Activated Charcoal as an Effective Additive for Alkaline Hydrolysis of Esters in Water

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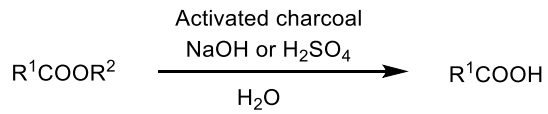
Reactions in water are a challenging investigation in synthetic organic chemistry. In order to dissolve organic substrates in water, surfactants are often used in organic synthesis. As the problem of surfactants, work-up is frequently difficult because of lathering. In addition, surfactants are not environmentally friendly because they polluted the water of rivers and ocean. Activated charcoal is amorphous carbon material possessing large surface area. It has been employed as an adsorbent for the removal of a smell, coloration, and impurities in the reaction mixture. Furthermore, it has been used as a catalyst carrier. During the course of our investigation on solid-mediated organic reactions,[1-3] we found that the alkaline and acidic hydrolysis of esters proceeded smoothly in water in the presence of activated charcoal.[4]

We examined the alkaline hydrolysis of a variety of esters. Esters were treated in aqueous 1.5 M NaOH solution at room temperature for 24 h at 400 rpm in the presence of activated charcoal. The reactions of methyl, ethyl, and *n*-propyl esters gave the corresponding carboxylic acids in excellent yields. When the products were solids, organic solvent-free work-up was possible.

Various esters were treated in aqueous 3M H_2SO_4 solution at 100 °C for 24 h at 400 rpm in the presence of activated charcoal. The reactions of methyl, ethyl, and *n*-propyl esters afforded the corresponding carboxylic acids in good yields.

The recycle experiments for the alkaline and acidic hydrolysis of ester were carried out. Activated charcoal could be recycled five times without the significant loss of the yields.

The reaction mixture consisted of the organic and aqueous phases. Activated charcoal was suspended in the organic phase of esters. It will be caused by the hydrophobic interaction between esters and condensed aromatic rings of activated charcoal. Although the detailed mechanism is not clear now, activated charcoal would adsorb esters on the surface by dispersion forces, and it may increase many ester molecules exposed to where the hydrolysis by aqueous NaOH or H_2SO_4 solution can occur.



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