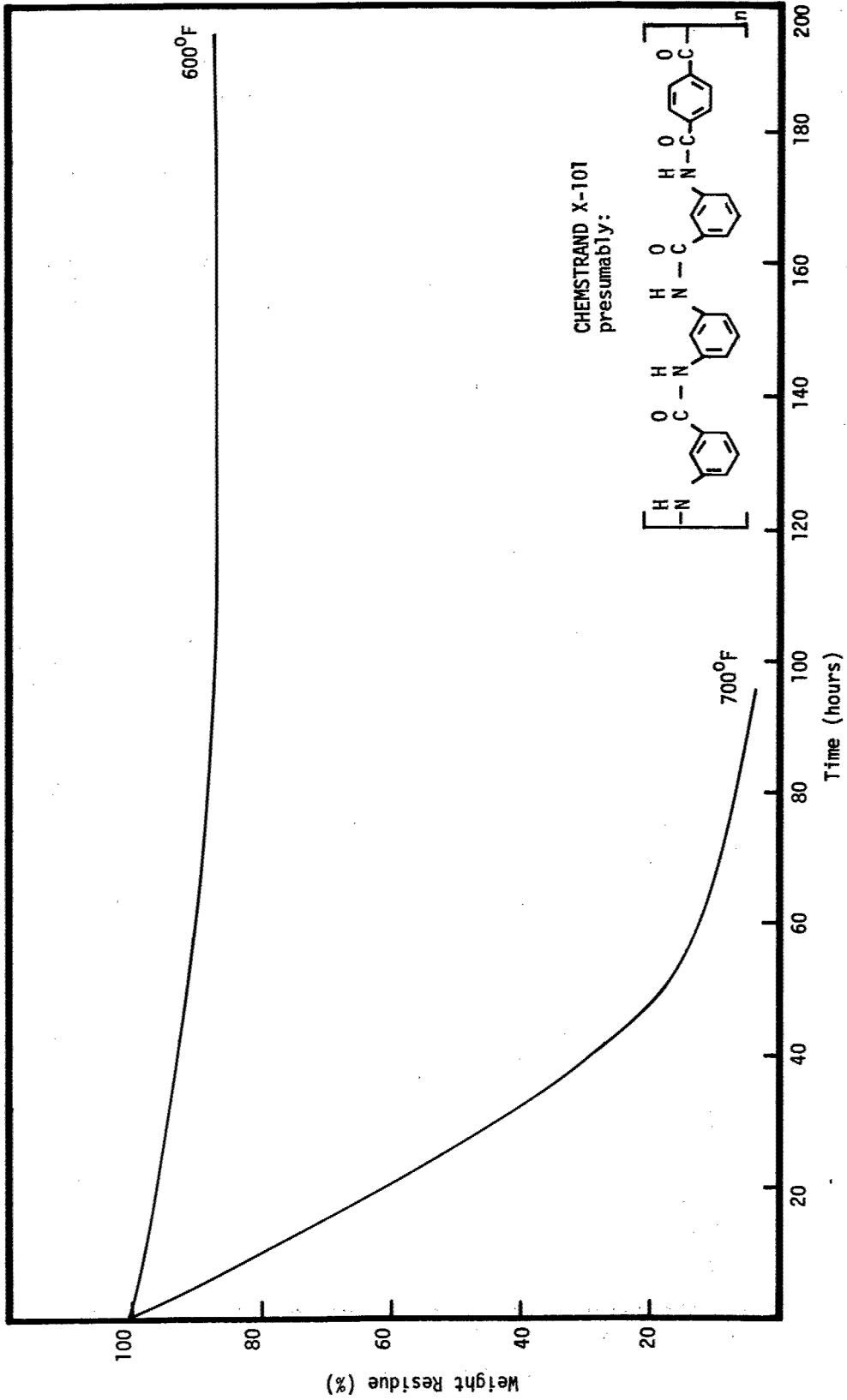


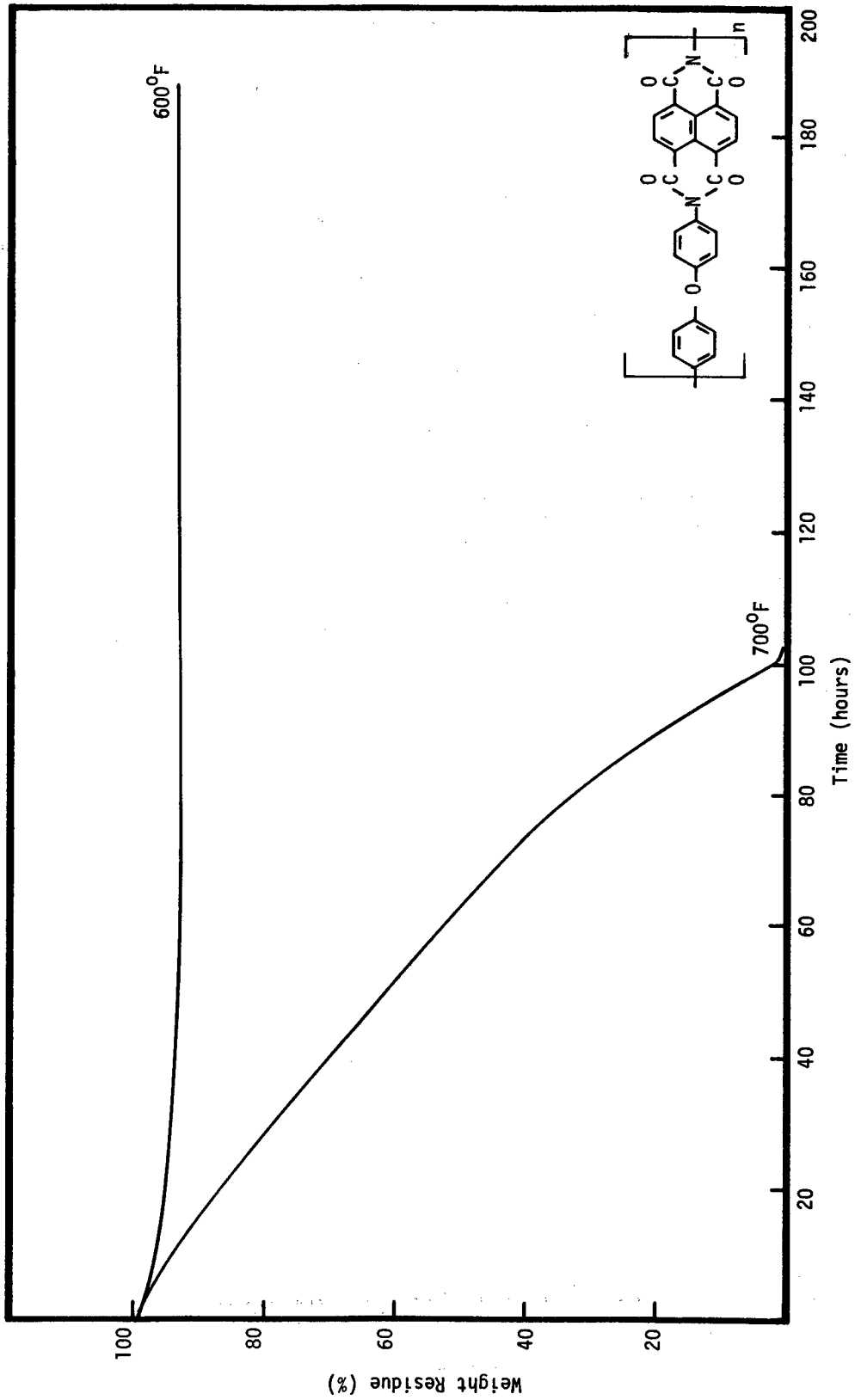


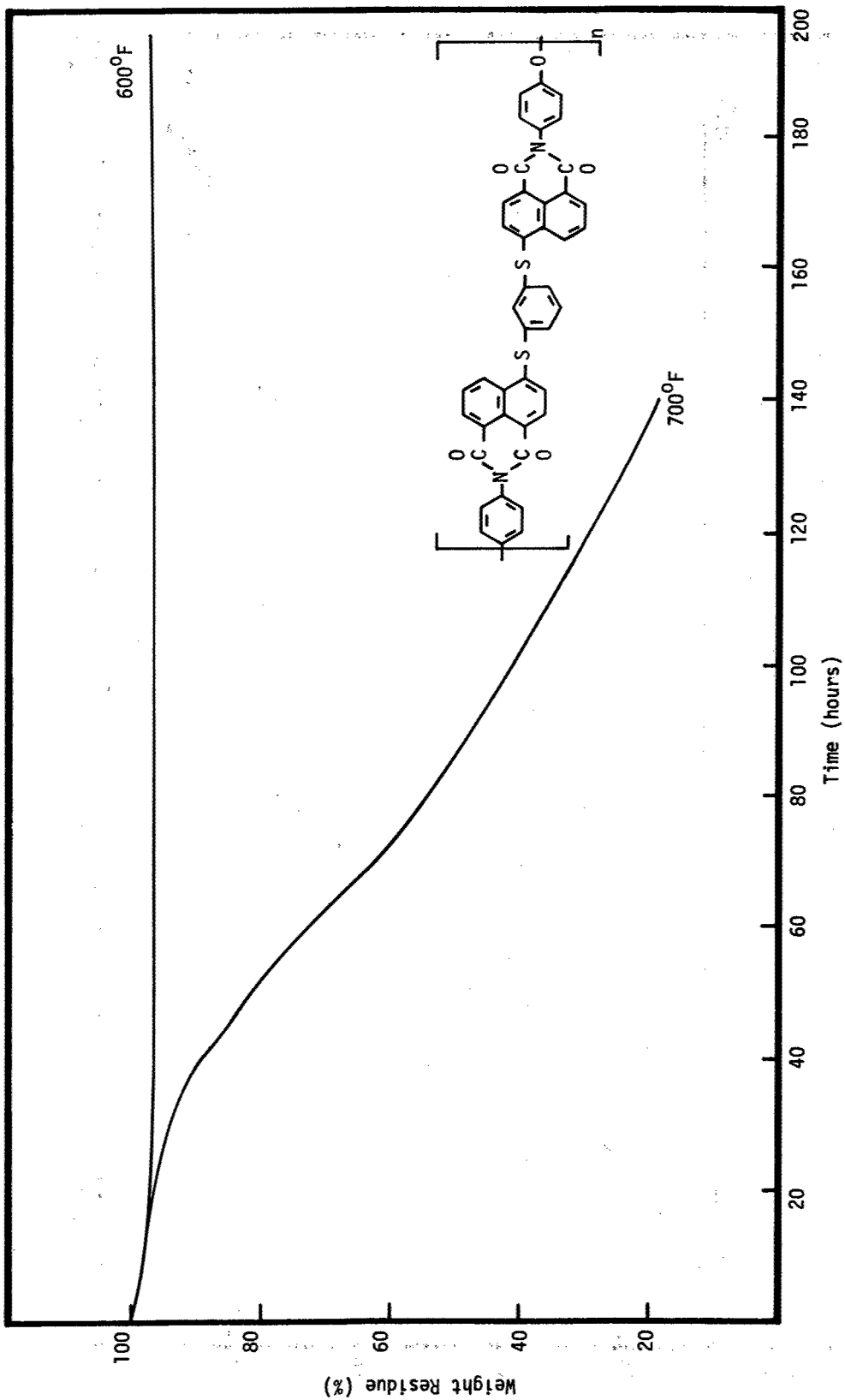


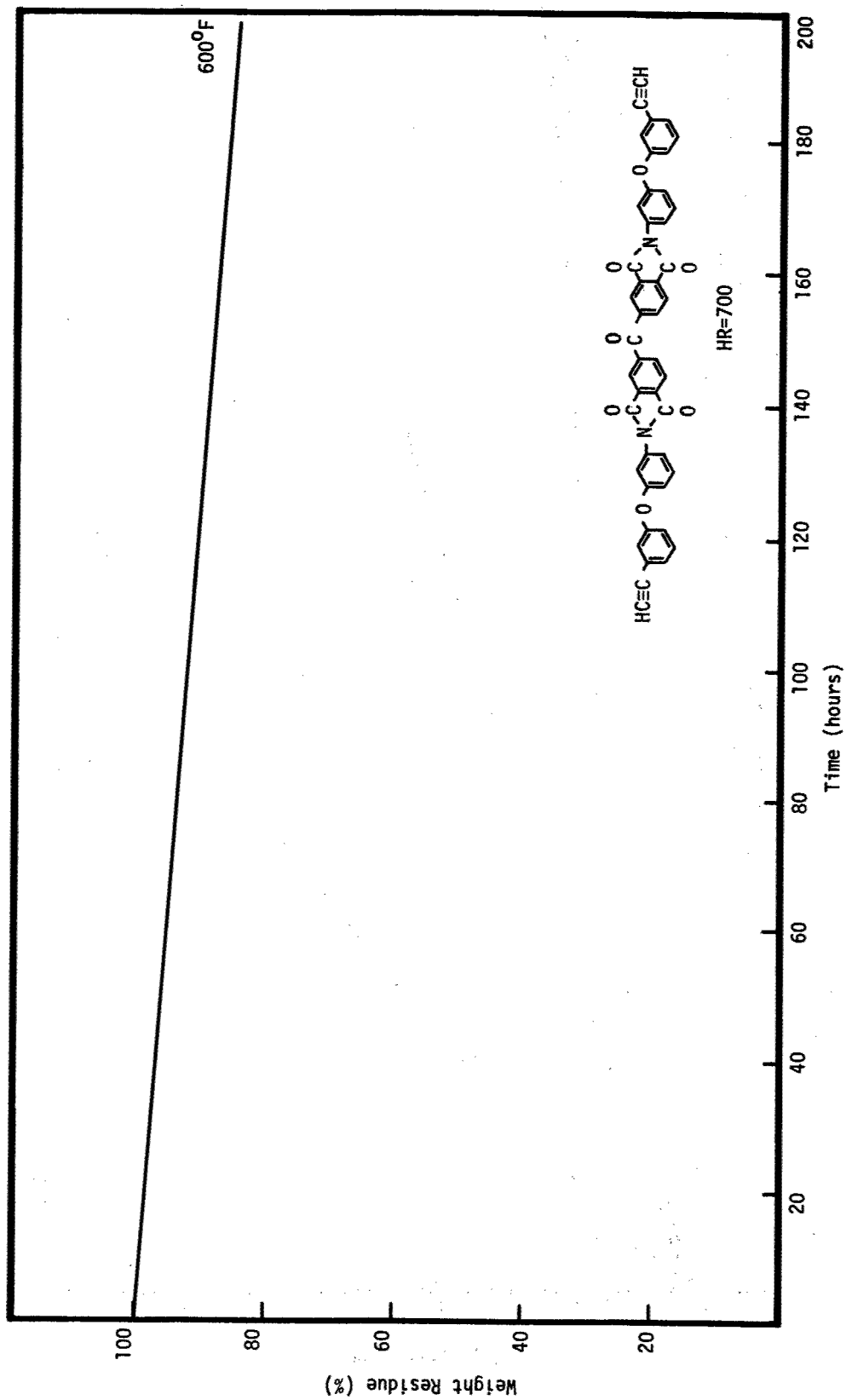


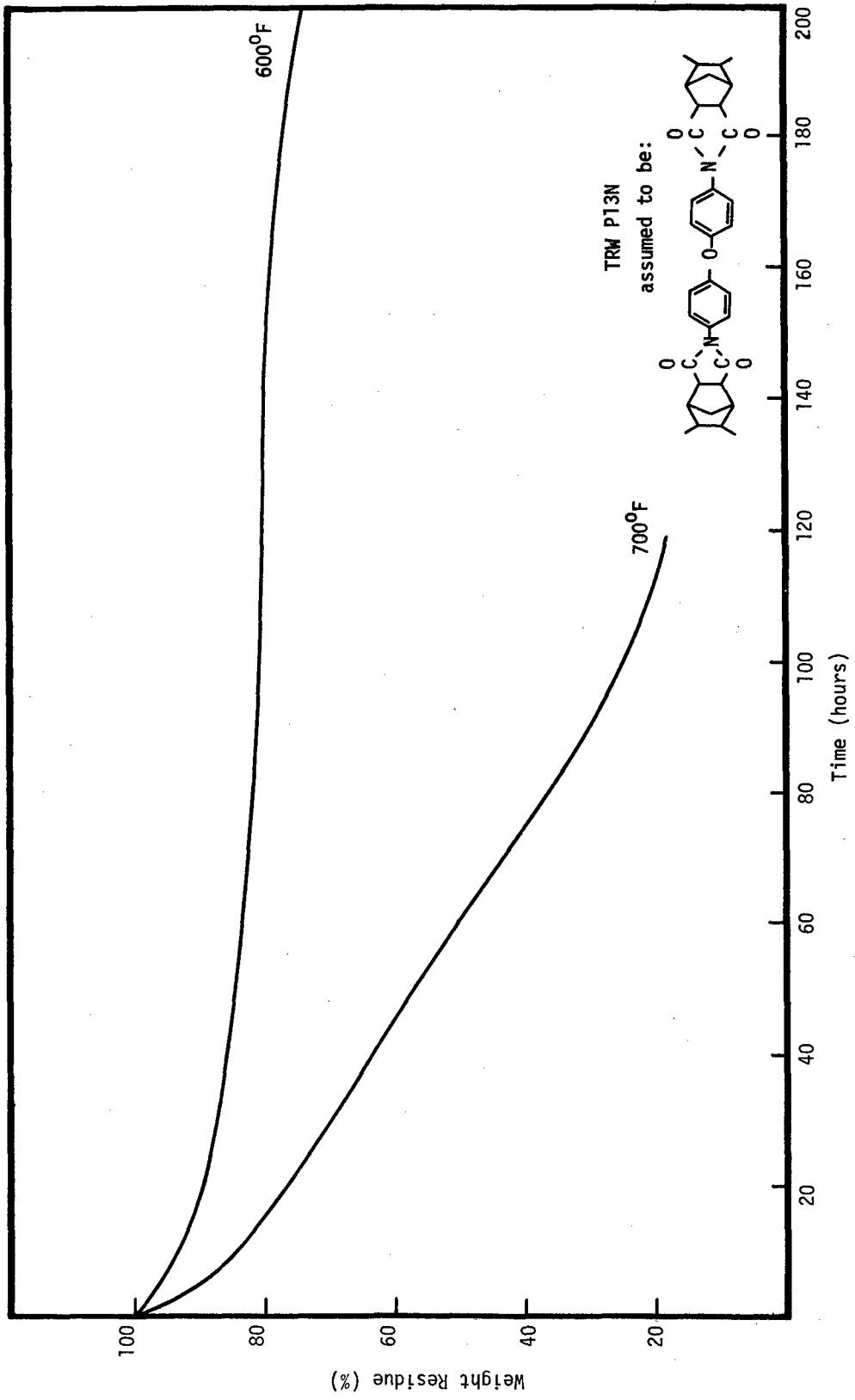


