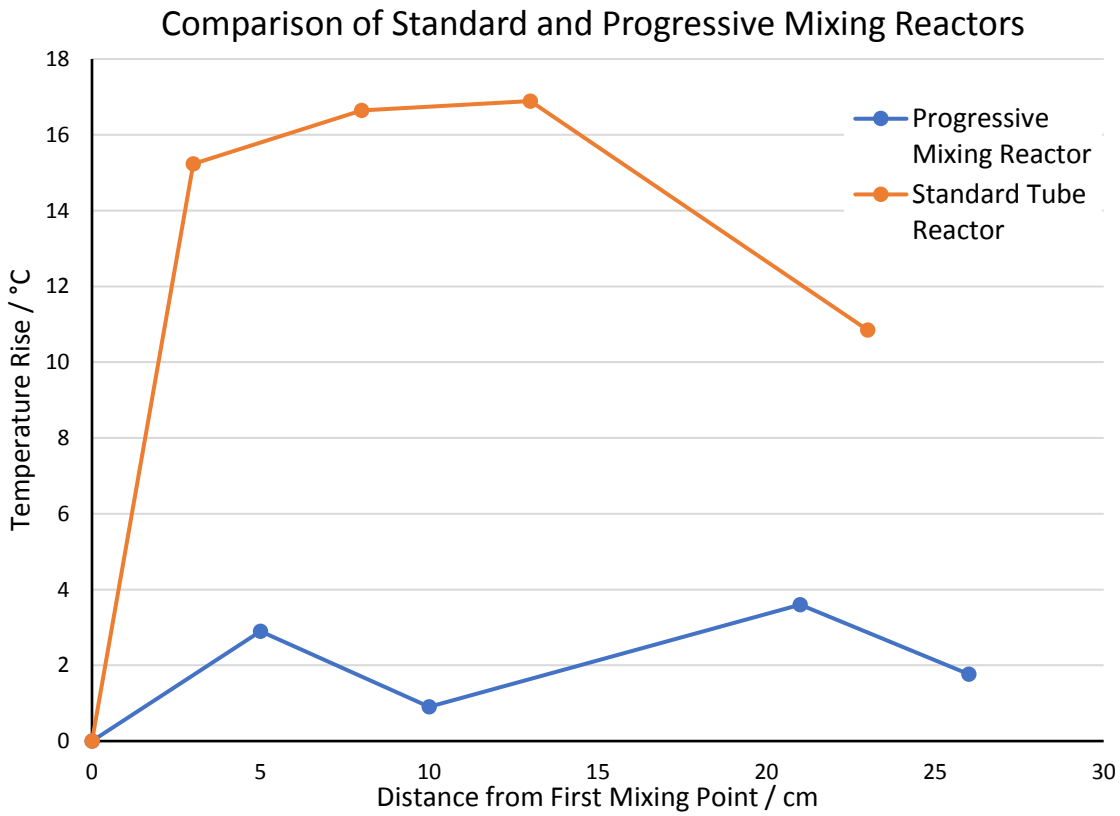
Progressive Mixing Reactor

Vapourtec have developed a new, advanced reactor designed to manage highly exothermic reactions by dispersing the high temperature generated using progressive mixing.

For some reactions, a T-piece mixer is very effective, and the rapid heat transfer capabilities afforded by a continuous flow reactor is able to prevent a significant rise in temperature. However, highly concentrated exothermic reactions can generate heat so rapidly that there is a significant temperature rise isolated within the mixing point, or shortly afterwards. Although this high temperatures region is limited to only a short section of the flow reactor it can be problematic from the point of view of promoting side reactions.

Controlling these exothermic processes could be very useful to the synthetic chemist, allowing access to highly energetic transformations, so Vapourtec have developed the Progressive Mixing Reactor. Instead of having one initial mixing point like a T-piece, the Progressive Mixing Reactor mixes progressively along its length (400 cm). As a result, fast, exothermic reactions are spread out along the reactor preventing any localised high temperature regions within the reactor, allowing highly exothermic reactions to be performed under isothermal conditions.

To demonstrate the difference between a standard reactor with a single T-piece mixer, and the Progressive Mixing reactor, we performed an acid base neutralisation between 9 M HCl and 9M NaOH and measured the resulting temperature rise at different points along the reactor length as shown below. In this experiment both the T-piece and reactor tubing was immersed in a water bath at a constant 20 °C:



It is clear that when using a reactor with a single mixing point a temperature rise of almost 17 °C occurs, whereas under the same conditions the Progressive Mixer reactor reduces the rise to less than 4 °C. We believe this enhanced control will enable the chemist to access these high-energy reactions with the confidence that the Vapourtec Progressive Mixing Reactor will prevent localised high temperatures.