77a Oleic Acid Oxidation in Supercritical Carbon Dioxide

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The United States depends heavily on petroleum from politically unstable countries to produce chemicals and fuels. To reduce this dependency, one of the main priorities of the U.S. Department of Energy is the development of technology to generate and produce energy and chemicals from renewable sources. The chemical industry consumes approximately 1 billion barrels of oil annually for the generation of specialty and commodity chemicals. A large fraction of these chemicals could be produced using lipids from renewable feedstocks. For example, many animal fats and vegetable oils contain unsaturated fatty acids (i.e., oleic acid), which can be oxidized to form diacids and epoxides. These chemicals are used to formulate herbicides, detergents, plasticizers, lubricants, and paints. This paper will describe the development of reaction mechanisms and rate expressions for the reaction of oleic acid with oxygen or hydrogen peroxide. The main products of oxidation are azelaic acid, pelargonic acid, and epoxides. Supercritical carbon dioxide (SC-CO_2) was used as a reaction medium because it eliminates mass transfer limitations and provides the possibility of products fractionation. Additionally, SC-CO_2 is completely oxidized and does not participate in the generation of undesired products. The reaction kinetics in SC-CO_2 will be compared to the conventional industrial process. The determined rate expressions and Arrhenius parameters were used to determine the process operating conditions that maximize selectivity towards a particular oxidation product.