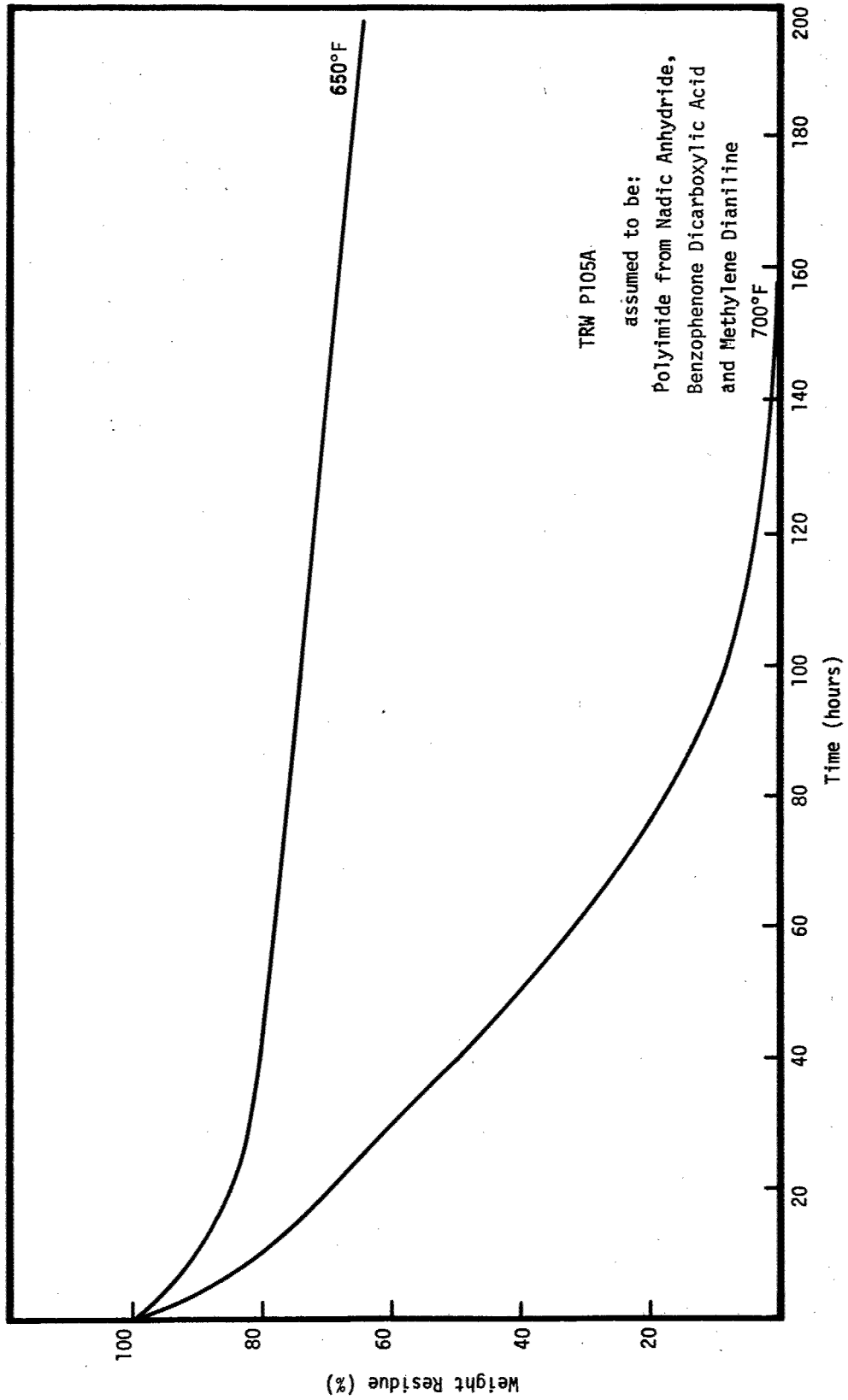


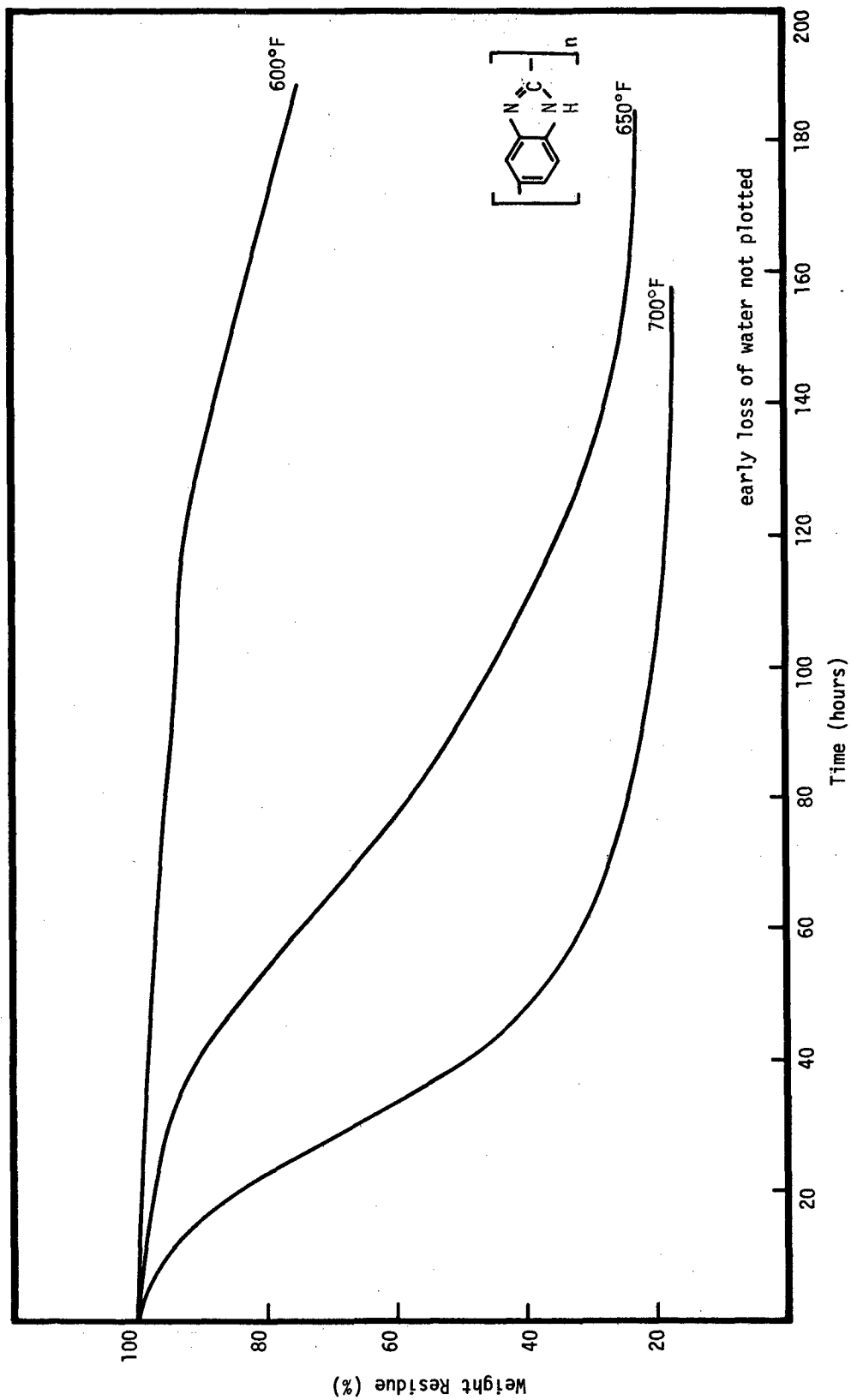


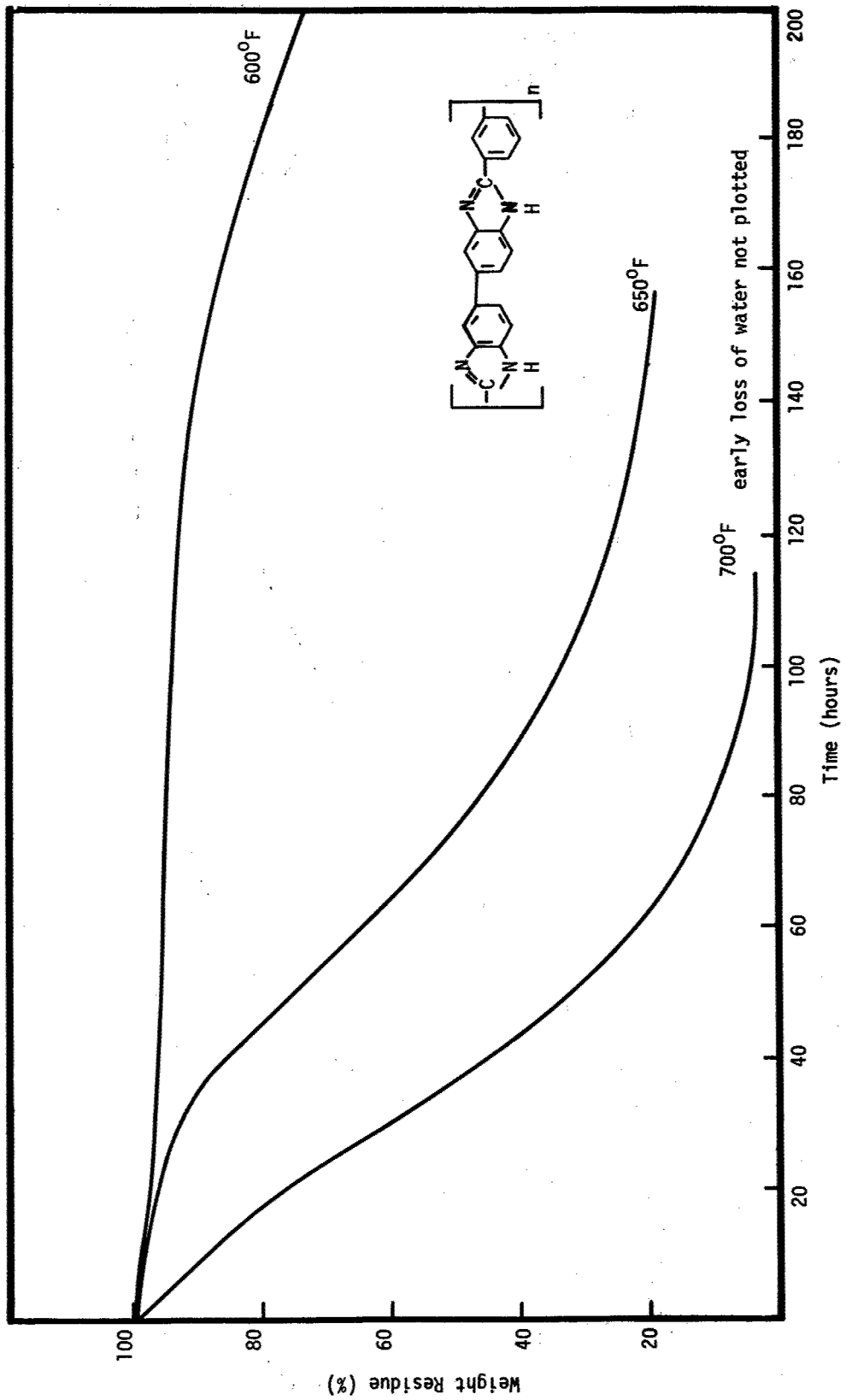


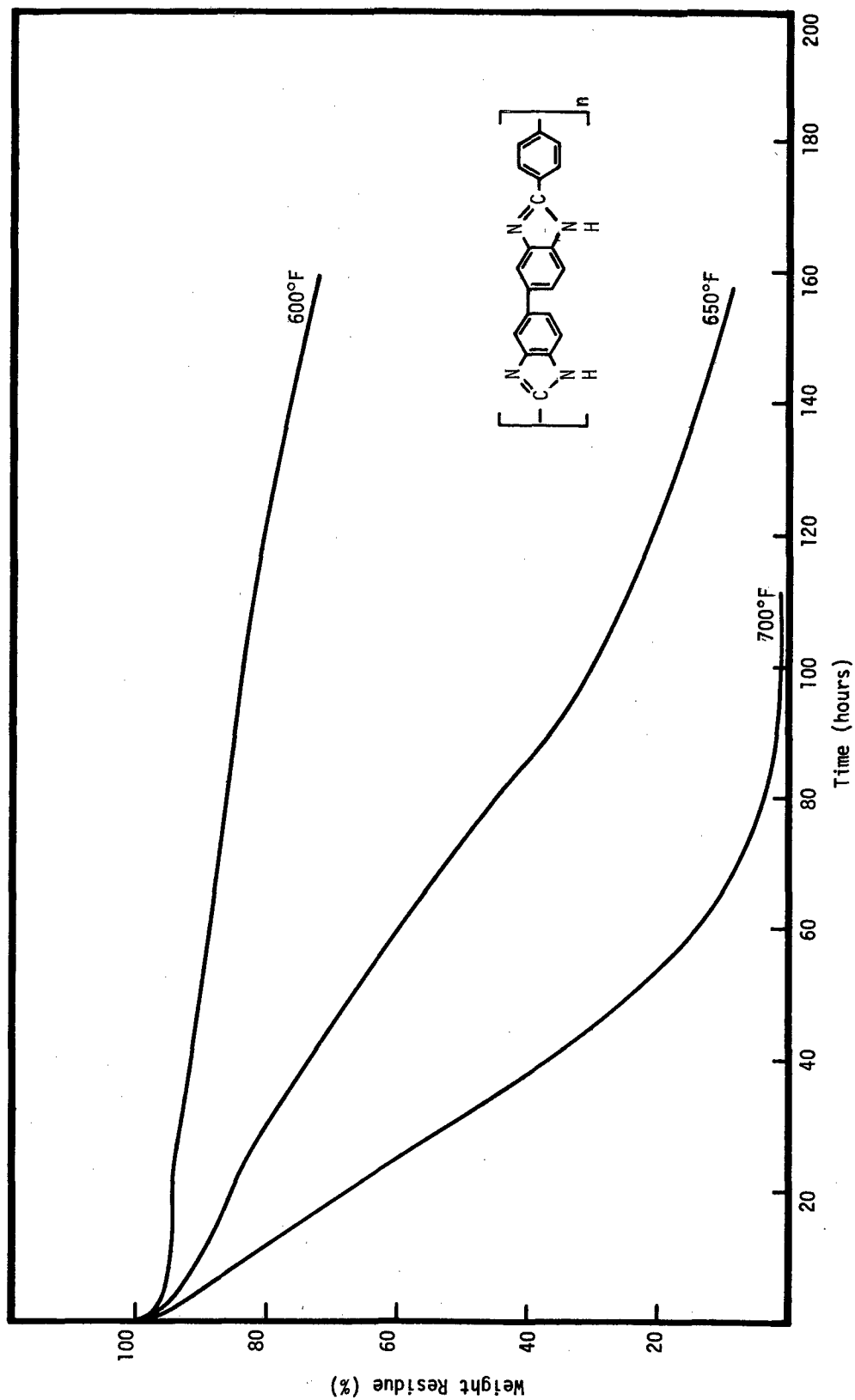


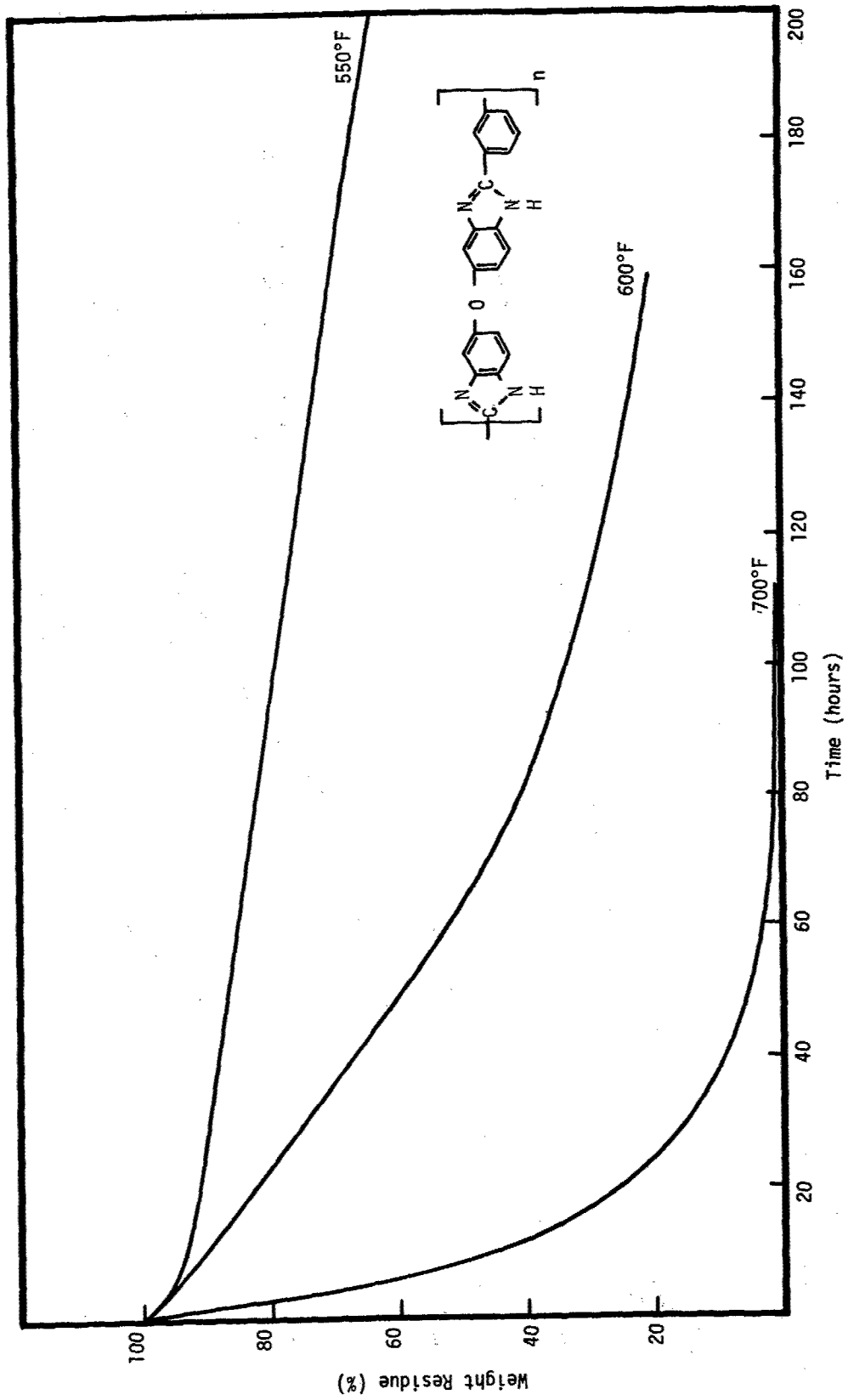


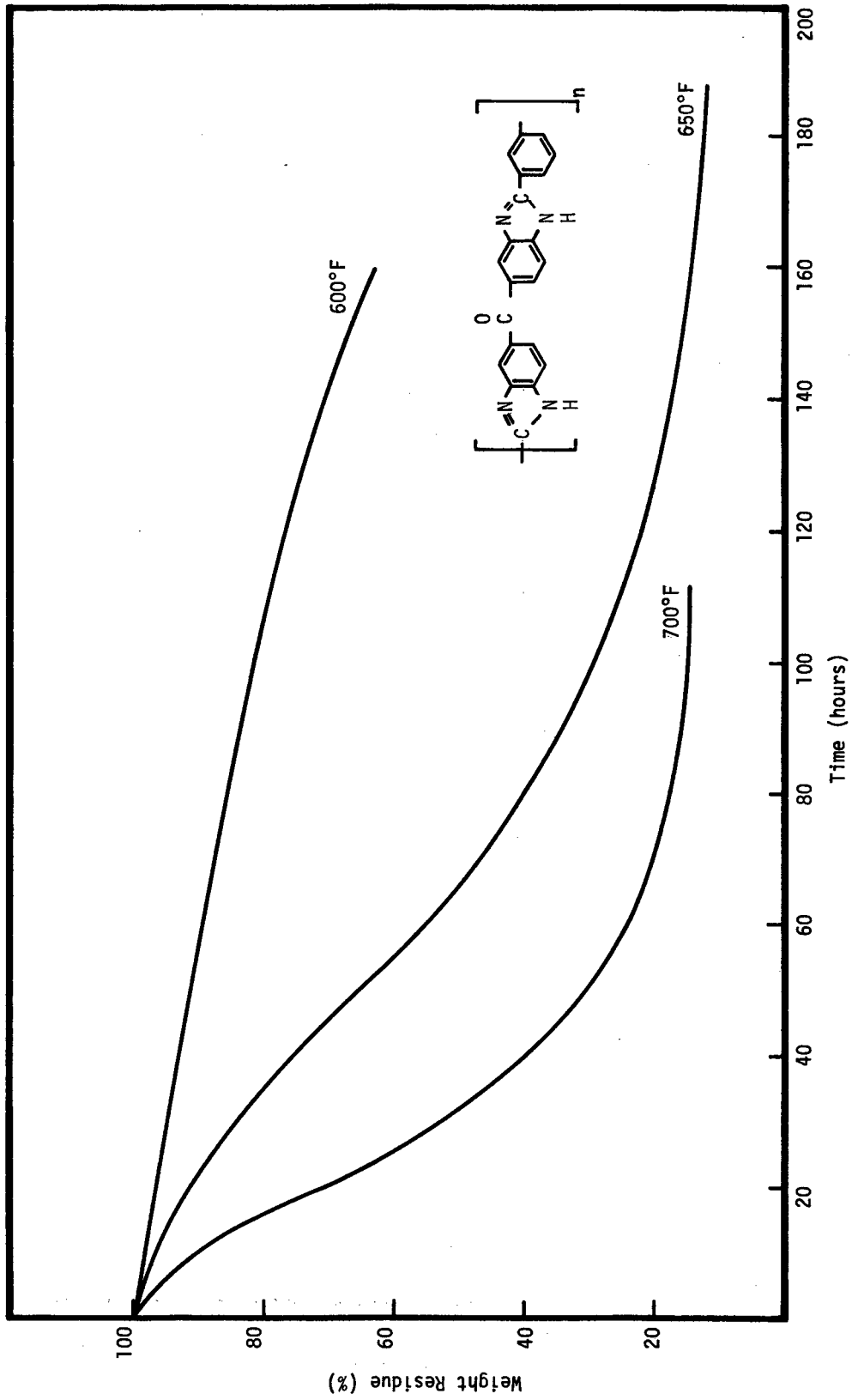


