JESSICA BETZ ABEL

COLUMBIA UNIVERSITY
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ADVISOR: GEORGE WHEELER

THE INFLUENCE OF GLASS TRANSITION TEMPERATURE ON THE PERFORMANCE OF ACRYLIC THERMOPLASTIC ADHESIVES

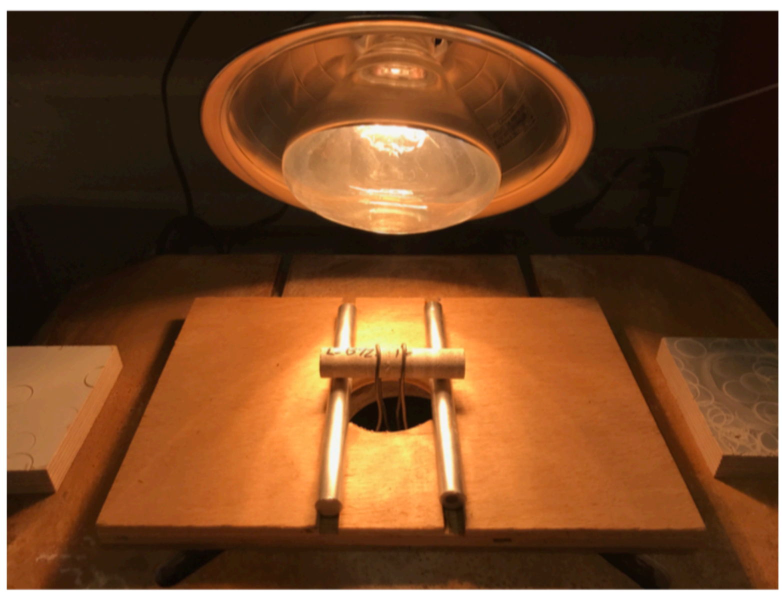
ABSTRACT

Acrylic thermoplastic resins are commonly used in conservation for consolidation and as an adhesive. They are popular with conservators due to their reversibility and their considerable strength in moderately temperate environments. Historically, these acrylic thermoplastics resins were used by conservators as a consolidant and a coating on ceramic material; though, in more recent decades, conservators have started using these acrylic thermoplastic resins as structural adhesives. These resins have been very successful as adhesives when used in climate-controlled museum settings, and as a result, there has been very little research focused on the issues of glass transition temperature and performance in high heat environments. When used in an environment that exceeds their glass transition temperature (T_g), the adhesives will soften and flow, causing the adhered objects to slump or fall apart.

This research examines the use of acrylic thermoplastic adhesives within a particular set of environmental parameters. The results of this experimental study are especially relevant for conservators working on the restoration of historical objects and monuments in climates where the Tg of acrylic adhesives is regularly exceeded by either air temperature or insolation. Four different adhesives (Paraloid B-72, Paraloid B-48N, Paraloid B-44, Paraloid A-11) and two adhesives mixtures (1:3 B-72:B-48N and 3:1 B-72:B-48N) which are commonly used by conservators were tested on two different substrates: limestone and ceramic terra cotta. These two materials were chosen because chemically they are very different. Environmental simulations were performed using a temperature cycling chamber which was followed by four-point bending tests to assess

strength and brittleness. The second part of the study tested the effect of temperature on the stress-creep behavior of each adhesive.

The results of these two tests confirmed empirical experiments carried out by conservators working in the field over the past decades. That is, all of the adhesive systems performed well at temperatures significantly higher that their reported Tgs and the two adhesive mixtures performed better than the B-72 in terms of stress-creep behavior. Additionally, the initial results for the B-44 and A-11, which performed well with both the limestone and terra cotta substrate in the four-point bend and stress-creep behavior, are a positive indication that these adhesives could be used as a conservation adhesive in high heat environments as an alternative to the more traditional B-72. The results of this study will contribute to a better understanding of the long-term behavior of adhesives in environments outside the climate-controlled museum.



Stress - Creep Testing: Infrared lamp above the specimen and 20 lb. of weight suspended below.