A new energy-saving solvent refining system for butyl rubber production

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Abstract

Butyl rubber is renowned for its gas impermeability and outstanding dampening characteristic, and has been used mainly in the automotive industry (inner tubes, curing bladders), as well as for electrical insulation[1]. It is obtained via copolymerization of a major amount of isobutylene and a minor amount of isoprene. Almost all world production of butyl rubber utilizes methyl chloride as a diluent and aluminum chloride as the co initiator[2]. Unreacted monomer and solvent which are consist of catalyst methyl chloride and solvent methyl chloride are recycled in solvent refining system.

The traditional solvent refining system[3] has four distillation columns which include solvent purification column (T-1), catalyst solvent column (T-2), solvent recovery column (T-3) and isobutylene recovery column (T-4). The feed is fed into T-1 and the top product of T-1 enters T-2, is separated into catalyst methyl chloride and solvent methyl chloride. Due to the butyl rubber polymerization is extremely sensitive to impurities, the purity of recycled solvents are required higher as follows: catalyst methyl chloride (min 99.9%wt), solvent methyl chloride (min 98.2%wt). T-3 is used to recycle methyl chloride from bottom products of T-1 and T-4 is used to separate isobutylene and isoprene from bottom products of T-3. Although the feed enters T-1 for non-sharp separation, which can reduce the separation difficulty of T-2, but the total energy consumption of T-1 and T-2 is comparatively large because of most of the methyl chloride is stripped repeatedly.

Optimization of traditional solvent refining system and reduction of energy conservation were carried out through integrating T-1 and T-2 into a new solvent purification column, which add a side-stream to product solvent methyl chloride because of its purity is lower than that of catalyst methyl chloride, and product
catalyst methyl chloride in top position. T-3 and T-4 flowsheet do not change because of the purity of isobutylene is near purity. Compared to the traditional solvent refining system, it is theoretically illustrated and represented by simulation means that the new solvent refining system can lead to an energy saving of 23% in the reboiler duty, equipment investment saving of 30% by eliminating a column. The proposal can be put into practice in solvent refining system or similar system. An industrial case study of solvent refining system is given by simulation based on Aspen Plus to demonstrate the effectiveness of the proposed flowsheet.