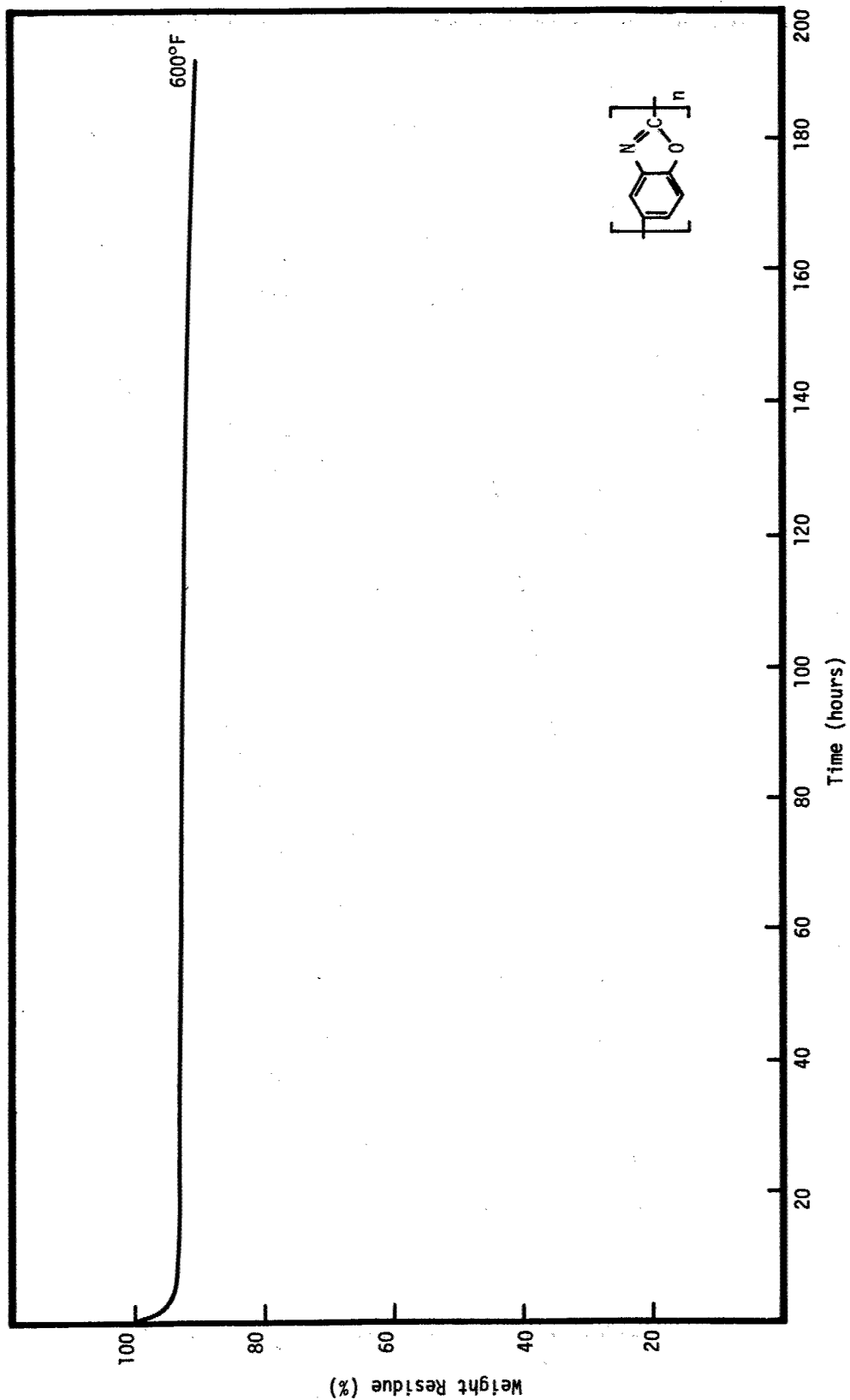


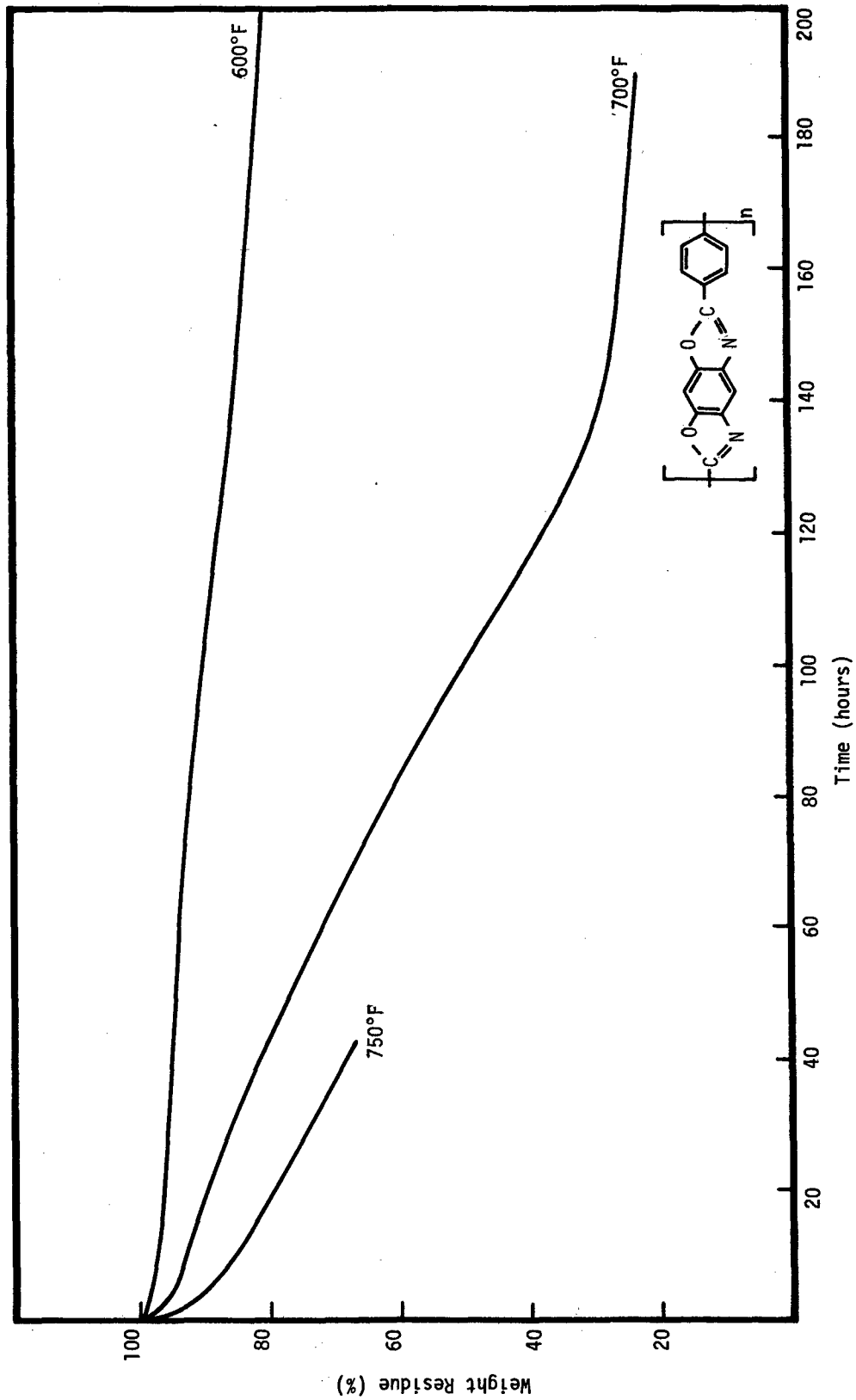


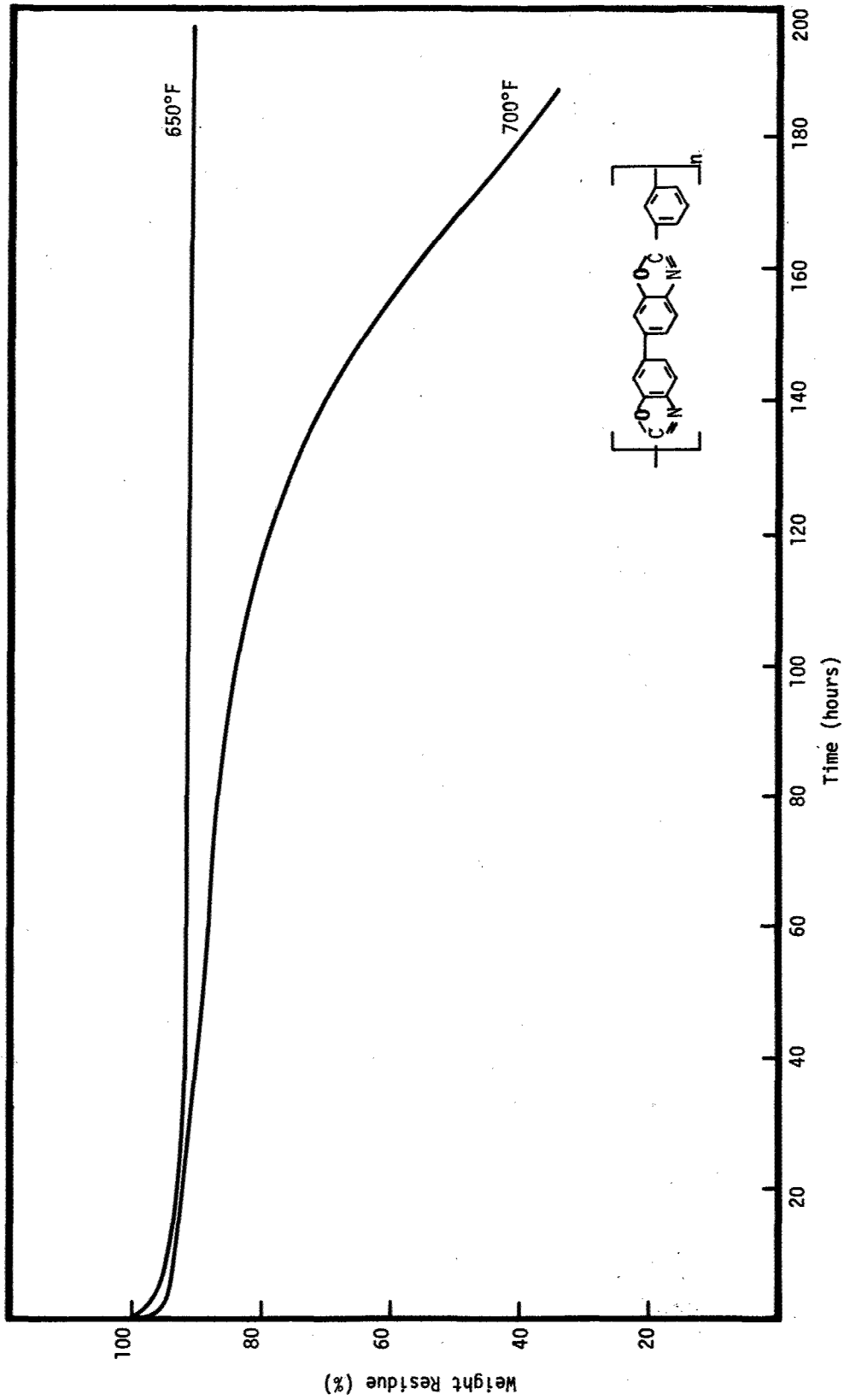


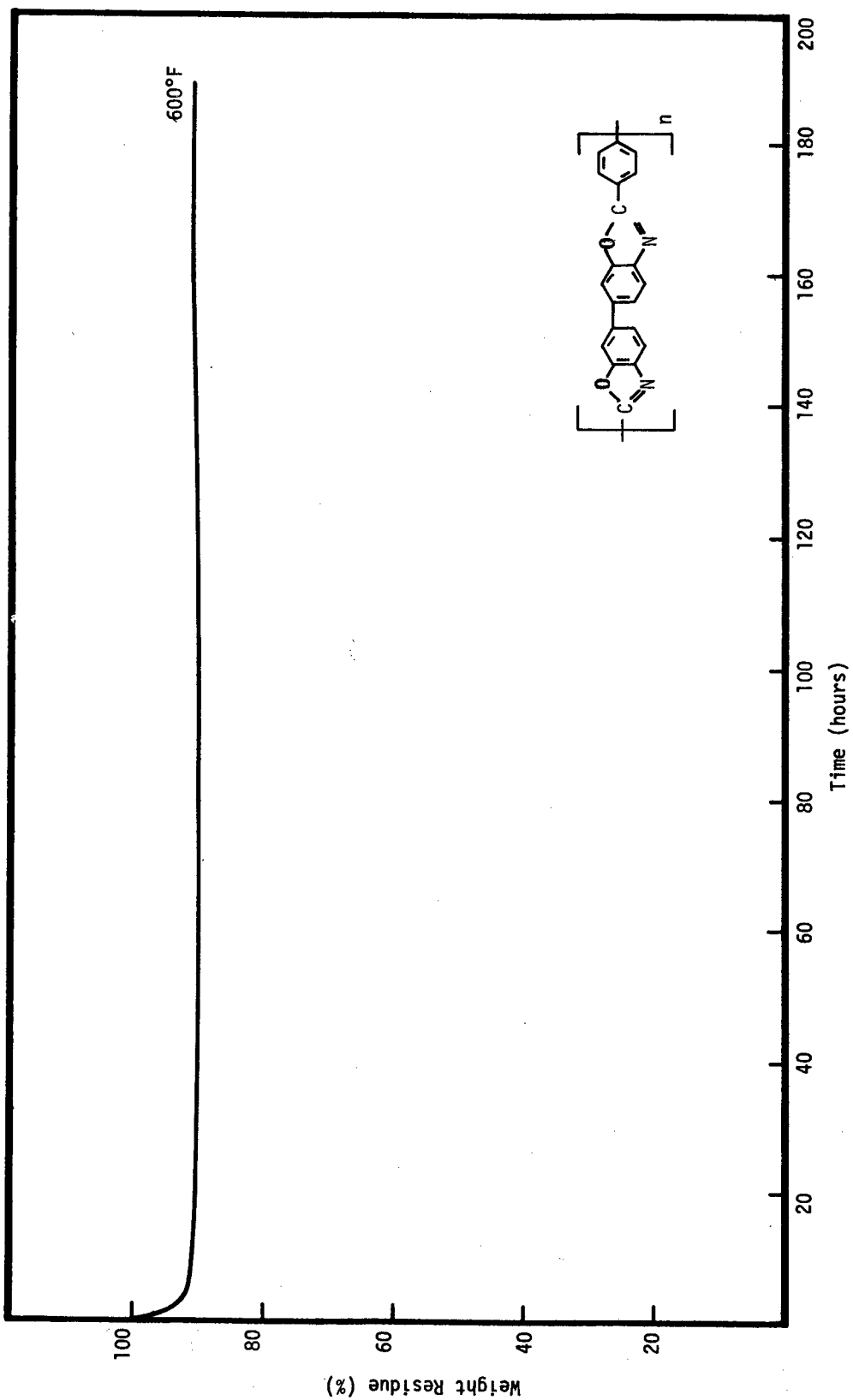


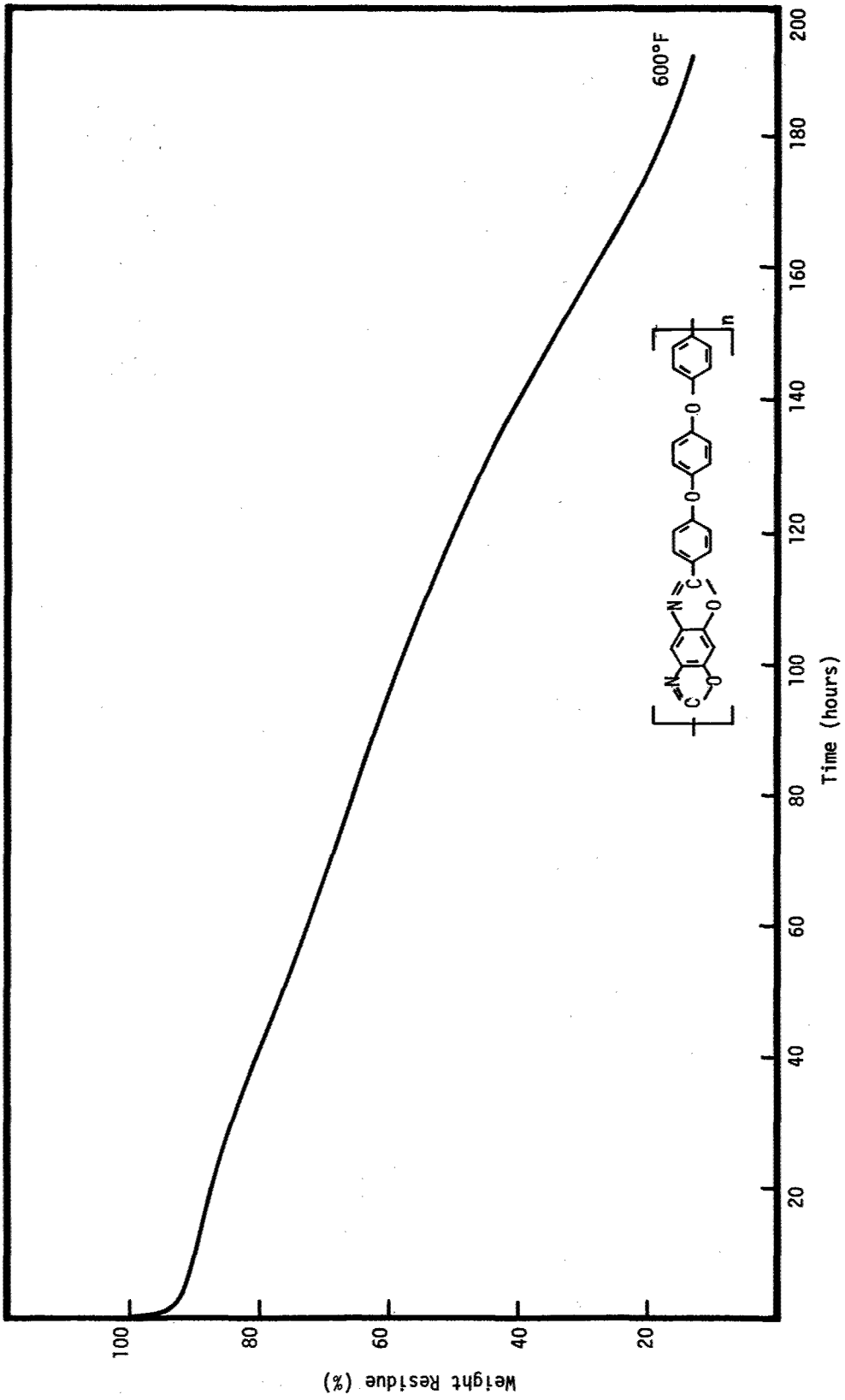


