Organic Process Research & Development

Editorial

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Continuous Processes: Go with the Flow!

I warn you, this will not be the first pun on 'flow' you will read here. I'm sure that, as undergraduates, your first experiments in freshman chemistry lab were the usual batch-type operations: mix them up, react, and work it up. It would have been quite a surprise if a continuous process experiment had been thrown at you first. Indeed, unless chemical engineering courses were involved, we could have easily passed through our entire academic careers without setting up so much as one flow process. It is no wonder, as the concept of deviating from the ease and simplicity of a batch operation alarms and confuses many at first, and overcoming that reticence is one reason to assemble a special issue in *Organic Process Research & Development* (OPRD) on the subject.

My first experience with a continuous process was in 1988 shortly after I joined DuPont. We had a Grignard reagent to be reacted with an α-chloro ketone to make a chlorohydrin intermediate to DuP860, an antifungal.[1] The addition generated so much heat that, on scale, it could not be kept at the temperature range required for stability over a reasonable reaction period. Instead, my engineer considered our resources at Chambers Works and asked me for a 4-L jacketed glass reactor. We set this up in the midst of a bay with two large feed tanks leading in and an overflow line leading to a 100-gal quench tank. The tiny glass reactor, dwarfed by the other fixed vessels in the bay, seemed so out of place. Nevertheless, once it started up, the reaction worked perfectly, and we made our delivery! Such a logical, simple, and elegant solution.

This issue on continuous processing contains a variety of ways to achieve flow chemistry, some simple and some not so, but in all cases there is a purpose for it and an admirable result, and what is that but the essence of style? Obviously we are not alone in our high opinion of continuous processes as this was one of the easiest special issues we have ever had to put together. Manuscripts simply 'flowed' right in! While industries such as petroleum refining, bulk chemicals, and polymer synthesis have used continuous processing for decades, we need to see more of it in pharmaceuticals, agrochemicals, fine chemicals, and other typical sources of OPRD's manuscripts. It is the future, at least where multikilogram scale is considered.

You will see a wide variety of flow chemistry in the contributions following this editorial. We start with two excellent reviews. If you do not have the time to read anything else, read these reviews. You will not be sorry. After these we follow with science as diverse as photochemistry, the Reformatsky reaction, nitration, diazomethane use, fluorine gas, the Diels–Alder reaction, hydrazine use, hydrogenation, boronation, and much more. It begins to seem as though there is not any area of chemistry that cannot be improved by flow chemistry for larger-scale preparations.

Considering how universities need to look forward to preparing their graduates for the jobs that will be out there, maybe in the near future those introductory chemistry laboratories will indeed start including flow setups in the curriculum. Not only are they relevant, they are usually safer and generate less waste than do batch operations once they reach steady-state conditions.As a result, it behooves OPRD to highlight and support such chemistry, and this special issue is a good place to start. For some of our younger readers, it may be a revelation to see how hazardous and/or sensitive chemistry can be done on a decent scale. For those more senior, perhaps you will find some new concepts to use in your work. If reading these examples inspires you to tell us about your continuous process, please write it up. I suspect we will have more special issues on this concept, but do not wait for that. Let us see what your creative 'flow' can generate (sorry; puns are *supposed* to be bad).

Jaan Pesti, Associate Editor

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