Abstract: A System Dynamics Approach to Modelling Degradation in Cellulose Acetate Film

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Historic Polymeric Materials (HIPOMS) present significant conservation challenges in museum and archival collections. Over the last twenty-five years many chemical and physical degradation processes in these materials have been identified. However, there are still open questions about the best approaches to the storage and display of HIPOMS in museums and archives. A key problem is that although there is awareness of specific degradation mechanisms, the ways in which these interconnect to produce observed damage phenomena is not well understood.

An example is cellulose acetate, which is important historically as one of the first semi-synthetic polymers. It was used for film reel and photographs, and also as a hard plastic in artworks and social history objects. Unfortunately this material is unstable in the long-term, putting these cultural artefacts at risk.

As it degrades, cellulose acetate produces acetic acid. The presence of acid causes further harm to the material. The choice of enclosure for cellulose acetate objects is important from a conservation perspective as it determines the acid levels to which the object is exposed. In this poster, we investigate the impact of using tightly sealed or open storage containers for storing cellulose acetate film, using a system dynamics model.

It was found that under recommended conditions for temperature and relative humidity, the expected lifetimes were substantially shorter than those predicted by guidelines developed for film stock. The lifetimes were significantly affected by choice of enclosure. The findings imply that we are potentially underestimating the risk to film collections. Practical outcomes from this research could be development of new guidelines, based on our more holistic approach to understanding degradation processes. These will enable conservators to make better-informed decisions about how to store cellulose acetate film.