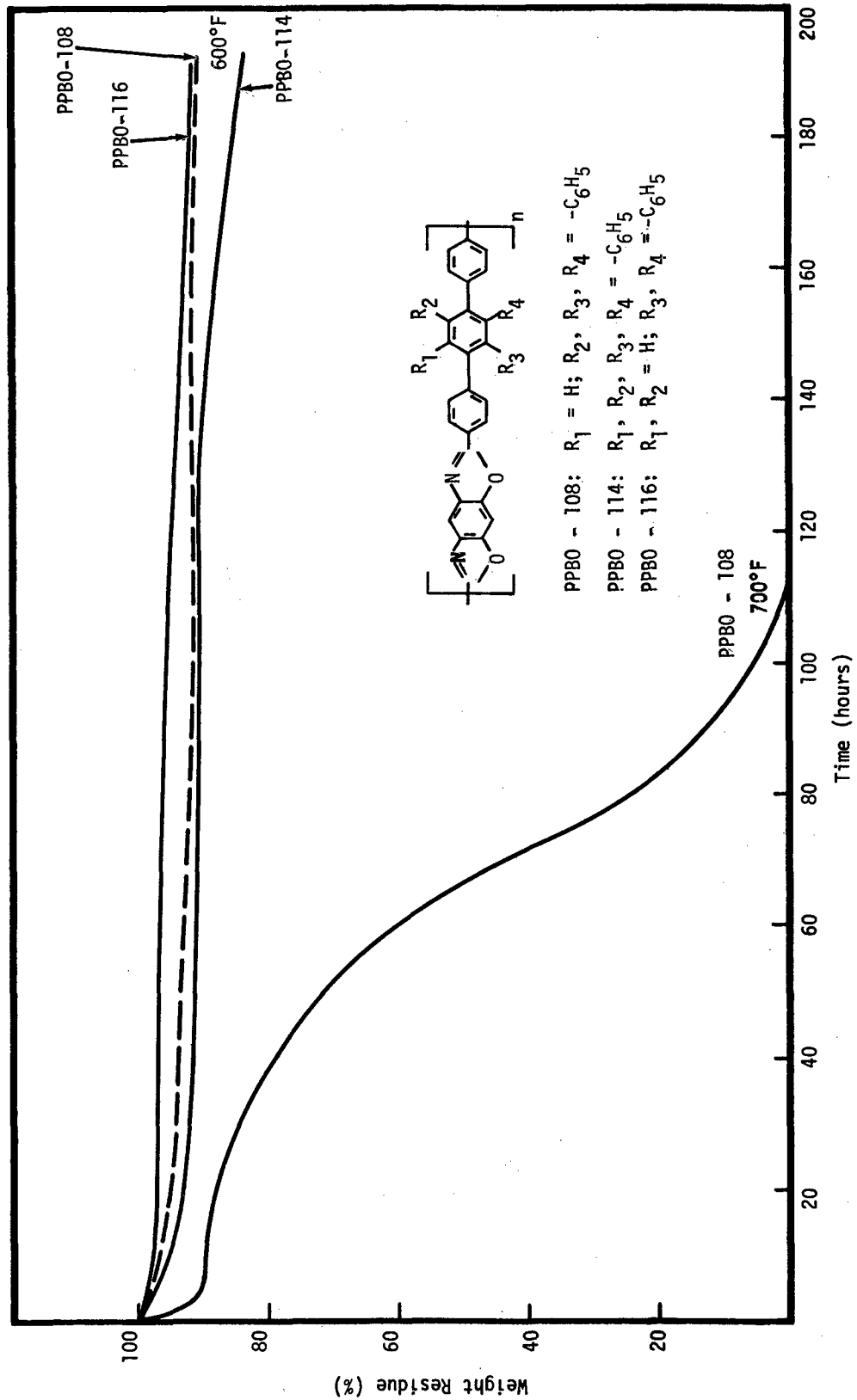


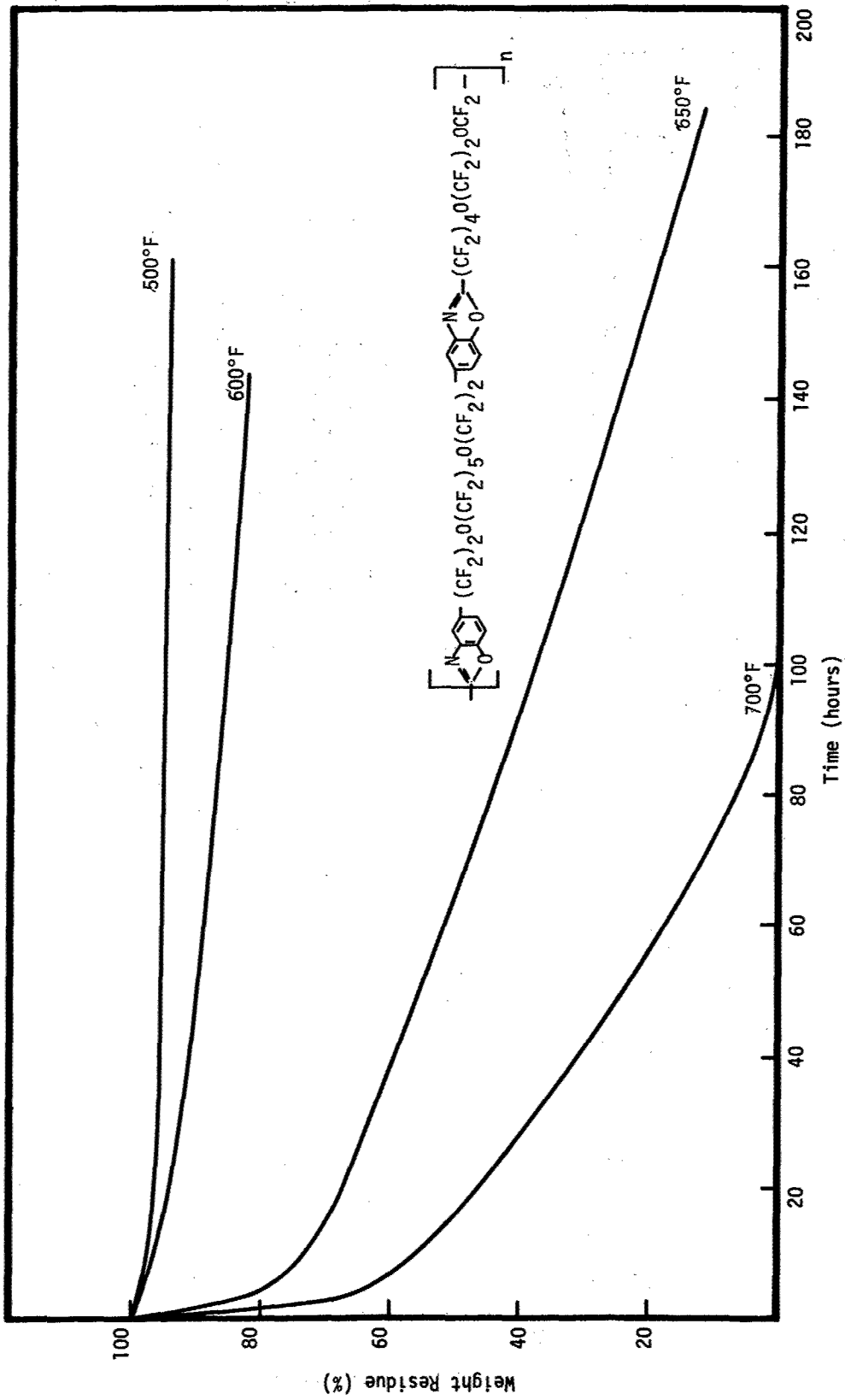


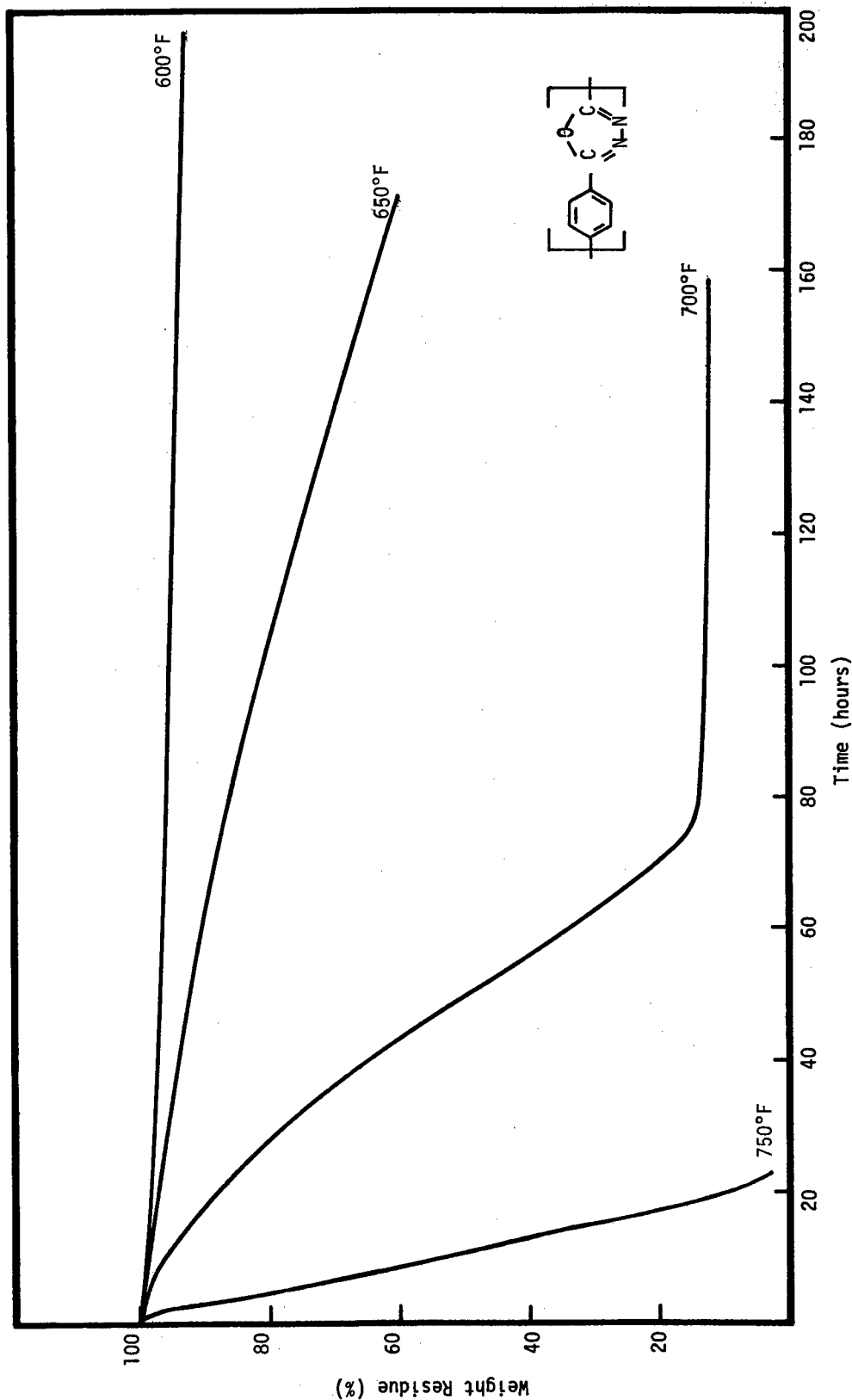


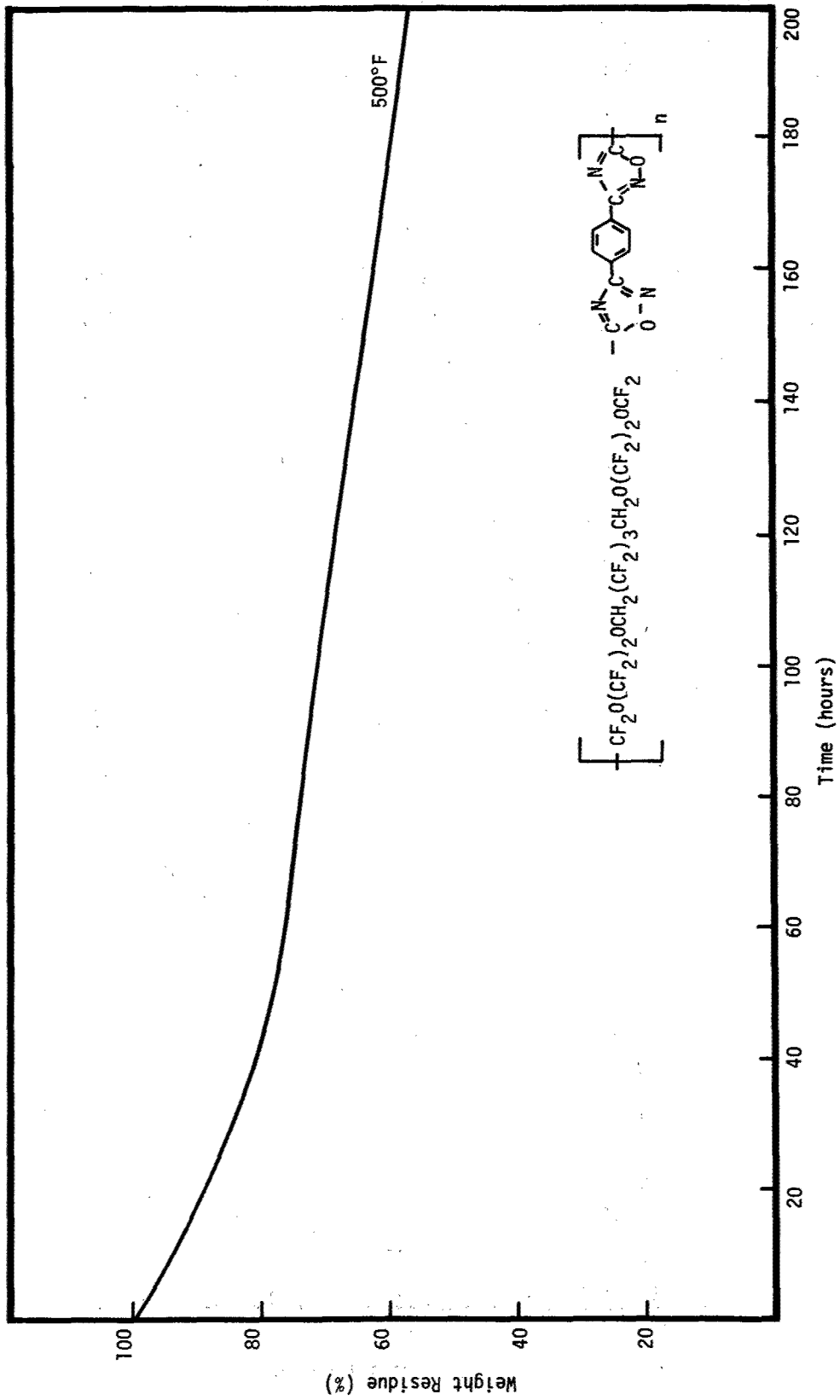


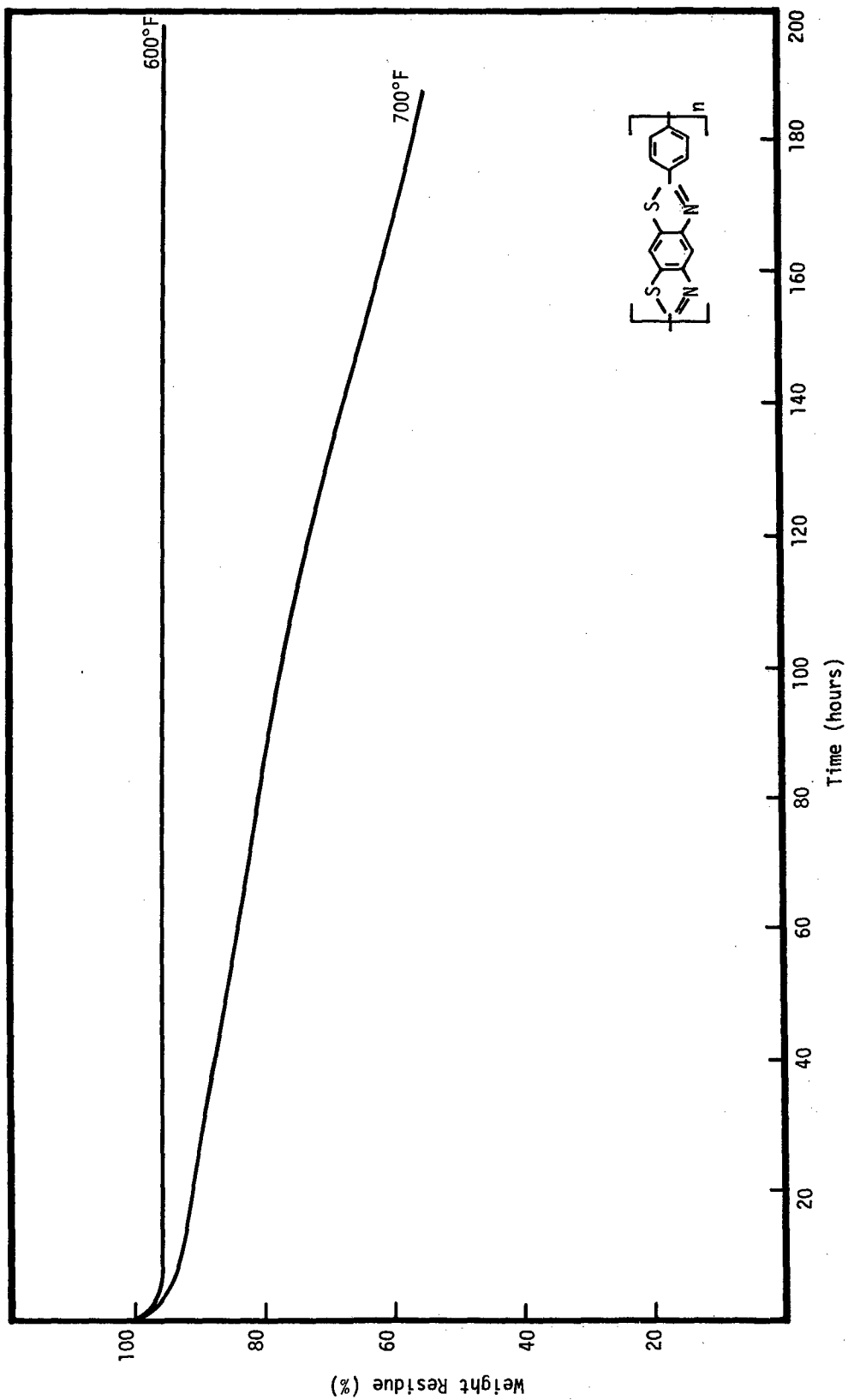


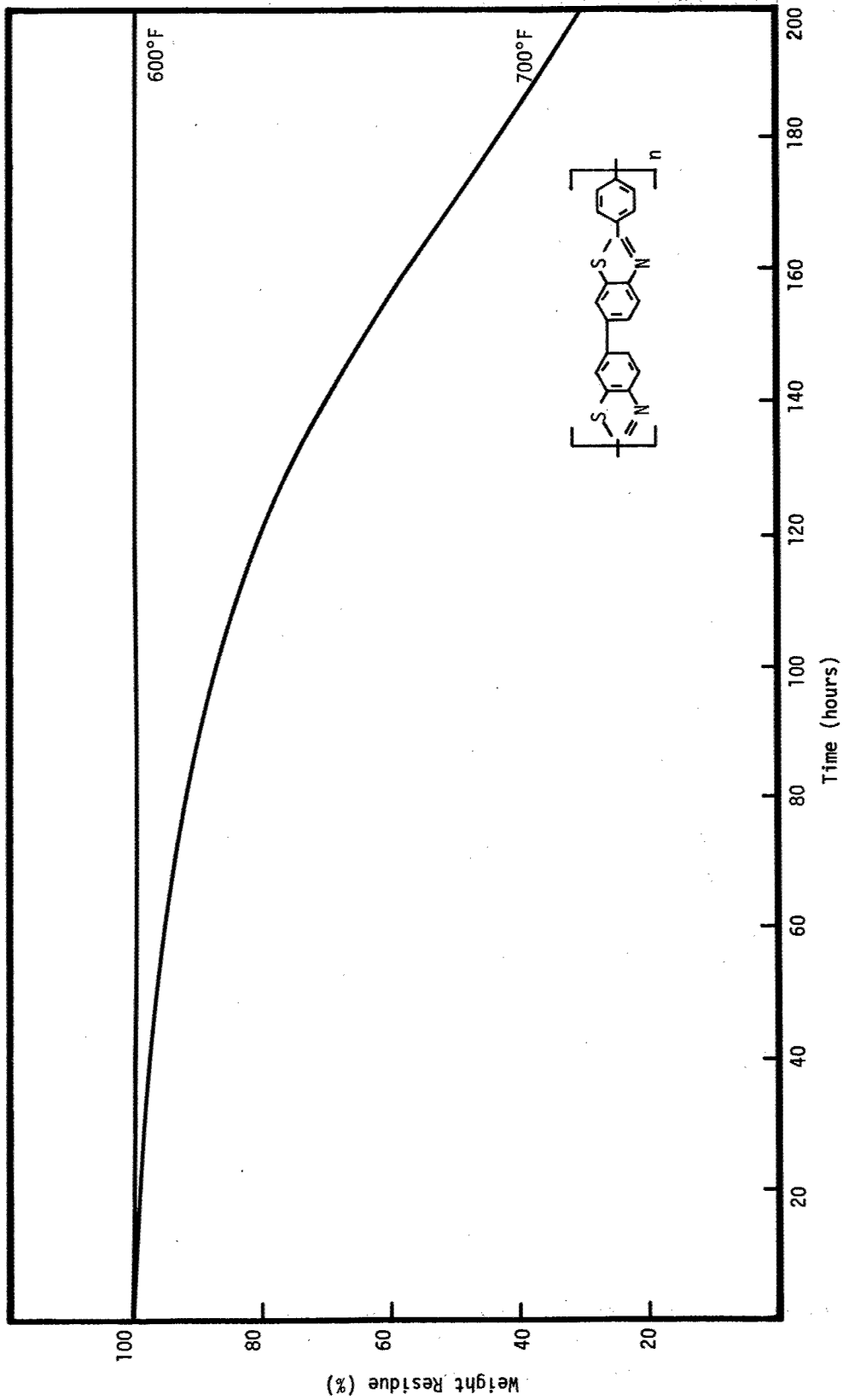


