GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: July 21, 1980

Project Title: Lab Analysis of Polystyrene

Project No: A-2711

Project Director: Dr. C. J. Ray

Sponsor: Talley Industries; Westclox; Athens Plant No. 1; Athens, GA 30607

Agreement Period: From 6/30/80 Until 8/31/80

Type Agreement: Purchase Order No. 16853, dated June 30, 1980

Amount: $500 (NTE)

Reports Required: Final Report

Sponsor Contact Person (s):

Technical Matters	Contractual Matters (thru OCA)
	J. D. Williams Purchasing Agent Talley Industries Westclox Athens Plant No. 1 Newton Bridge Road Athens, GA 30607

Defense Priority Rating: N/A

Assigned to: CMSL/MSD (School/Laboratory)

COPIES TO:

- Project Director
- Division Chief (EES)
- School/Laboratory Director
- Dean/Director—EES
- Accounting Office
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- Project File (OCA)
- Project Code (GTRI)
- Other

CA—3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: 10/8/80

Project Title: Lab Analysis of Polystyrene

Project No: A-2711

Project Director: Dr. C. J. Ray

Sponsor: Talley Industries; Westclox; Athens Plant No. 1; Athens, GA 30607

Effective Termination Date: 8/31/80

Clearance of Accounting Charges: 8/31/80

Grant/Contract Closeout Actions Remaining:

- X Final Invoice
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other _____

Assigned to: CMSL/MSD (School/Laboratory)

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Library, Technical Reports Section
EES Information Office
Project File (OCA)
Project Code (GTRI)
Other Suspense 11/8/80

CA-4 (1/79)

LAB ANALYSIS OF POLYSTYRENE

EES Project No. A-2711

for

Westclox Division of General Time Corporation
Talley Industries
Athens, Georgia 30607

submitted by

Material Sciences Branch
Chemical and Material Sciences Laboratory
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332

August 1980

Summary

Plastic lenses made from three different sources of polystyrene material were exposed to ultraviolet and visible light in an accelerated weathering machine. The polystyrene from Amoco developed a cloudiness after 48 hours of testing. The cloudiness intensified throughout the 168 hour exposure period. Polystyrene from Foster Grant and U.S.S. Chemicals remained clear but it did develop a slight yellow color in comparison to unexposed material.

1.0 Background

In late 1978, the Engineering Experiment Station (EES) was contacted by representatives of Westclox regarding the fogging of clock lenses while on display in various stores. The lenses are made from polystyrene plastics. Three possible causes of the fogging were advanced: ultraviolet light (UV) induced changes, solvent contamination or exposure, and radiation induced damage from radioactive sources used in smoke detectors. Visual and infrared analysis of fogged lenses and consultation with nuclear scientists eliminated the latter two mechanisms (reference: letter of Ben James, Industrial Extension Division, EES to Jerry Rice, Westclox dated February 19, 1979). Exposure of clear lenses and clear portions of lenses already clouded in an accelerated weathering machine demonstrated that the fogging could be induced by exposure to simulated sunlight. In this type of testing the UV portion of the light is the chief aggressive agent. However, only plastic lenses made from material supplied by Amoco showed fogging. Polystyrene lenses made from Foster Grant and Monsanto products remained clear after the same exposure.

The work reported here is the accelerated weathering testing on three different lots of general purpose polystyrene. Each lot is from a different manufacturer of polystyrene. The details of the experimental conditions are given in section 2.0 and the results are given in section 3.0.

2.0 Experimental Conditions

An Atlas Weather-Ometer, Model 65-WR, was used to provide exposure to simulated sunlight. The light source was a xenon arc filtered through borosilicate glass. The light was operated at 5000 watts. The spectral power output of this xenon lamp in comparison with natural sunlight is presented in Figure 1. The relative humidity was 50 percent and the air temperature in the chamber was $22^{o}C$. No water spray was used in the testing.

The three lots of plastic lenses or clock faces supplied were identified as Amoco General Purpose Polystyrene #315003 (trial lot 857), U.S.S. Chemicals General Purpose Polystyrene #315003 (trial lot 864), and Foster Grant General Purpose Polystyrene #315003 (trial lot 875). Each lot had twenty lenses.

Sixteen lenses from each lot were selected for exposure testing; the remaining four from each lot were stored in the dark. A small hole was drilled in each test lens for mounting in the weatherometer chamber. This drilling did not crack or cause any visual change in the lenses. The lenses then were mounted on aluminum panels and the aluminum panels were mounted on the sample rack carousel of the weatherometer.

