N86-29357

PHOTOTHERMAL DEGRADATION STUDIES

JET PROPULSION LABORATORY

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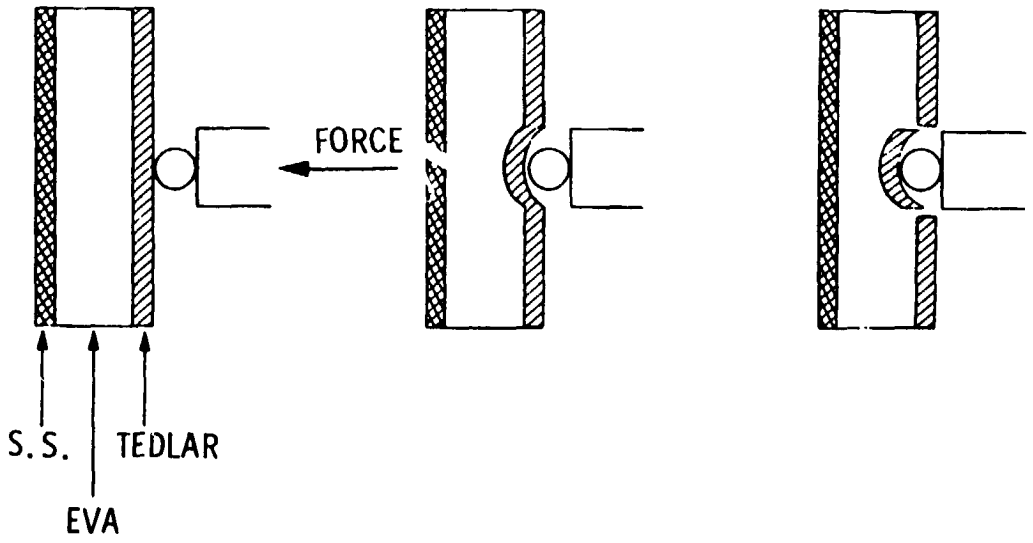
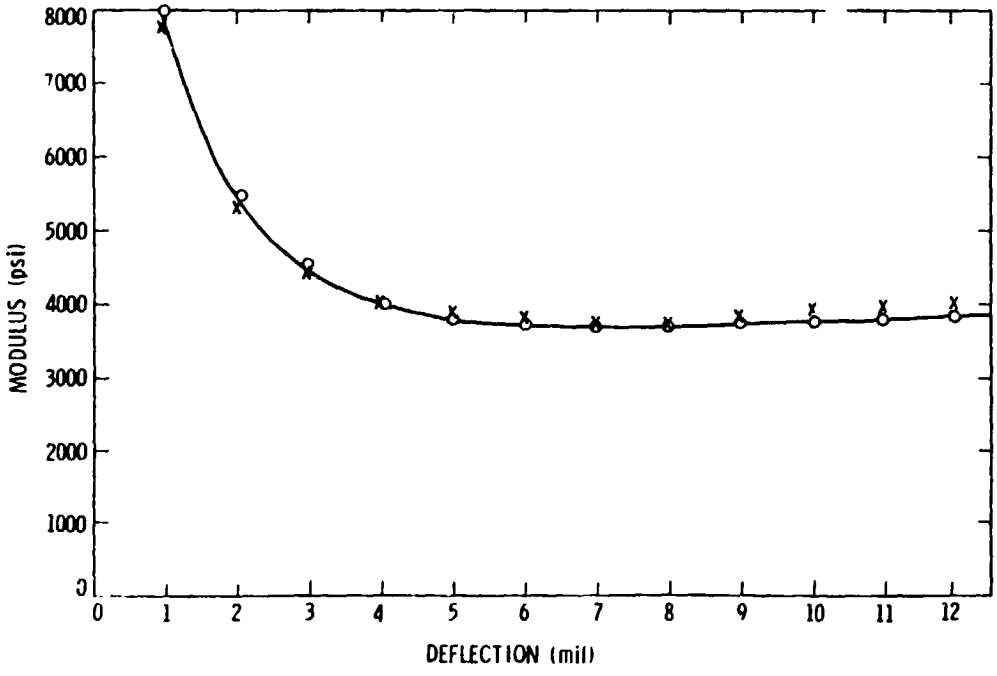
Accelerated Testing Development

- OBJECTIVE
  - DEVELOP VALID ACCELERATED TESTING METHODOLOGY IN ORDER TO EVALUATE MATERIALS FOR 30 YEARS LIFE
- APPROACH
  - IDENTIFY FAILURE MODES
  - DETERMINE ACCELERATED TEST CRITERIA
  - DEVELOP ACCELERATED TESTING METHODOLOGY

