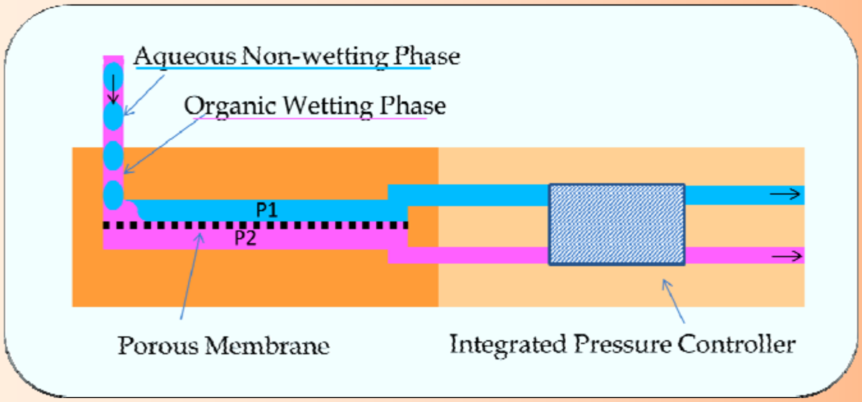
# Integrated Liquid-Liquid Separator

Zaiput Flow Technologies' patented liquid-liquid membrane-based separator provides continuous flow separation of streams of non-miscible fluids.

**Separator's Use**. The separator has one inlet for the mixed stream and two outlets respectively for the organic and aqueous phase. Its use does not need any preparation or calibration.

## How it Works:

The device exploits a porous membrane and differences in wettability between the aqueous and organic phases to separate the two streams. An integrated pressure controller ensures constant performance. Streamlined design provides *plug and play* functionality.




## Key Features:

- Can separate liquids **regardless of density differences**
- Can separate **emulsions**
- In continuous processing, separation can be done continuously and in–line
- **Very low dead volume**
- Excellent chemical compatibility
- Can operate under pressure
- Comes at a lower price than competing technologies
- **Scalable** from lab to production
- Separation efficiency reduces solvent demand
- Ideal for reactive/unstable intermediates
- Ideal for high value chemicals

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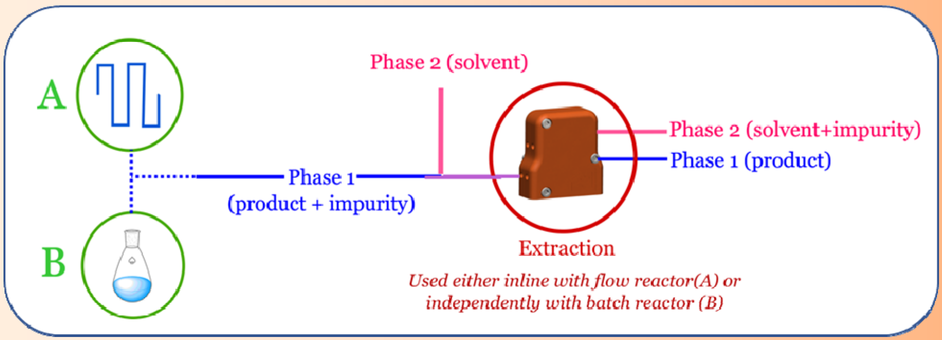
**Zaiput Flow Technologies**

Groundbreaking Innovations in Flow Chemistry

For more information, contact us at info@zaiput.com, visit www.zaiput.com or call us at +1-617-149806

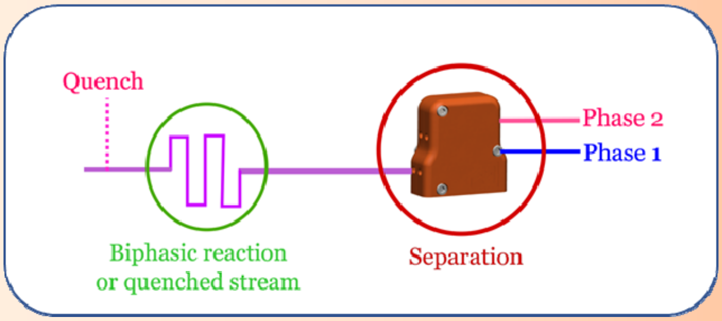
# *Examples of Applications*

## Liquid-liquid extraction/in-line workup



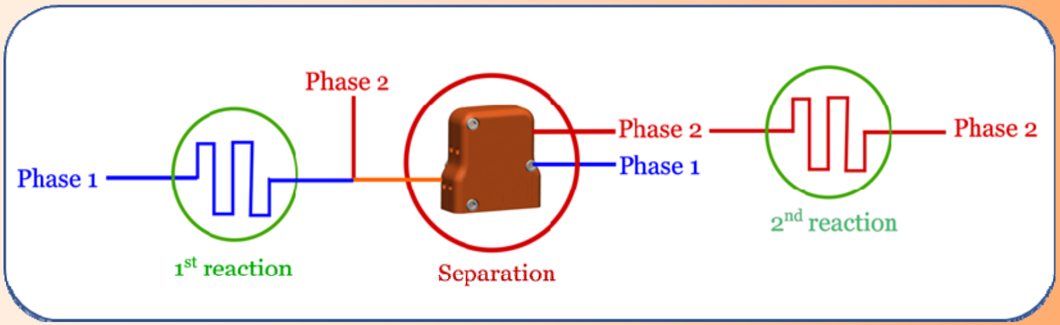

A reaction (in flow or batch) can be followed by a continuous extraction. Advantages are speed, low dead volume, continuous operation and quick separation of emulsions.

