Waste minimization by process modification

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Abstract

Waste minimization by modification of reaction and separation parameters is defined as changing the selectivity of the process so that undesirable waste products are minimized while desirable products are produced. This research involves development of examples of waste minimization by process modifications which can be used as guidelines for minimization of waste generation.

Waste minimization by process modification was investigated for the allyl chloride process. The investigation focused on modification of reaction and separation parameters to minimize the production of 1,2 dichloropropane (1,2-DCP) by-product while maintaining the production of allyl chloride (3-chloro-1-propene) product.

For the two-reaction model, the minimum production of 1,2-DCP by-product appears to occur at the following reactor and separation parameter (2) conditions: (1) Plug flow reactor, adiabatic operation, 800°F (425°C), 1:1 molar propylene/chlorine ratio, residence time, $\geqslant 1$ s; (2) distillation column = D-2, 20 psia (1.35 bar) distillate/feed mole ratio = 0.97, and reflux ratio, $R \geqslant 0.5$. For the two-reaction model, the minimum cost associated with handling the 1,2-DCP by-product appears to occur at a propylene/chlorine mole ratio of about 1.

For the three-reaction model, the minimum production of 1,2-DCP by-product appears to occur at the following reactor (1) and separation parameter (2) conditions: (1) plug flow reactor, non-adiabitic operation, 674°F (340°C), 6:1 molar propylene/chlorine ratio, residence time = 1.5 s; (2) distillation column = D-2, 20 psia (1.35 bar), distillate/feed mole ratio = 0.58, and reflux ratio, $R = 5$. For the three-reaction model, the minimum cost associated with handling the 1,2-DCP by-product appears to occur at a propylene/chlorine mole ratio of about 6.