The total test exposure period was 168 hours. The clarity of the lenses was checked visually at 24 hour intervals when possible.

3.0 Results and Conclusions

Two lots of polystyrene maintained clarity throughout the 168 hour test period. These were lot 864 from U.S.S. Chemicals and lot 875 from Foster Grant. The polystyrene lenses from Amoco (lot 857) developed a visually detectable level of cloudiness after 48 hours of exposure. The cloudiness or opacity continued to increase throughout the test. These results are consistent with the previous work.

The U.S.S. Chemicals and Foster Grant polystyrene materials developed a yellow tinge during the test period. This color change is what one would expect from polystyrene exposed to UV light. The yellow color was, however, only evident in side-by-side comparison with unexposed lenses.

The total exposure to UV light used in this testing cannot be specified since the instrumentation to make such a measurement is not now a part of the weatherometer. Light meters for this purpose, however, are available. The test as run though is typical of accelerated weathering requirements in paint

specifications. Hence, the testing machine, operating conditions, and exposure period need to be included in a standard. A control material needs to be included in such testing since accelerated tests are good for relative comparisons but there is little, if any, translation of machine time to "real world" time.

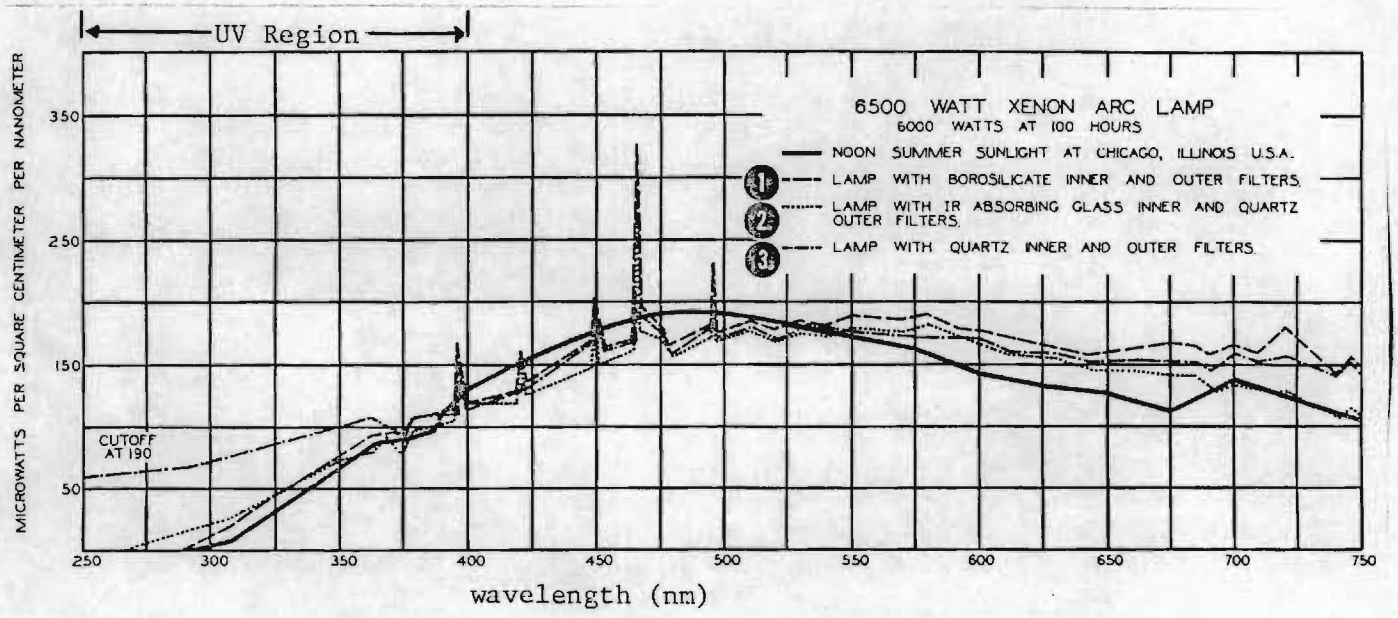

Figure 1. Spectral Intensity Curve for Xenon Arc Lamp (source: Atlas Electric Devices Company Bulletin No. 1300B).