How to select a proper continuous-flow reactor for organic synthesis?

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Pharmaceutical production has historically relied on multipurpose batch vessels in order to produce material through scheduled production campaigns. Although this method is flexible, it is becoming less effective in addressing the changing landscape of pharmaceutical production, where more complex and potent molecules are required to be produced more rapidly and can have fluctuations in their demand. This lecture will describe a method for developing intensified and dedicated pharmaceutical processes, known as mini-monoplants.

In addition, a methodology is introduced to select reactor technologies based on the reaction kinetics and phases involved (Table 1). The reactor design is also discussed in terms of operating conditions, including flow patterns, when optimizing product yields in a reaction network. Importantly, not all reactions benefit from continuous flow or miniaturization, and thus process intensification should be implemented modularly as reactor geometry and operating conditions invariably affect transport-reaction, kinetics interactions, their relative time scales (i.e., Damkohler numbers).

Table 1. The reaction/reactor matrix

Rates / Phases	Homogeneous	Liquid-Liquid	Gas-Liquid	Solid-Liquid
Type A	**Plate** SZ/TG	N.A.	Plate LL	**CSTR** **TVF**
Type B	Plate**s** SZ/TG + **Coil**	Plates LL + Coil Coil with **Pulse-Flow**	Plates LL + Coil with **pressure**	CSTR**s** / **Packed Bed** Coil with Pulse-Flow **(HP)**
Type C	**Static mixer** **Coil**	Static mixer + Coil with **Pulse-Flow**	Static mixer + Coil with **pressure**	CSTRs Coil with Pulse-Flow **(HP)**

[1] Plouffe, P., Macchi, A. Roberge, D.M., *Org. Process Res. Dev.* **2014**, 18, 1286−1294.
[2] Doyle, B.J., Elsner, P., Gutmann, B., Hannaerts, O., Aellig, C., Macchi, A., Roberge, D.M., *Org. Process Res. Dev.* **2020**, 24, 2169−2182.