

**USING A KINETIC APPROACH TO CHARACTERIZE BIODEGRADATION RATES OF THREE  
CELLULOSIC FABRICS IN SOIL**

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**Abstract**

Biodegradation of cellulosic fabrics in soil has environmental and forensic implications. A field study was conducted to determine the biodegradation rates of 100% rayon, cotton, and Tencel<sup>®</sup> fabrics buried in a Captina silt loam soil under warm, moist conditions. Following 0, 14, 28, 42, 77, and 112 days of burial, the fabrics were excavated to determine the amount of fabric remaining and biodegradation rates were calculated using zero-order kinetics. Zero-order rate constants were 2.6, 1.2, and 0.5/day for rayon, cotton, and Tencel<sup>®</sup>, respectively. Calculated half-life values or the time required for 50% of the material to decompose for rayon, cotton, and Tencel<sup>®</sup> were 22, 40, and 94 days of burial, respectively. The data indicated that optimal conditions resulted in rapid biodegradation of the cellulosic material in aerobic, moist, warm soil. Increased crystalline cellulose content and longer polymer chain length reduced fabric biodegradation rates. By adjusting the rate constants for temperature and moisture, it was possible to broaden the application of the results from the field study. Using correction factors, the calculated half-life values decreased as temperature increased and increased as the soil dried with the least biodegradation occurring under cold dry conditions. Data from the study could be useful in developing alternative fabric disposal methods such as land application and mixing with aerobic surface soil which would divert fabric waste from landfills. The results could also be used to estimate the time fabrics had been buried in soil and the information could be useful in forensic investigations.