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RAPID IDENTIFICATION OF STICKY SHED SYNDROME IN MAGNETIC TAPE USING ATR-FTIR AND MULTIVARIATE STATISTICS

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The Library of Congress, Washington, D.C., holds more than 500,000 magnetic tape objects. Many are degrading rapidly, and like many cultural heritage institutions and archives, a rapid method to identify degraded tape is needed to allow for treatment prioritization prior to copying, digitizing, or both. Even in the most ideal storage conditions, magnetic tapes are known to degrade. Tapes produced during the 1970–1990s often contain polyester-urethane (PEU) binders to hold magnetic particles onto polyethylene terephthalate substrates. PEU binders are known to degrade via hydrolysis, which causes squealing, shedding, or both, of magnetic material onto playback device heads. This condition is referred to as sticky-shed syndrome. There are no known non-destructive methods for rapidly identifying degraded magnetic tapes. Several brands and models of tapes are known to contain PEU binders and are known to degrade. However, tapes are rarely held in their original packaging or even kept on original hubs, making classification by visual inspection impossible. Playing a tape is the currently accepted method for classifying a tape as either sticky-shed or not sticky-shed. If the tape squeals, flakes, or gums playback equipment, it is classified as sticky-shed and removed from the digitization workflow for treatment. This process can not only render the playback device unusable, but it can permanently damage the tape and lead to loss of data.

This presentation will focus on the use of Attenuated Total Reflectance—Fourier Transform Infrared Spectroscopy (ATR-FTIR) combined with multivariate statistical analysis as a rapid, non-destructive, identification tool for the identification of degraded magnetic tape. Researchers at the Library of Congress and other labs have attempted to use ATR-FTIR to differentiate sticky-shed and non sticky-shed tapes by identifying small differences in peak shapes and shifts. Because of the number of manufacturers and formulation changes, predicting the presence of degradation through analysis of peak comparisons is difficult and requires significant technical expertise. The use of multivariate statistics allows for simultaneous comparison of the spectral ranges with the greatest amount of variation between different groups of sticky-shed and non sticky-shed tapes. Once a database of spectra is developed, the use of statistics is expected to allow ATR-FTIR to be used as a non-destructive predictive indicator for collection items.

ATR-FTIR allows for the analysis of the surface binder approximately 500 nanometers into the sample. Multiple crystals and ATR designs were tested to identify the conditions under which no damage to the tape was observed under optical microscopy. The dispersed pressure of an ATR system was used to hold the tape against a large, flat, germanium crystal during measurement. Each measurement required 30–40 seconds to acquire. One hundred 1/4-inch reel-to-reel tapes from the Library's collection were measured with ATR-FTIR and the results analyzed. Tapes were also played through the traditional method by audio engineers at the Motion Picture Broadcasting and Recorded Sound Division of the Library to determine whether they had sticky-shed syndrome. The methods used along with the results from both methods were compared and will be discussed.

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