Simulation and Evolutionary Optimization Aspects in a Chemical Process

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Abstract

Chemical engineering industries have a great inter-related complex impact on economic development of societies and environmental aspects in many countries. Therefore, considering the environmental concern and economic analysis are very crucial for any chemical process. In this study, nylon-6 polymerization process is studied economically and environmentally using multi-objective optimization (MOO). Nylon-6 production process (Vereinfacht Kontinuierliches (VK) column) is simulated using Aspen Plus program. The process mainly consists of two continuous stirred tank reactors (CSTR) as STAGE1 and one plug flow reactor (PFR) as STAGE2. In addition, nine cases are studied with different economic and environmental objectives. These objectives are often conflicting and the result for each case consists of many optimal solutions which called Pareto optimal solutions. Excel-based MOO (EMOO) program is used to obtain the Pareto fronts and their corresponding decision variables. EMOO is based on a binary coded which is non-dominated sorting genetic algorithm (NSGA-II). Each case is a trade-off between two different objectives. For example, case one is a trade-off between the nylon-6 flow rate in POLYMER stream and the total residence time and case four is a trade-off between the selectivity and the payback period. The results show that, the effective decision variable in case one is theSTAGE1 pressure and for case four is the feed flow rate. The same procedure is followed for all nine cases and the Pareto optimal solutions are obtained.