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Effects of various impurities on the purification of styrene by a new technique combining distillation and crystallization

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Stripping crystallization (SC) is a new separation technique which combines distillation and crystallization. Basically, SC is operated at a triple-point condition, in which the liquid is simultaneously vaporized and crystallized due to the three-phase equilibrium. In essence, the process is continued until the liquid phase is completely eliminated and only the pure solid crystals remain in the feed. Thus, crystal washing is not required since only pure solid crystals remain in the feed and no impurities are adhered on the crystal surfaces at the end of SC. In the previous research, SC has been successfully applied to separate p-xylene from the mixed xylenes. SC is introduced in this work to purify styrene (ST) from the multi-component system consisting of ST, ethylbenzene (EB), p-xylene (PX), m-xylene (MX) and o-xylene (OX). Styrene is one of the most important aromatic compounds and is used extensively in the manufacture of polystyrene. Due to the close boiling points of ST, EB, PX, MX and OX, it is rather complicated and energy-intensive to separate them by conventional distillation. A thermodynamic model is developed to determine the three-phase equilibrium conditions and direct the SC experiments. The experiments show that SC can be effectively applied to purify ST from the mixture. However, as EB is more easily incorporated into the ST crystal lattice compared to PX, MX and OX, it becomes more difficult to further purify ST for a higher concentration of EB in the mixture.

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