462g Reactors for Solid-Acid Catalyzed Alkylation Processes

Subramanya Nayak, R.C Ramaswamy, P. A Ramachandran, and M. P Dudukovic

The solid acid catalyst based alkylation of iso-butane/butene process is an environmentally benign alternative to the conventional hydrofluoric acid (HF) and sulphuric acid (H2SO4) based processes. One of the major challenges facing the commercialization of the solid acid catalyzed alkylation technology, as of today, is the lack of robust catalysts with longer catalyst life. Three decades of research have produced several solid acid alkylation catalysts with good initial activity, but all of them deactivate rapidly. Given this limitation, the performance of alkylation process can be improved by minimizing the rate of the side reactions (that deactivate the catalyst) and increasing the desired product yield through optimal contacting pattern and reactor schemes. In the current work we have theoretically investigated and compared the performance of various contacting pattern and reactor schemes such as CSTR, CSTR-in-series, packed beds and circulating fluidized bed. The effect of multiple injection of olefins on the alkylate yield and on the catalyst deactivation in the above reactor systems is analyzed. The effect of catalyst holdup, catalyst particle size and other operational parameters such as flow rates of paraffin and olefin on the reactor performance is studied. The operational flexibility of various reactor configurations from the regeneration point of view is also discussed.