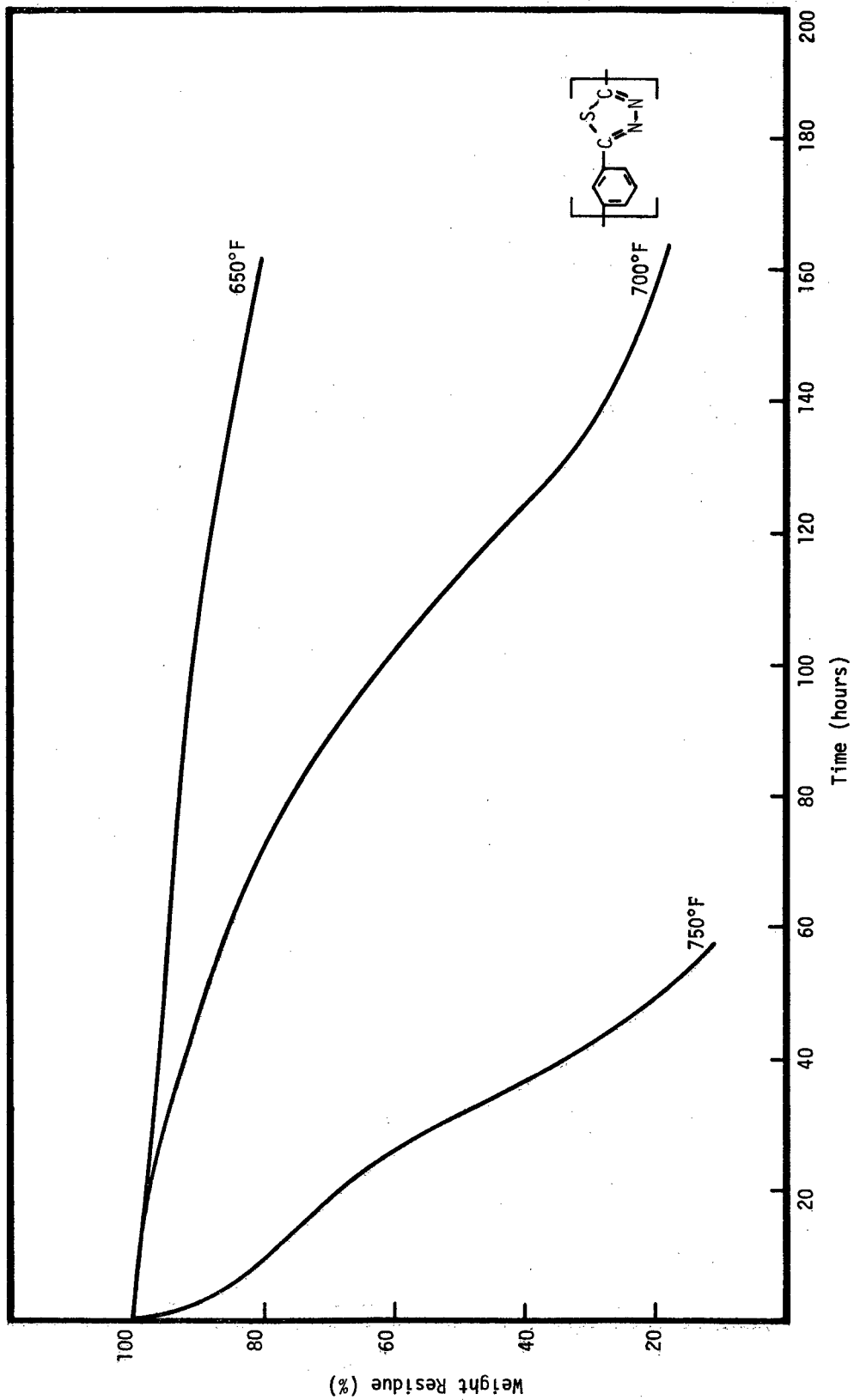


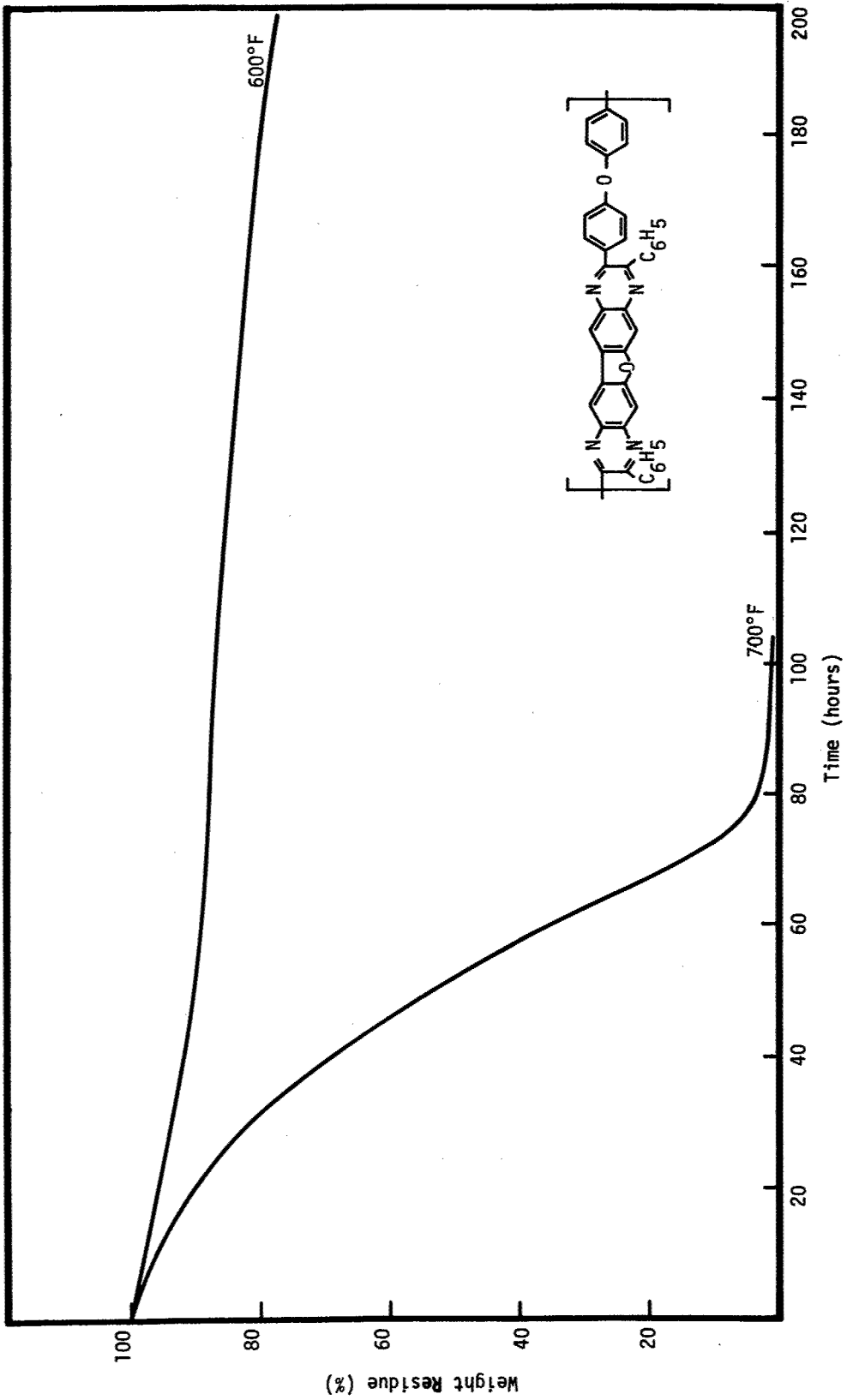


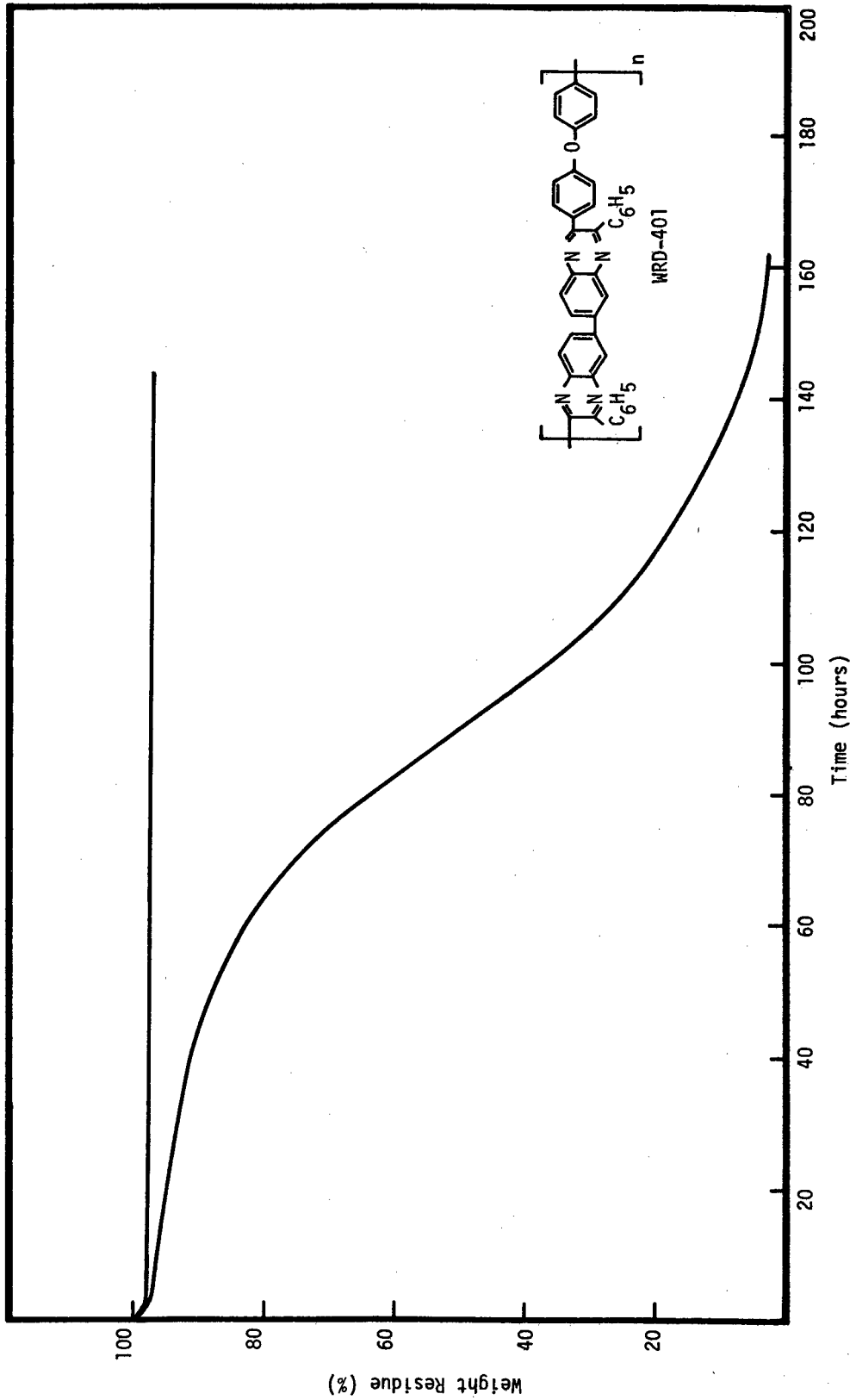


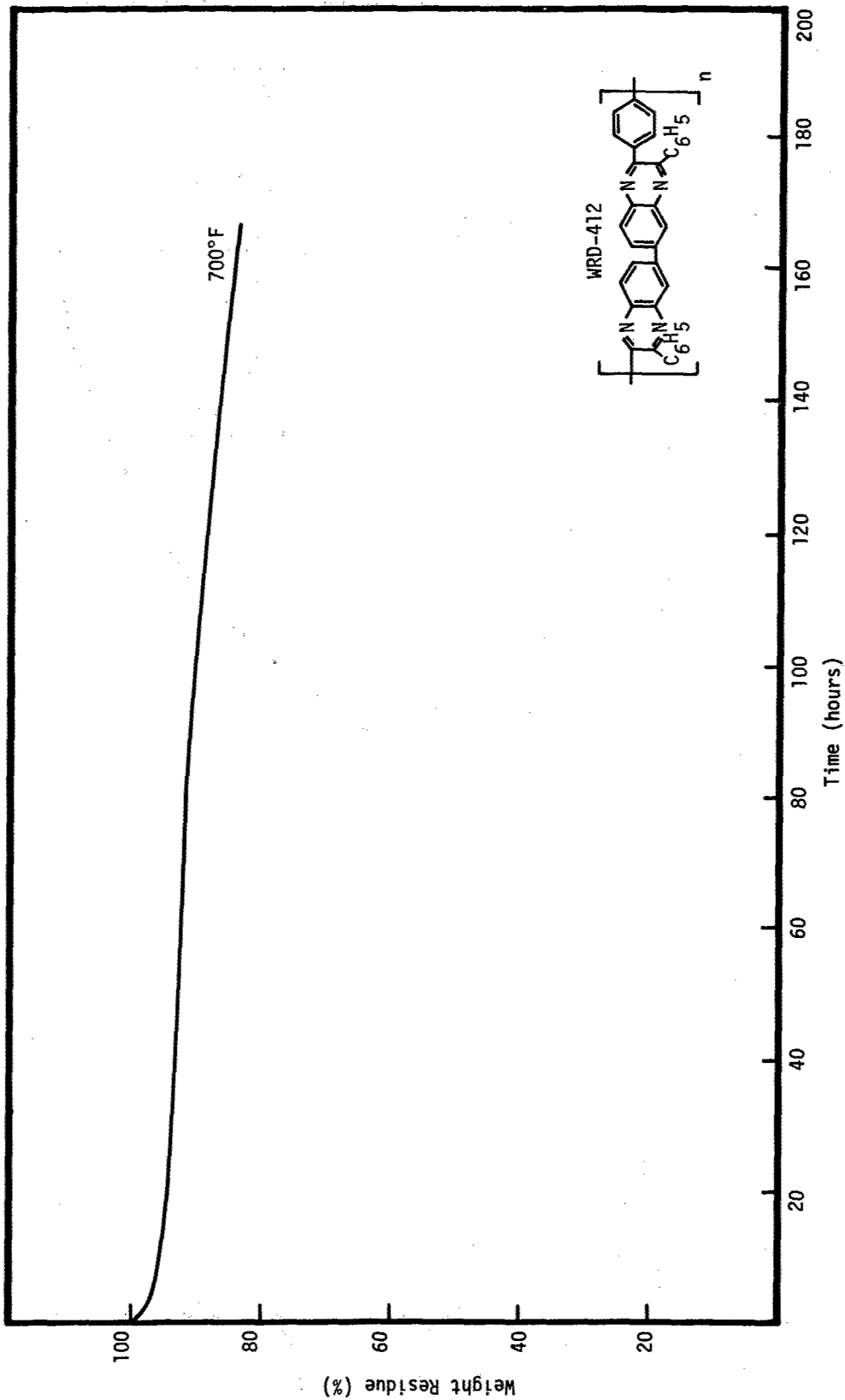


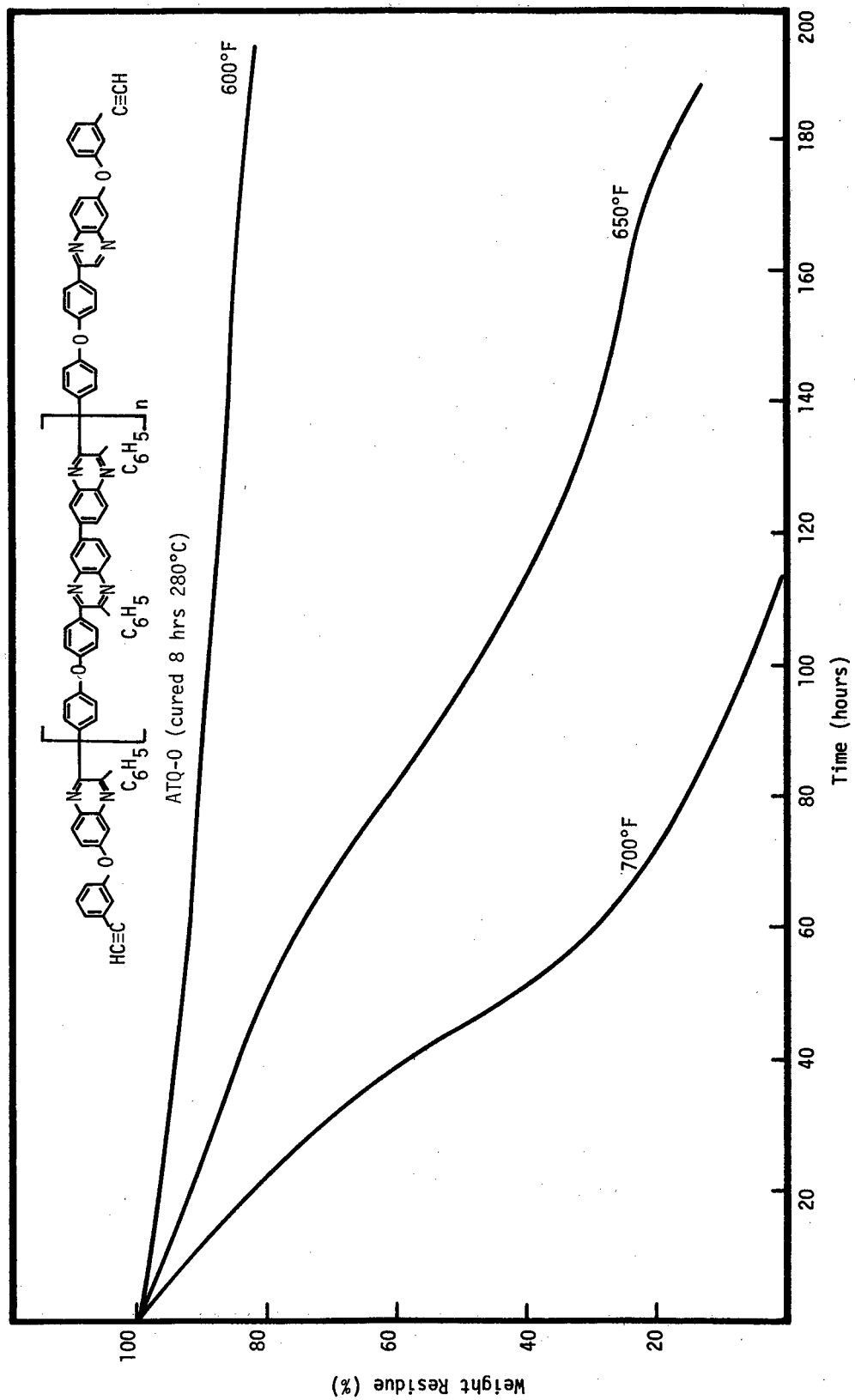


