Title: **A process model for vinegar syndrome: Towards an increased understanding of degradation in cellulose acetate artefacts**

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Abstract: It is well-documented that one of the first signs of degradation in cellulose acetate artefacts is the emissions of acetic acid, lending this phenomenon the nickname of "vinegar syndrome" for its characteristic smell [1]. This is believed to be due to the breakdown of the cellulose acetate polymer by reaction with water, or hydrolytic deacetylation. While some degree of deacetylation alone may not cause marked changes in the properties of cellulose acetate artefacts, acetic acid can catalyse other degradation reactions, such as depolymerisation, which can have a more severe impact on the physical stability of the object. Such changes can reduce compatibility with plasticisers or other additives, leading to the migration of these components. Emissions of acetic acid from degrading cellulose acetate objects have also been linked to an increased rate of degradation in other objects stored nearby [2].

The evolution of acetic acid (as measured by free acidity) in degrading cellulose acetate objects is observed to proceed with an induction phase, where little change is observed over a period of time, followed by the initiation of vinegar syndrome, where the rate of change in free acidity increases dramatically. At the initiation point, the deacetylation reaction is said to become autocatalytic, as increasing quantities of acetic acid are available to catalyse the reaction.

Current conservation literature suggests that the autocatalytic point is reached at 0.5 free acidity [3]. This criterion, and the current model of vinegar syndrome, are the basis for preventive conservation strategies used in care of heritage collections containing cellulose acetate. This poster will present a new approach for understanding vinegar syndrome based on process modelling, with a particular focus on reaction kinetics and the factors which influence them. Preliminary results of the proposed model will be presented and the implications of this for conservation strategy will be discussed.

[1] Reilly, J. (1993). *Instructions for Using the Wheel, Graphs, and Table: Basic Strategy for Film Preservation*. [online] Imagepermanenceinstitute.org. Available at: https://www.imagepermanenceinstitute.org/webfm_send/299 [Accessed 28 Oct. 2017].

[2] Curran, K., Možir, A., Underhill, M., Gibson, L., Fearn, T. and Strlič, M. (2014). Cross-infection effect of polymers of historic and heritage significance on the degradation of a cellulose reference test material. *Polymer Degradation and Stability*, 107, pp.294-306.

[3] Bigourdan, J. (2006). Stability of Acetate Film Base: Accelerated-Aging Data Revisited. *Journal of Imaging Science and Technology*, 50(5), pp.494-501.