

61e Chem-E-Car Experiments in Unit Operations Laboratory

Sundararajan V. Madihally, Jeremy W. Tillman, and Randy S. Lewis

Recently, the Chem-E-Car Competition has become a signature event of the annual AIChE student conference. It has become a fun-filled activity with an increase in participation by a wide number of AIChE Student Chapters. However, this ample opportunity has not been exploited as a teaching tool to demonstrate chemical engineering principles. For example, one could demonstrate simple concepts such as estimating gas pressure for the acetic acid/baking soda reaction (a popular reaction used in Chem-E-Cars) or determining the rate of reaction. The competition can also be used as a tool to enhance technical writing skills, apply reactor design methods, perform energy and mass balance calculations, estimate costs, and apply team management skills. In this regard, a new experiment was developed at OSU in the Unit Operations Laboratory using a Chem-E-Car. A model car was built using transparent PVC to facilitate easy visualization of the process. Further, the car was designed with interchangeable wheels and nozzles to accommodate experiments demonstrating fluid mechanics. A pressure transducer was installed to continuously acquire the transient changes in pressure using a computer. In addition, a pressure relief valve was placed on the model to demonstrate safety principles. Using the acetic acid/baking soda reaction, students (a team of three) were asked to develop a relation between the amounts of reactants and the total pressure. When the reactants were mixed, the system appeared to attain an equilibrium pressure as more CO₂ was released with the venting of gas. Students were asked to perform detailed material and energy balances accounting for the solubility of CO₂ in water, which could vary with the total pressure. Further, they were asked to check the effect of changing the nozzle diameter on the decreasing pressure. This low-cost experiment not only reinforces the concepts of thermodynamics but also prepares the students for safe engineering practice. Implications of this experience and a number of other possible experiments will be discussed in detail.