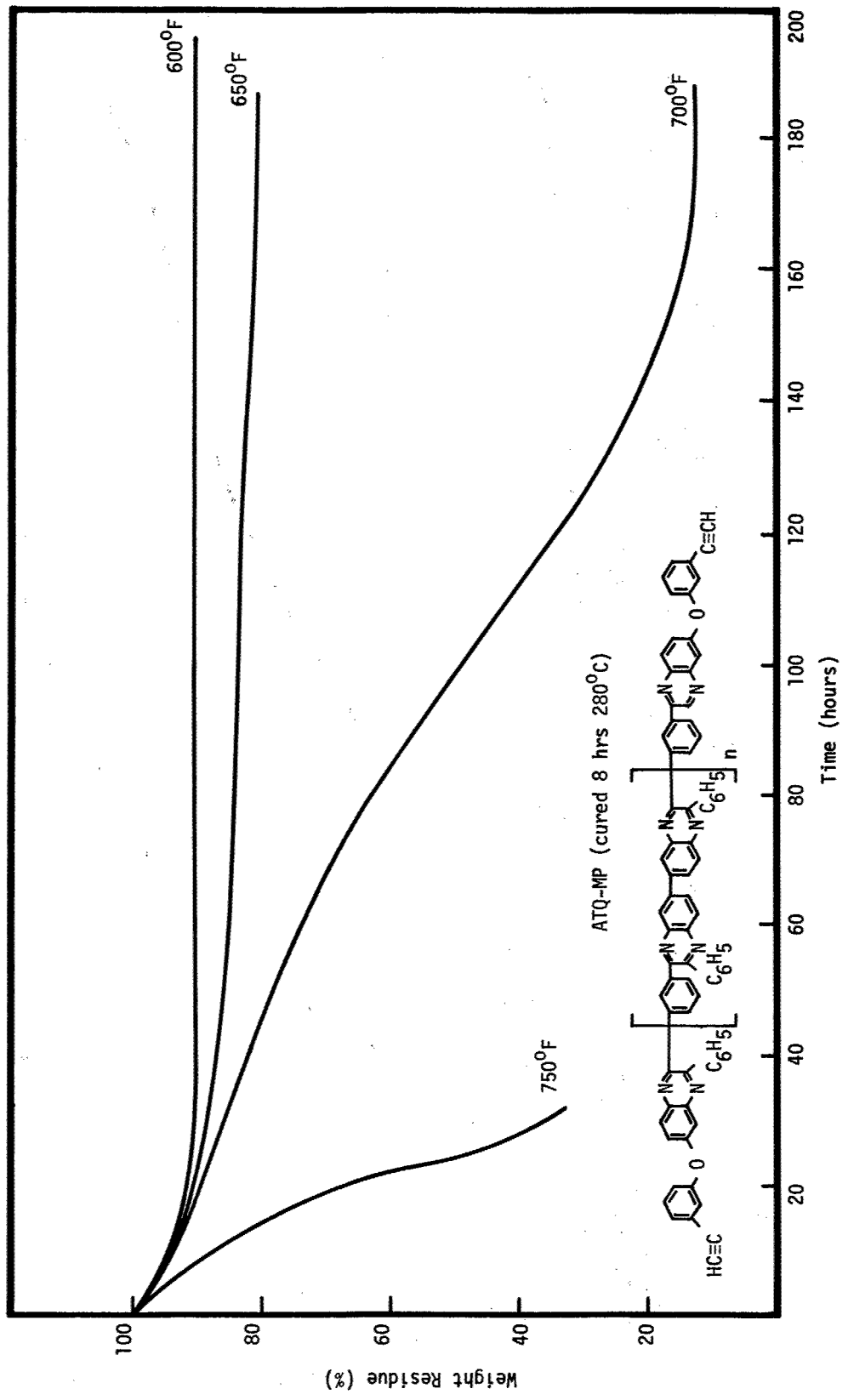


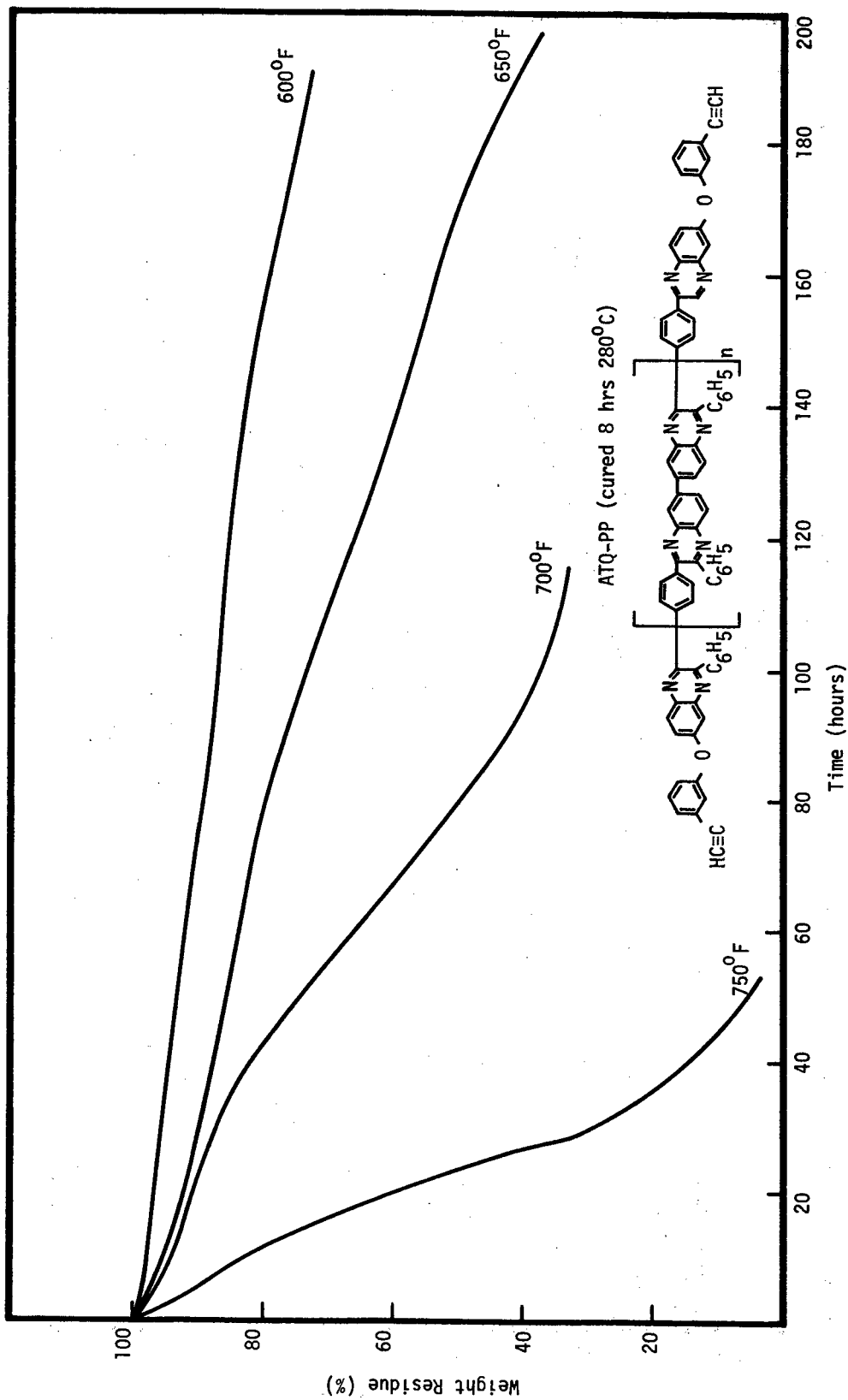


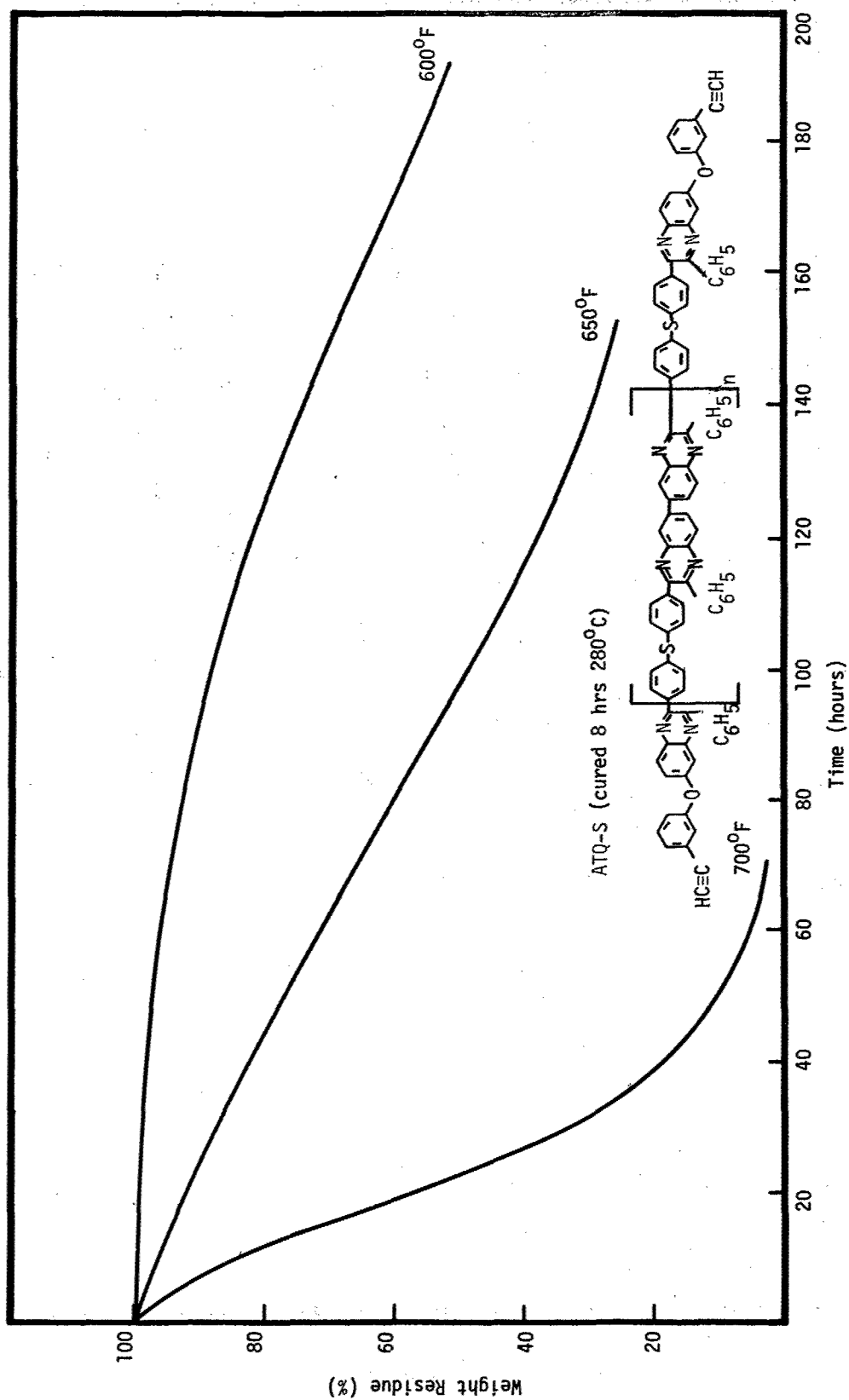


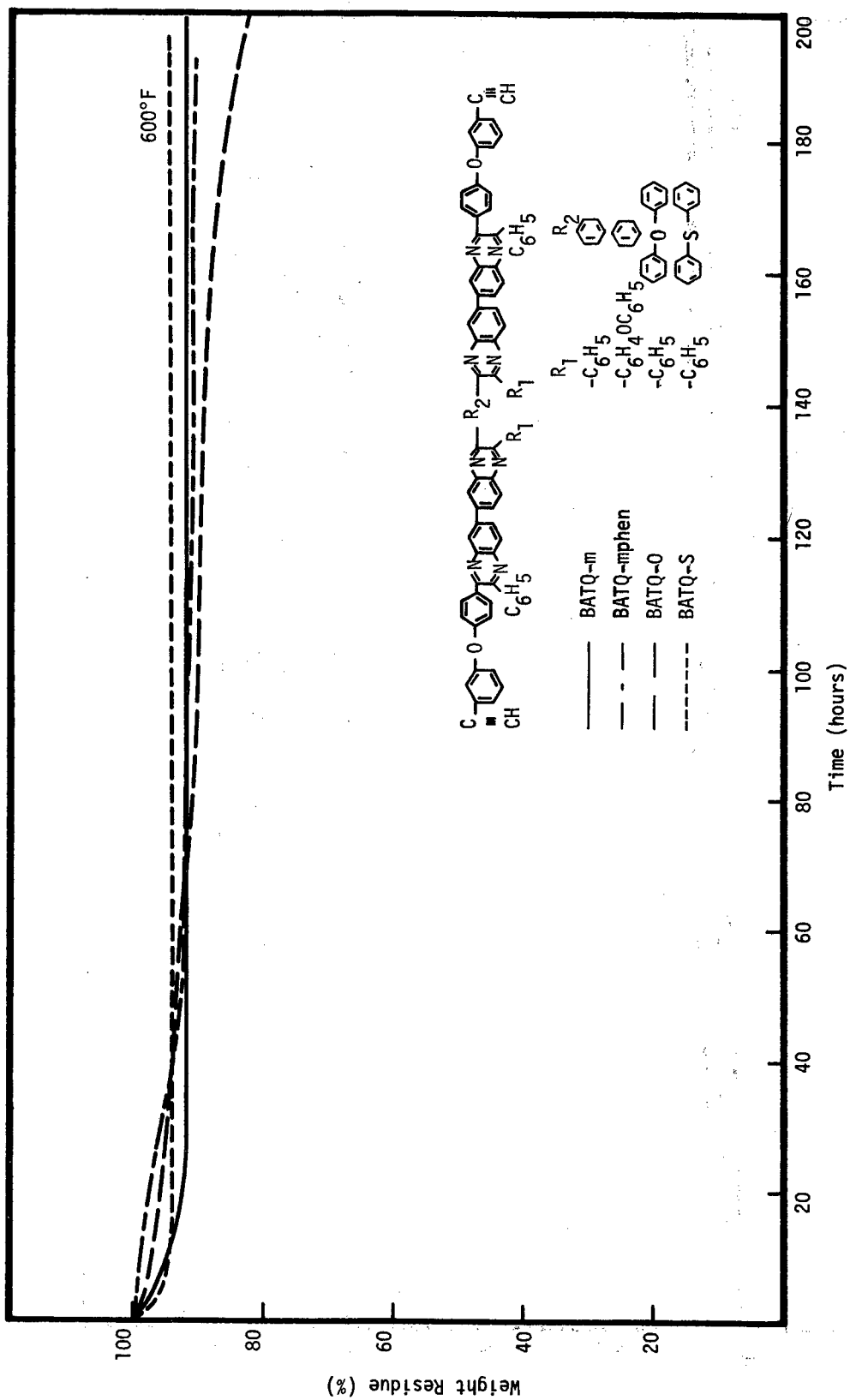


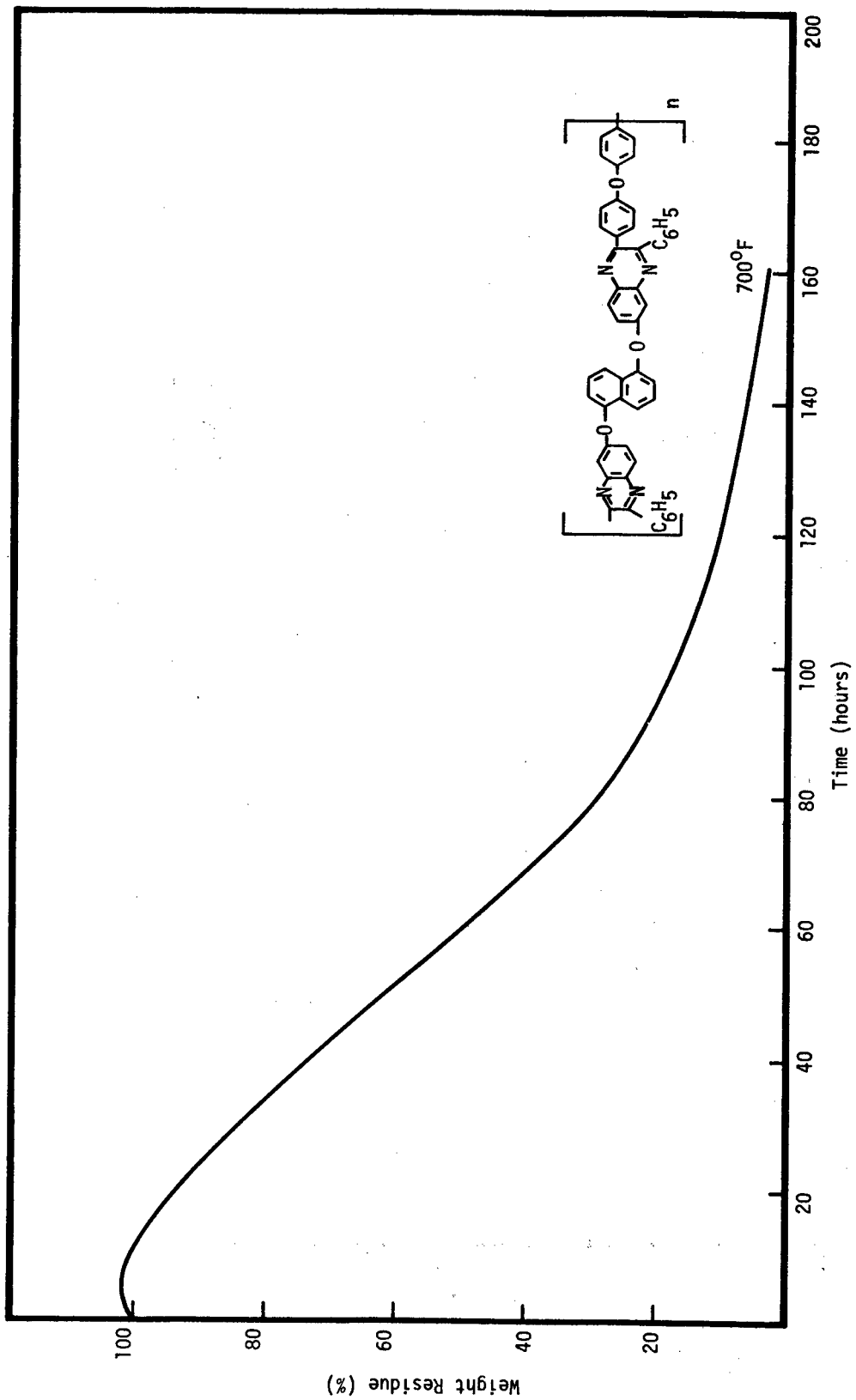


