

Abstract

The percent organic carbon (%OC) is an important soil fertility measure that has important implications in agricultural productivity and food security. In this study, a UV-visible spectrophotometric technique was investigated and applied to quantify %OC from selected soil samples along a river basin that traverses agricultural farmlands, a forest and sewage treatment lagoons for a comparative survey purposes. The study was based on the measurement of absorbance of Cr(III) species that arise from oxidation of sucrose (which is 42.11% carbon) by dichromate ions which contain Cr(VI) species. The uv-visible spectrophotometric double beam wavelength scan measurements elucidated the conversion of Cr(VI) to Cr(III) ions and a calibration plot was developed with $r^2 = 0.99$. The analyte peak was identified in the region from 750 nm to 550 nm (the absorbing Cr(III) species) with a turning point maximum at 576 nm. The kinetic profile of sucrose oxidation by the dichromate ions was studied via absorbance of Cr(III) and Cr(VI) as a function of the reaction time and was used to characterize the reaction model. The absorbance of Cr(III) as a function of reaction time fitted best into the non-linear Belehradek power function equation $y = a(x-b)^c$, where y = absorbance; x = time(s); a , b , c = are constants (r^2 of 0.91). Kinetic analysis revealed that the reaction that leads to the formation of Cr(III) during sucrose oxidation proceeds via pseudo first-order kinetics ($r^2 = 0.83$). A comparative quantitative analysis indicated that the sewage treatment lagoons had the highest %OC content at about 5.5-6.6%OC. The soils sampled from the forest regions had about 4.6-5.8%OC whereas the river bank soils had the lowest levels at about 2.0-2.5%OC. A statistical t -test analysis showed that the %OC levels in sub-soils were significantly higher than those of the top-soils ($p > 0.05$ at 95% CI).