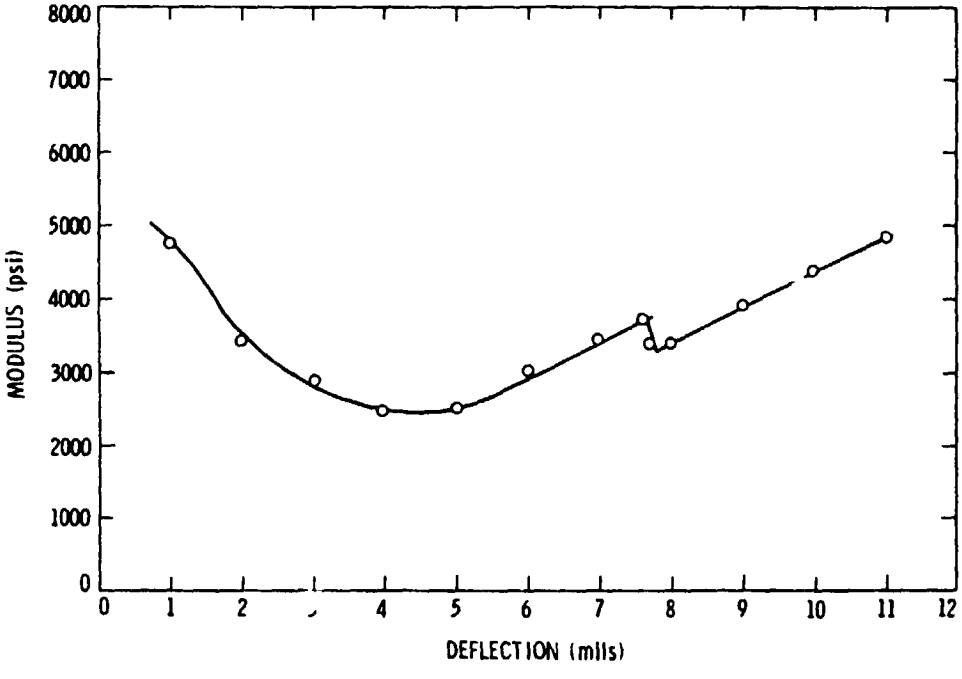
Compression Testing of Tedlar/EVA/S.S. Module



Control Sample (Between Cell)



Sample B (Between Cell)



Compression Testing of Tedlar/EVA/S.S. Module

	SAMPLE	DEFLECTION POINT (mil)	MODULUS (psi)
OVER CELL	A	4.4	9,000
	B	3.8	8,000
	C	9.7	5,200
BETWEEN CELL	A	9.0	4,700
	B	7.7	3,800
	C	> 12	2,900

A = OUTDOOR, REAL TIME, 500 DAYS, 75°C

B = ACCELERATED, 6.5 DAYS, 85°C, 8 SUNS

C = ACCELERATED, 6.5 DAYS, 98°C, 5.5 SUNS

Simulation and Modeling of Photothermal Degradation of Tedlar (Conclusion)

- TWO OR MORE DEGRADATION PATHWAYS EXIT
- THEY HAVE SUBSTANTIALLY DIFFERENT E_{act}, SO THAT
  - RATE k_1 PREDOMINATES AT TEMP $\leq 85^{0}C$
  - RATE k_2 PREDOMINATES AT TEMP $> 90^{0}C$
- DAMAGE IS CHIEFLY UV DRIVEN
- TEDLAR IS THE MATERIAL UNDERGOING DEGRADATION
- QUAL TEST TEMPERATURE SHOULD BE $\leq 85^{0}C$

Mechanistic Studies of Photothermal Degradation

- OBJECTIVES
  - TO STUDY MECHANISTIC PATHWAYS OF PHOTOTHERMAL DEGRADATION
  - TO DETERMINE PHOTOTHERMAL REACTION RATES FOR MOLECULAR KINETIC MODELING
- APPROACH
  - LASER-FLASH ESR SPECTROSCOPY TO DETERMINE KEY REACTION INTERMEDIATES AND THEIR KINETICS

