2-phenyl ethyl acetate production by Continuous reactive distillation through catalysis by ion exchange resin

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Abstract: 2-phenyl ethyl acetate (PEAct) is an aromatic flavor ester, which have several applications in our day-to-day life such as cosmetics, soaps, shower gels, shampoos, deodorants etc. [1] Its naturally extracted amount from plants such as Hyacinth reseda Freesia magnolia etc. is not enough to fulfil the daily demand [2]. Synthetically, it can be prepared by esterification of 2-phenyl ethyl alcohol (PEA) with acetic acid (AA) via an acidic catalyst as shown in Figure1. "Amberlyst-15" an ion exchange resins has proven to be a promising catalyst for esterification reactions due to its high activity, selectivity, reusability, and ease of handing [1]. Esterification of PEA with AA is an equilibrium limited reaction, to attain full conversion of PEA, water or ester must be removed continuously [3].

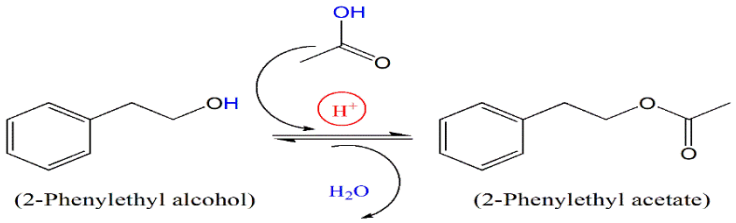

Figure 1: Esterification reaction of 2-PEA with acetic acid over an acidic catalyst

In this study, we are using Reactive distillation (RD) where reaction and separation occur within the single unit, for continuous production of PEAct. Toluene is selected as an entrainer to remove the water continuously as it forms minimum boiling azeotrope with it. Further, it helps in controlling the RD reactive section temperature that contains Amberlyst-15 which has thermal limitation of 393K.Theorical studies were performed in Aspen Plus RADFRAC module using experimentally validated rate law. The rate law was determined by studying the effect of various parameters such as temperature, feed molar ratio, stirring speed, catalyst loading etc. in a batch reactor. The ASPEN simulations were performed for a feed molar ratio of 1:1 (PEA: AA), and it was found that without entrainer the temperature in the reactive section is much higher than 393K for complete conversion of PEA to form PEAct (purity >99%). While using an entrainer gives advantages of temperature control in reactive section and water removal at optimum condition. Further, to ascertain the results, the simulation of RD available in our lab is done. The experiments will be performed to examine experimental and theoretical results.

References

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