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## **XRF and FTIR Analysis of certain African historical documents**

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The aim of this work was to assess the oxidative degradation risk and suggest conservation methods of certain historical documents. All the documents studied were obtained from the National Library of South Africa except one that was obtained from a private library at the city of Timbuktu, Mali. The Abbey pH pen method was used to check the pH level of all the samples. It was found that all the samples except two were acidic. The sample from the Timbuktu manuscripts was found to be extremely acidic with a pH level of below 5.0. It is recommended that all the acidic samples be de-acidified using the Bookkeeper process in order to retard the process of degradation due to hydrolysis. XRF technique was used to study the elemental composition of the samples. In all the samples six elements namely Fe, Cu, Mn, Ca, K and S were detected. It was found that older documents had higher concentrations of Ca and hence have a considerable alkaline buffer than recent documents. It was also observed that the levels of Ca dropped significantly in the samples dating between 1800 and 1890 coinciding with the period during which paper making technology changed. The concentrations of K and S also decreased around 1890. Iron remained considerably high and was detected in all the samples. Copper and manganese were found to be at very low concentrations compared to Fe. The nature of the fibres that make up the samples studied was determined using FTIR. It was found that all the samples were made of cellulose. The Courier sample also had lignin and hemicellulose. The Total Crystallinity Index (TCI) of each of the samples was also calculated in order to determine the susceptibility of cellulose to degradation agents. This index is the ratio of the integrals of the FTIR band at 1372 cm<sup>-1</sup> to that at 2900 cm<sup>-1</sup>. The integrals were taken over the ranges 1390 – 1339 cm<sup>-1</sup> and 2959 – 2830 cm<sup>-1</sup> for the bands at 1372 cm<sup>-1</sup> and 2900 cm<sup>-1</sup> respectively. The Lateral Order Index (LOI) was also calculated using the ratio of the integrals of the absorption bands at 1420 cm<sup>-1</sup> to that at 898 cm<sup>-1</sup>. These bands are known to be sensitive to the relative amounts of crystalline versus amorphous structure in the cellulose. It was also observed that all the samples had clay but none of the samples had gypsum as a filler material. Traces of calcium carbonate were found in four of the samples studied. Kaolin was also found in all the samples except two. Only one sample showed the presence of gelatine.

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