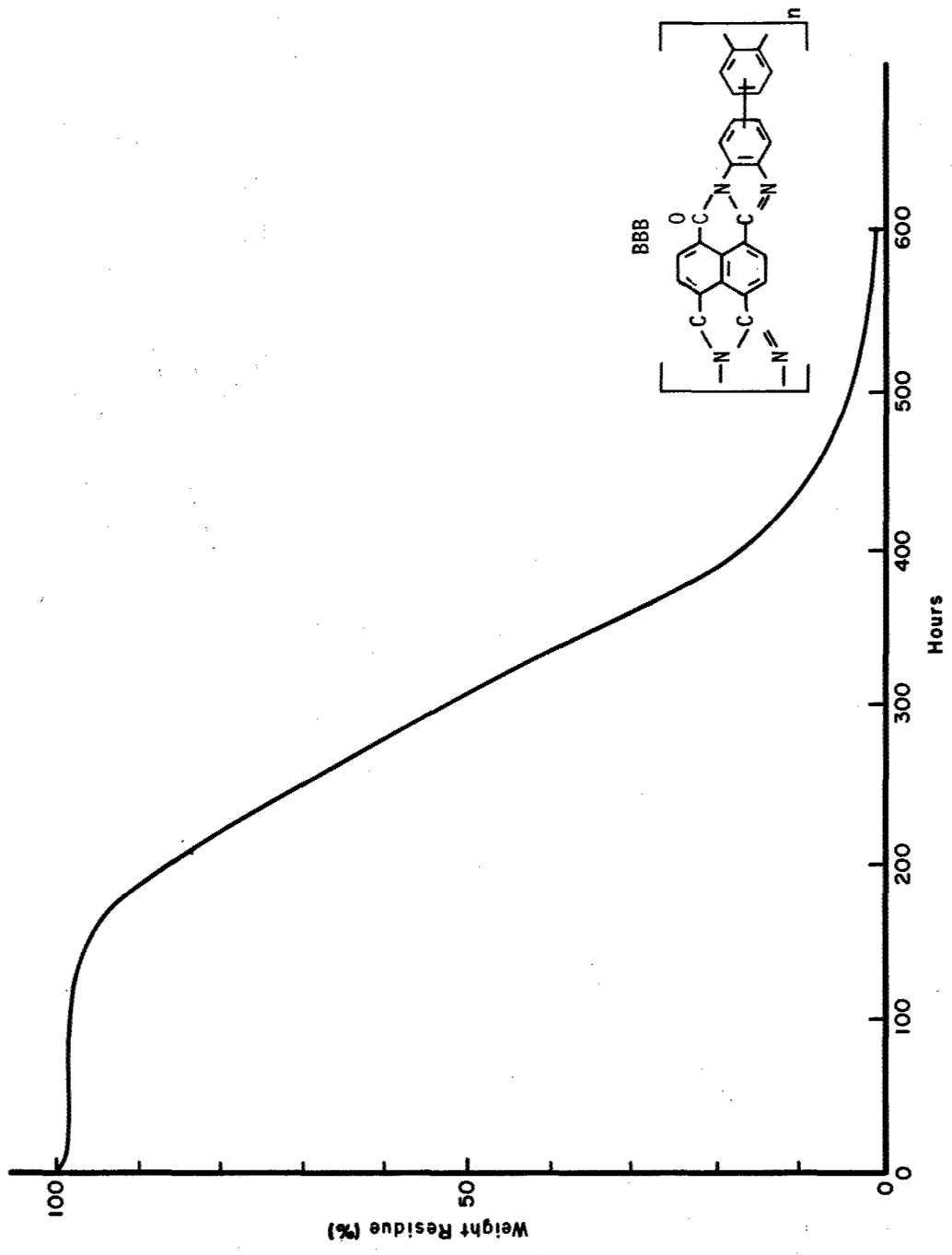


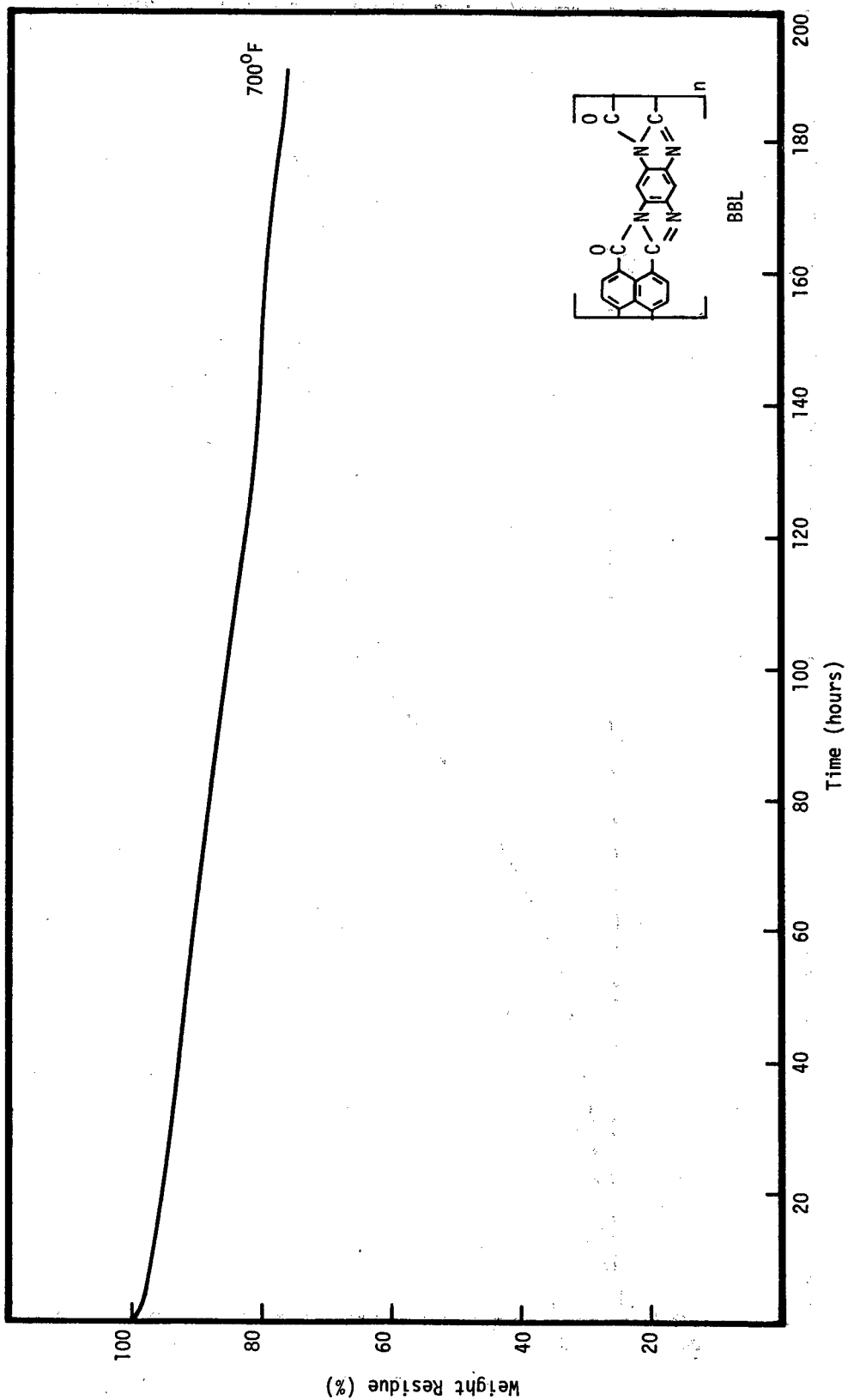


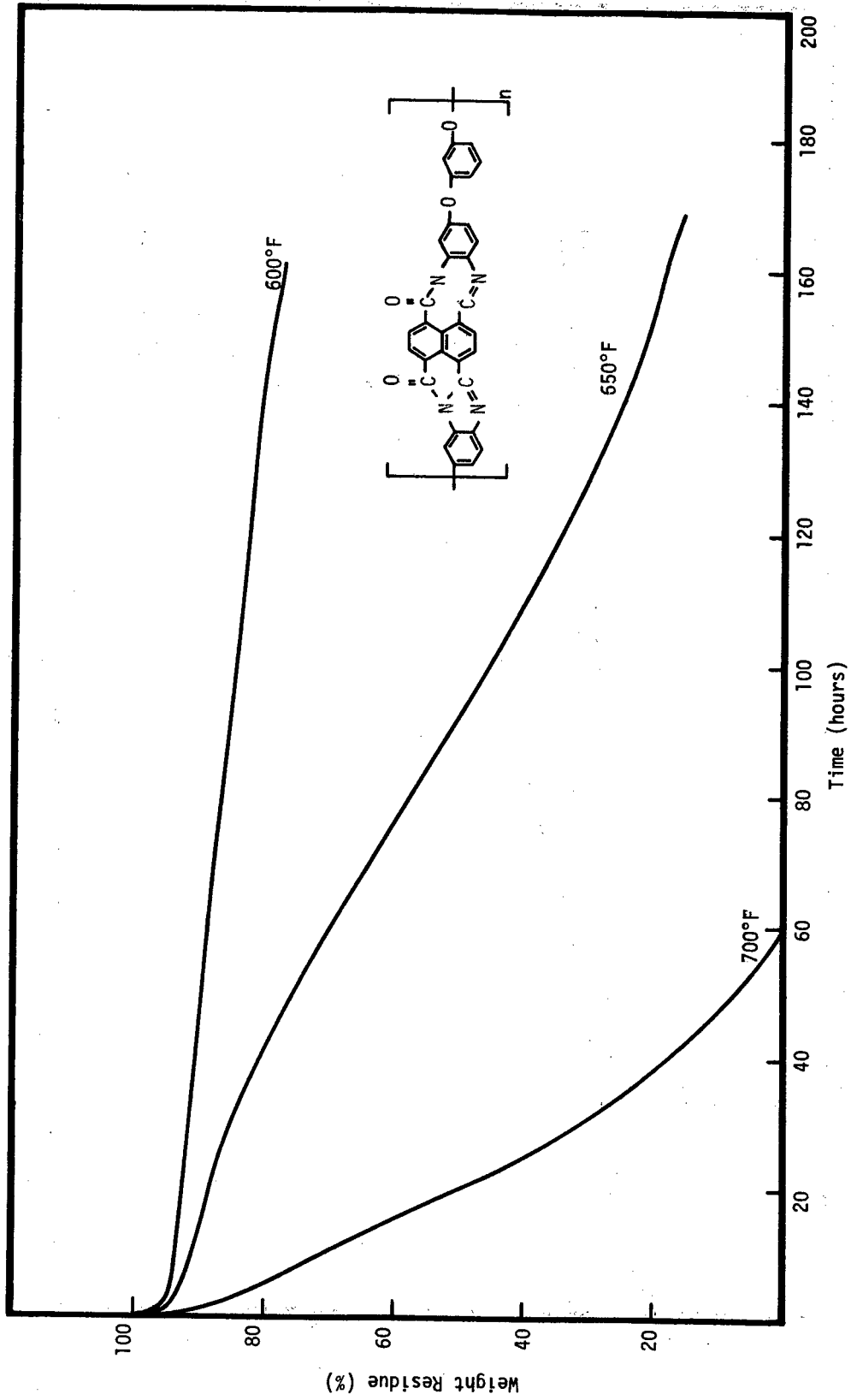


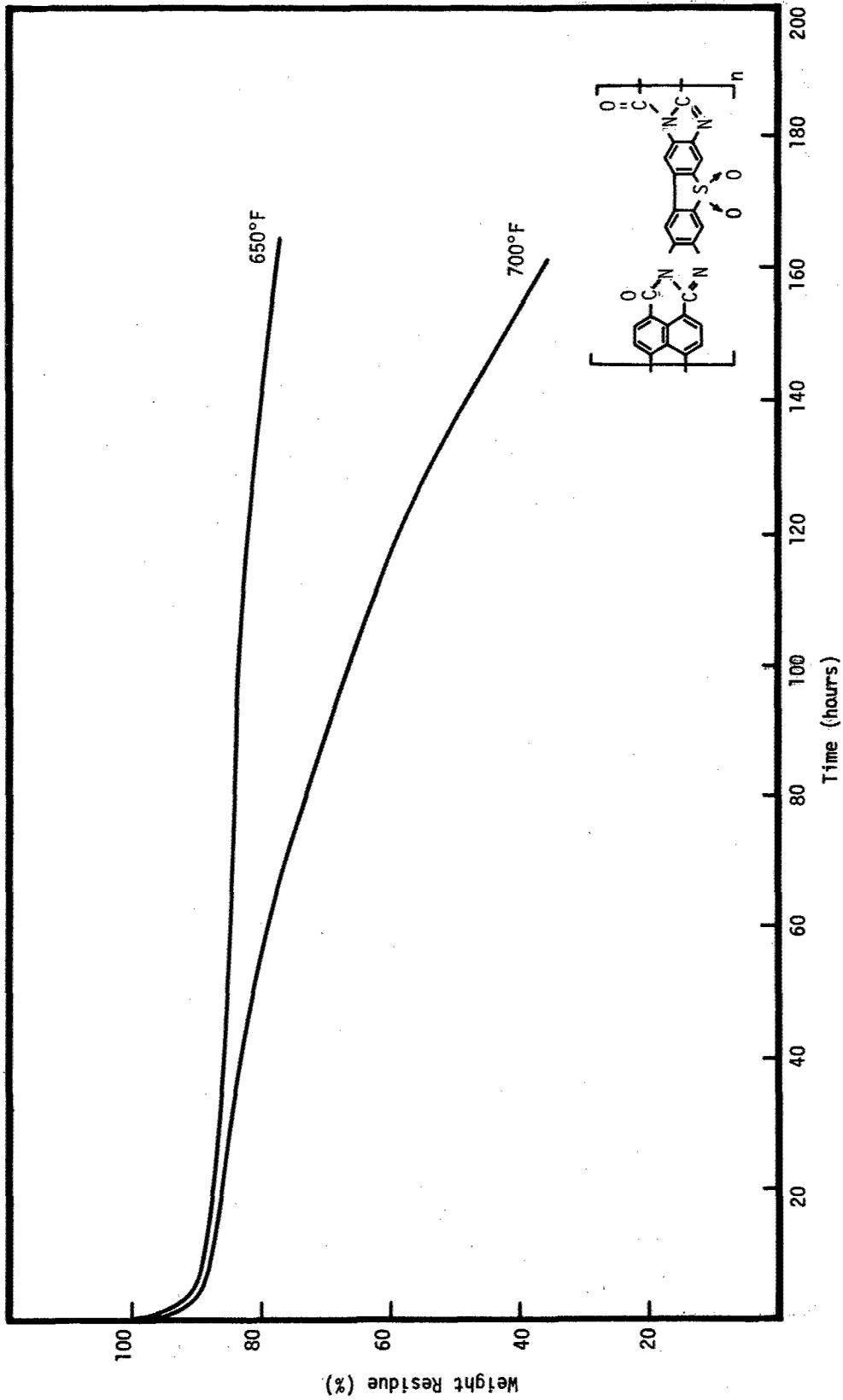


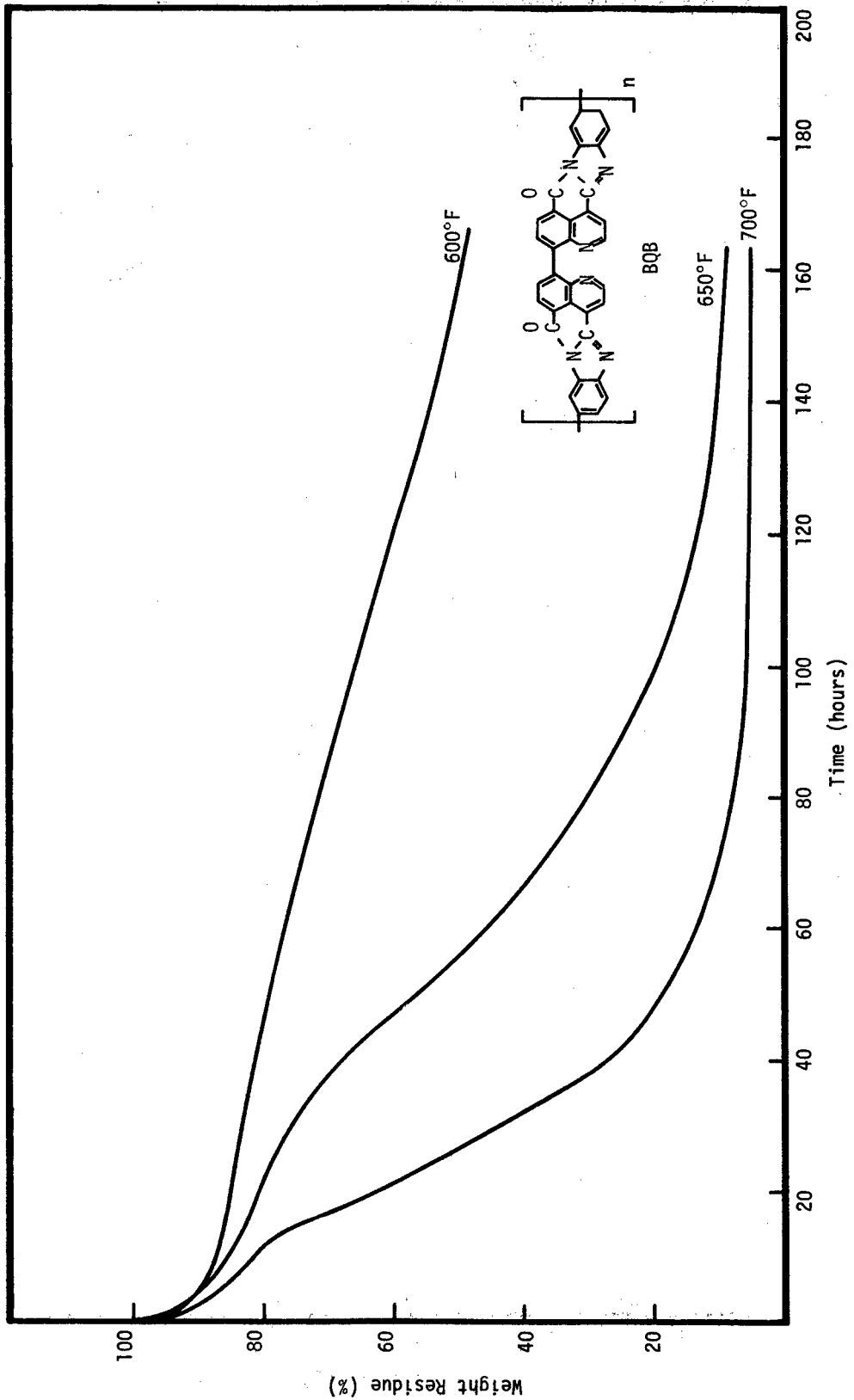


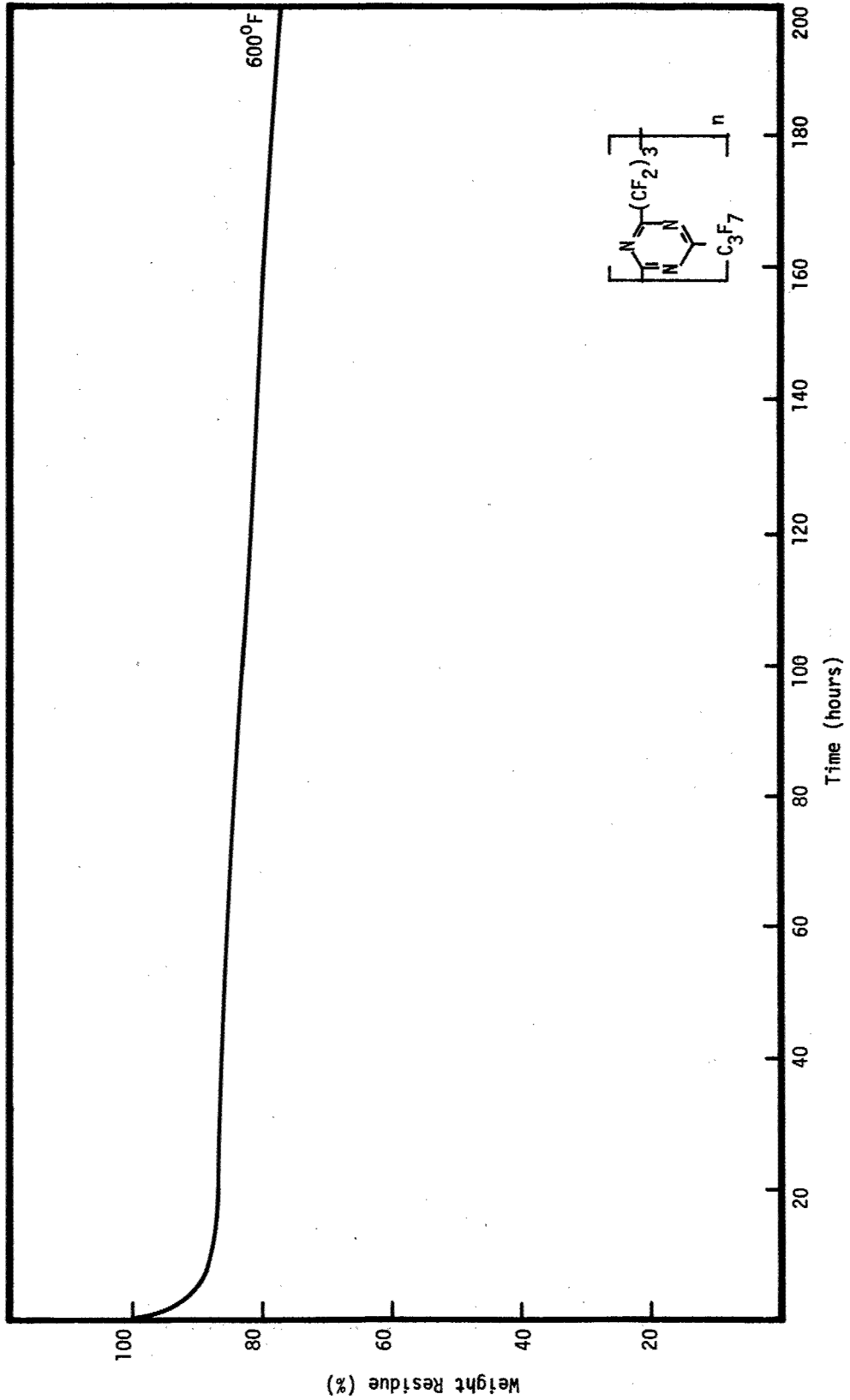