Mechanism of Photooxidation

$$R\text{-}R \xrightarrow{h\nu} R\cdot$$

$$R\cdot + R\cdot \xrightarrow{k_1} R\text{-}R \qquad \text{CROSSLINKING}$$

$$R\cdot + O_2 \xrightarrow{k_2} RO_2\cdot \qquad \text{OXIDATION}$$

$$RO_2\cdot + RH \xrightarrow{k_3} R\cdot$$

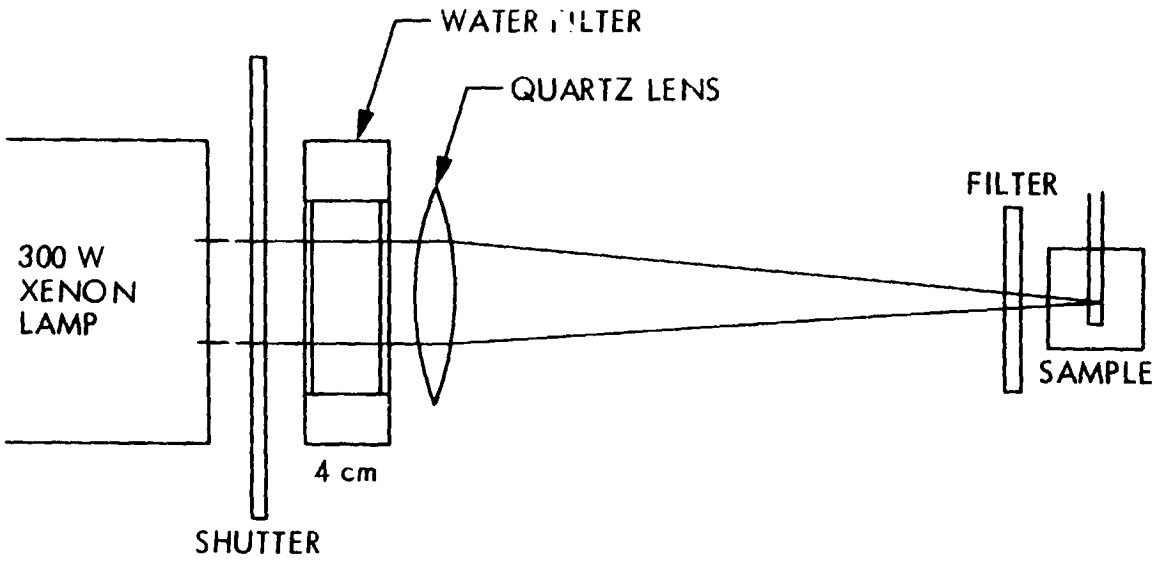
PRELIMINARY RESULTS

$k_1 = 10^{-2}$ liter/mole sec

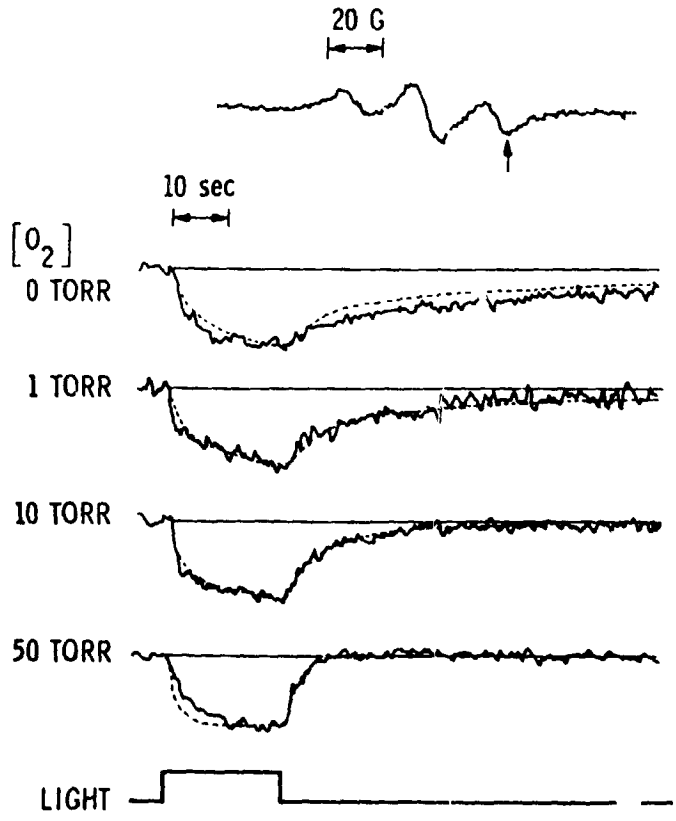
$k_2 = 1.3 \times 10^{-2}$/sec

$k_3 = 10^{-1}$/sec

Flash ESR Apparatus



Time Resolved ESR Spectra of Photogenerated Polymeric Radicals



Photothermal Mechanistic Studies (Conclusion)

- KEY TRANSIENT RADICALS RESPONSIBLE FOR PHOTOTHERMAL DEGRADATION IDENTIFIED AND CHARACTERIZED
- ALL IMPORTANT RATE CONSTANTS FOR TEMPERATURE AND O_2 LEVEL
- PHOTO-OXIDATION DEGRADATION MODEL DEVELOPED