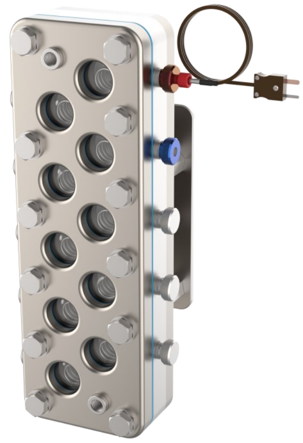
Technical Note

AM Technology
Engineering Chemistry

AMT TN-01

Bourne Reaction Characterisation of the Coflore® ACR

Introduction



The Coflore® Agitated Cell Reactor (ACR) is a multipurpose flow reactor designed for laboratory and small scale manufacturing duties. By separating the flow channel into a series of discrete cells with independent dynamic mixers, it offers plug flow, low pressure drop and good mixing over a much wider range of operating conditions than PFRs or static mixers. It can also handle materials that would block a micro reactor.

In reactor design, the fluid mixing rate can have an important effect on the yield and selectivity of chemical reactions. For reactions with fast kinetics and especially for fast competitive/consecutive (C/C) reactions, slow mixing rates can limit the overall reaction rate and/or promote slow side reactions relative to fast desired reactions. Thus, for many industrially important fast competitive reactions, slow mixing lowers the yield of desired product(s).

AM Technology collaborated with Imperial College London to characterise the Coflore® ACR in relation to the effect of residence times, Reynolds numbers, micromixedness ratio and pressure drop. Comparative tests were run in a stirred batch vessel and a static mixer reactor.

Experimental Design

The 3rd and 4th Bourne reactions are a hydrolysis of either ethyl chloroacetate (ECA) or dimethoxypropane (DMP) reacting in competition with the parallel neutralisation of sodium hydroxide and hydrochloric acid. These reactions are sensitive to mixing making them an ideal choice for the purpose of this study.

Conclusion

The results obtained within the ACR indicate a higher level of mixing efficiency than the other devices for both Bourne reactions, especially for the slower 3rd Bourne. The high level of power dissipation is an acceptable criterion for micromixing control, while control of the residence time is a conservative approach to mesomixing conditions. High level of mixing, indicative of the micromixing scale is achieved whist having a large operating window in terms of the residence time.

Due to the upward flow, a low pressure drop across the system was observed whilst maintaining a high level of mixing intensity. Compared to the static mixer, at equal Reynolds numbers, the ACR had a much larger residence time akin to a semi-batch approach. This is advantageous when considering process controllability.

The vertical orientation of the ACR and the high residence times are perceived as issues for plug flow behaviour, however, negligible back mixing and low pressure drops have been validated.

Acknowledgments

AM Technology thank Prof. Shah and Mayank Patel, Chemical Engineering Department, Imperial College, London for this work.

Imperial College London

AM Technology Berkeley Court, Cheshire, United Kingdom +44 1928 237 420 info@amt.uk