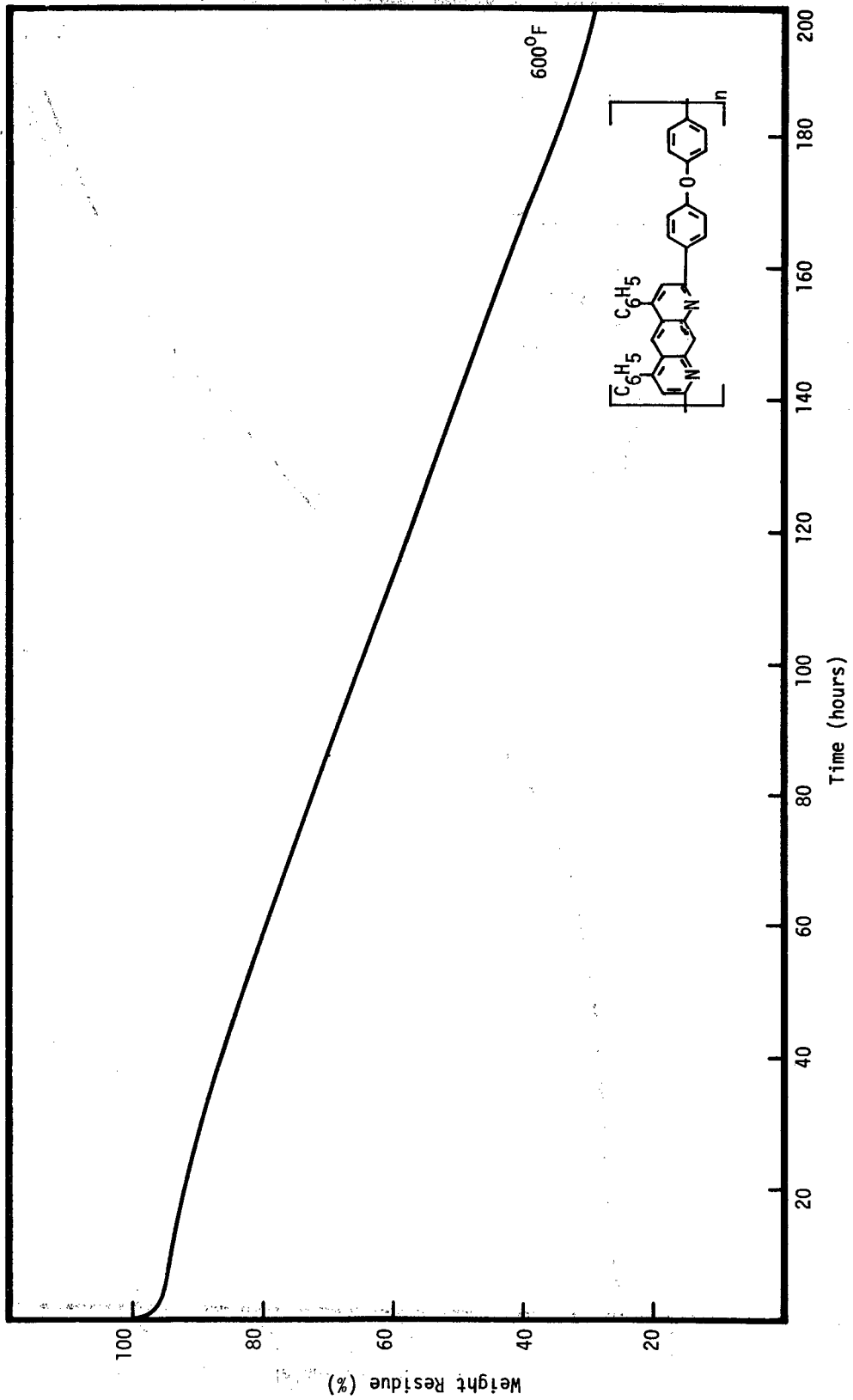


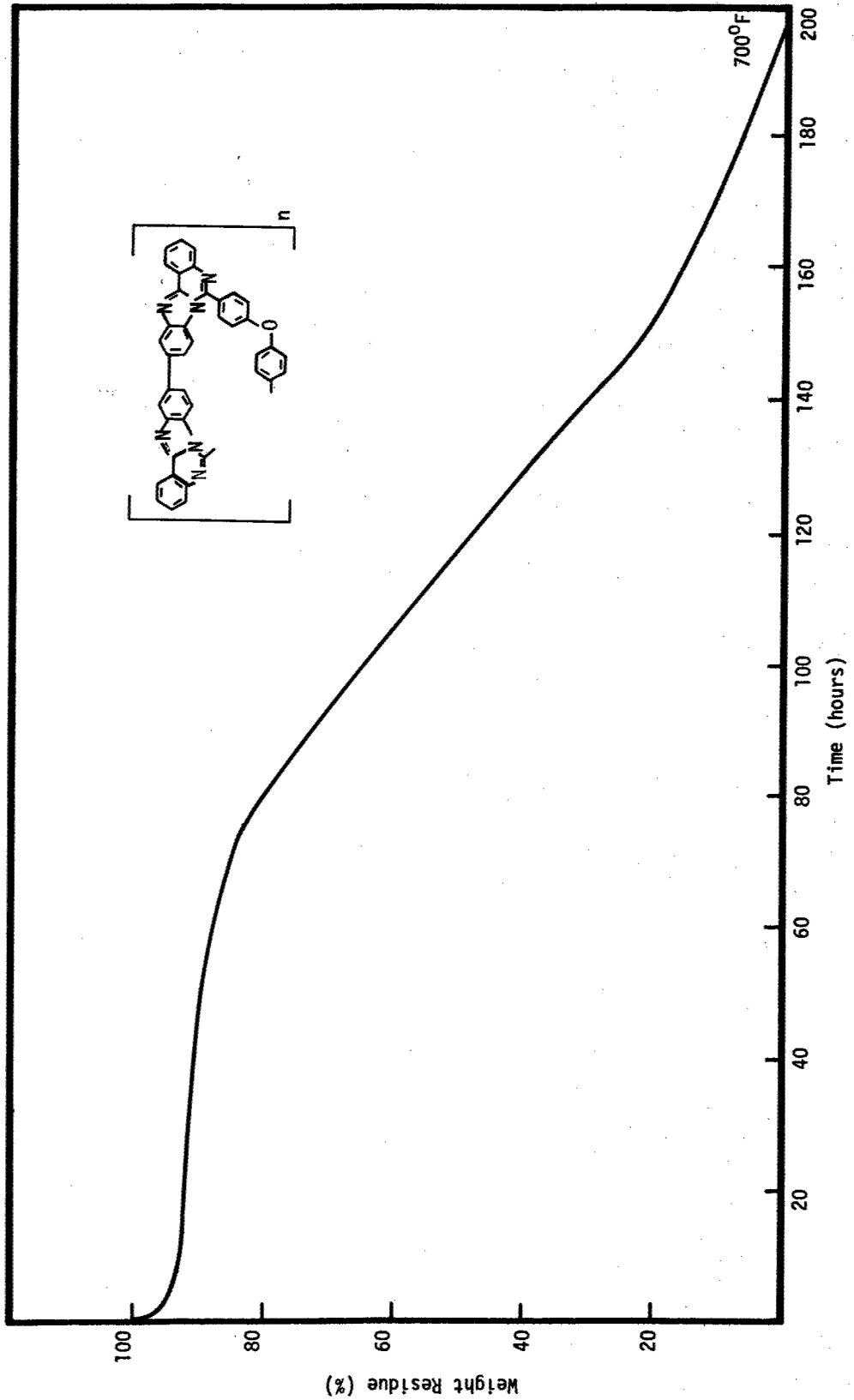


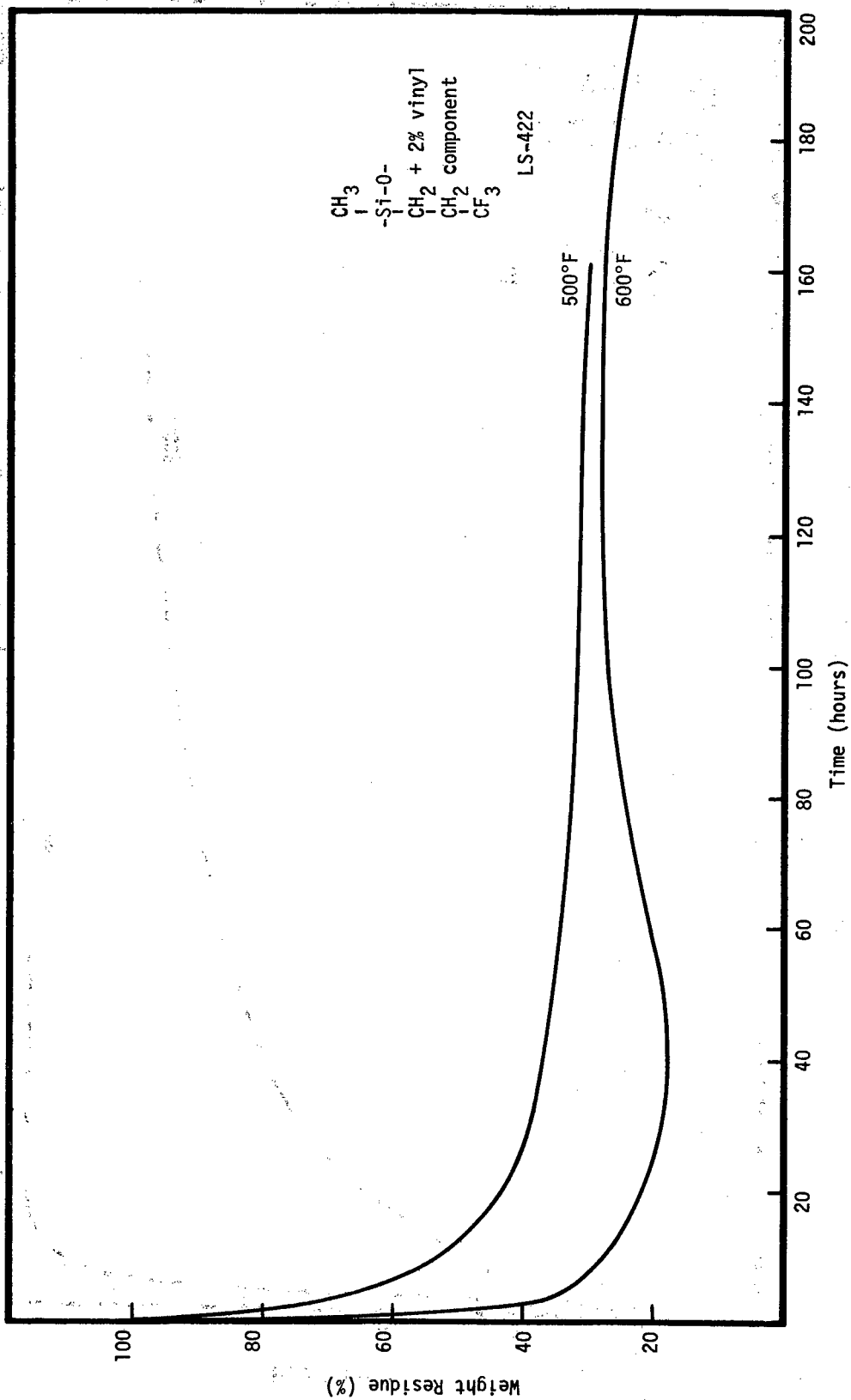


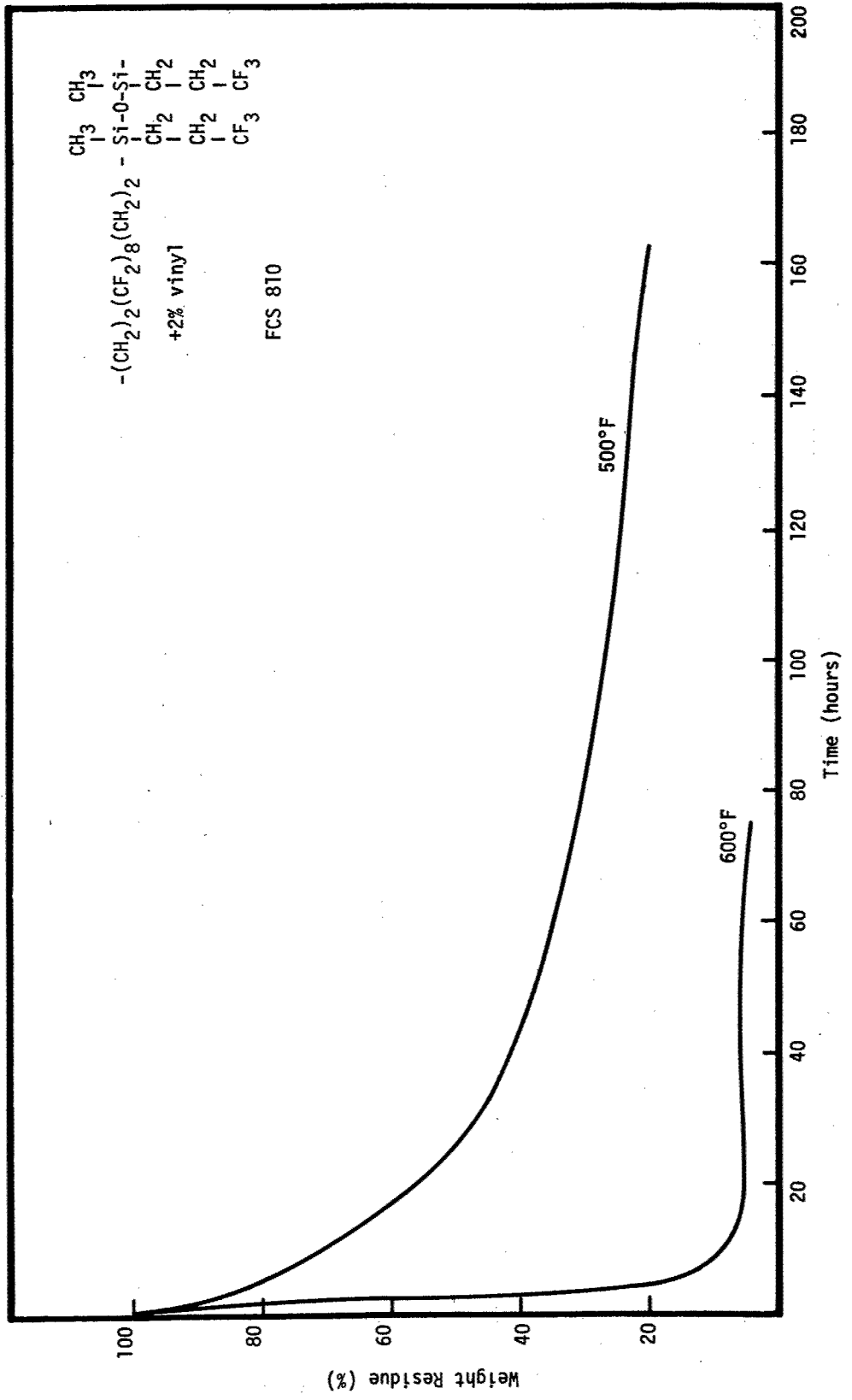












SECTION IV

LIFE EXPECTANCY CURVES

