ABSTRACT

The brewing industry is facing challenges on rising commodity prices and utility prices that rise by a high margin on a yearly basis. Effective methods are required to reduce other process variables which elevate the operational costs in the production of beer. The aim of this study was to design and investigate the optimal control philosophy for beer fermentation using the proportional integral derivative (PID) control algorithm in the Micro-Brewery at the University of the Witwatersrand. This will be achieved by controlling the cooling regimes of the fermenter jacket in order to compute the gain constant (K_1) that would minimise the dead time (T_d) and process reaction time (T_i) and produce a beer which will have desirable palatability attributes. All investigations were performed using a *Saccharomyces cerevisiae* yeast strain and wort of 14.3^0P apparent extract. The controller constant, the dead time and rise time were found to be 9.6 second ,2 seconds and 1second, respectively**.** The Isoamyl acetate, Ethyl acetate and Ethyl Caproate esters were found to be 6.8, 25 and 9 ppm, respectively and the vicinal diketones (VDK) level was found to 20 ppb at the end of the fermentation. This study showed that beer colour (EBD) was found to improve with fermentation temperature for the first 2 days then remain unchanged and showed that temperature is a possible process variable in the optimisation of colour. The study also showed that the fermentation rate and duration increase with increase in temperature. The flavour ratio (R) improves as the temperature increases. The developed simulation program helped in selecting optimal profiles to reduce dead time and improve the controller efficiency.