Heat and mass transfer studies of palm kernel cake (PKC) in fluidized bed fermenter

Abstract

Solid state fermentation (SSF) which involves the growth of microorganism on moist solid substrates in the absence of free flowing water, has gained renewed attention over submerged fermentation for specific applications. During the SSF process in fermenter, there are three main engineering problems encountered such as the removal of metabolic heat from the substrate, diffusion of O2 and moisture through the substrate, and heterogeneity of the substrate and inoculum. A fluidized bed fermenter in which the particles move independently like a fluid was proposed to conduct the study. Throughout the study, rapid heat transfer from PKC to air was experimentally observed within the first 150 s with a temperature drop of 30 °C. This indicated that the excellent heat transfer between palm kernel cake and air allows solid state fermentation of PKC without accumulation of metabolic heat in the fermenter. Apart from heat removal, water adsorption study on PKC from air to bed was carried out. It showed that the increase of adsorbed water in PKC was proportional to air relative humidity and inversely proportional to superficial air velocity. The maximum moisture content adsorbed by PKC under fluidization conditions was around 10% (on dry basis). Finally, mathematical models for heat and mass transfer were proposed which can predict the experimental data quite satisfactorily.