## Biphasic reaction or quenching system




In liquid-liquid reactions, often the reaction stream needs to be quenched by an immiscible phase. Zaiput's liquid-liquid separator can be used downstream or in-line to separate the biphasic reaction.

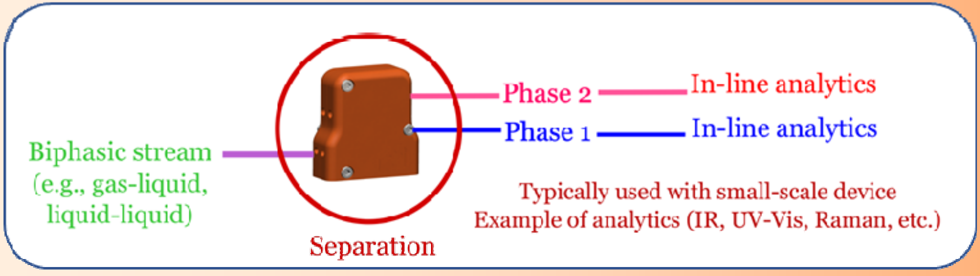
## Solvent switch (between reactions)




Solvent switching is a common step in multistep synthesis. In general, it is done manually and in a batchwise process that is slow and tedious.

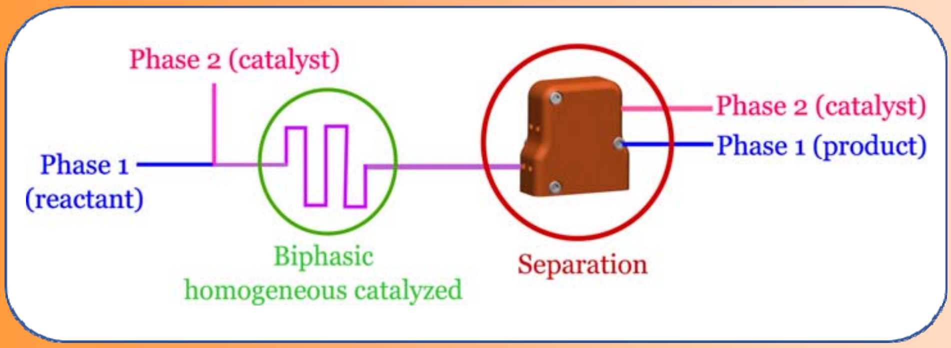
Alternatively, Zaiput's liquid –liquid separator can be inserted between 2 reactions by simply connecting the streams

## Analytical/process monitoring



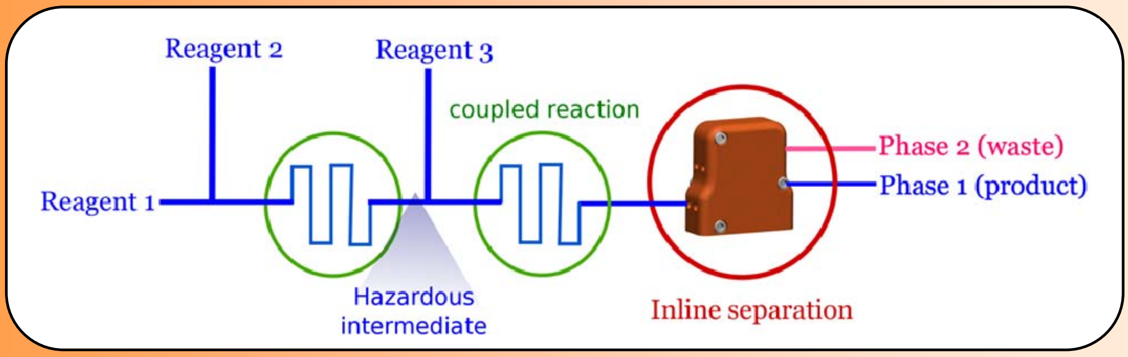

Separation of bi-phasic systems with a Zaiput device allows direct use of in-line analytical equipment.

## Homogeneous catalyst recovery



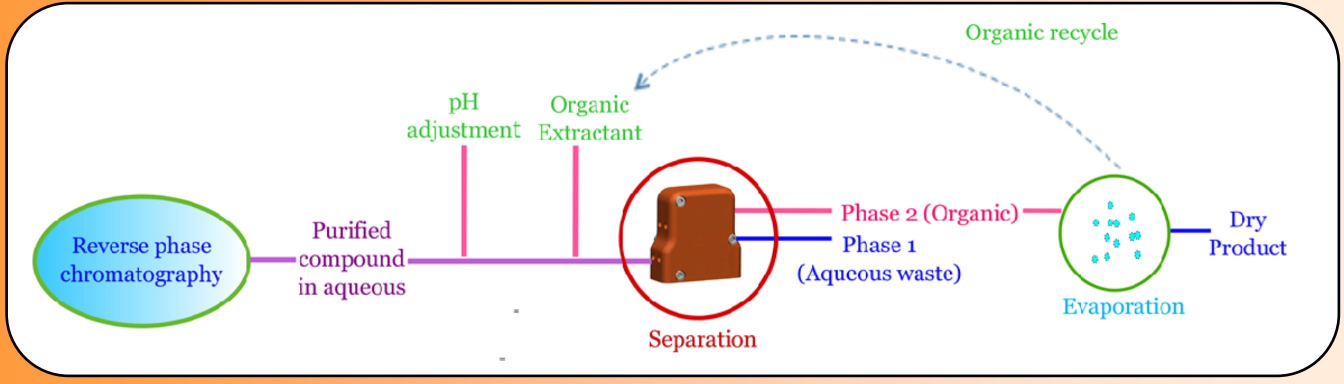

Despite its high selectivity, it is difficult to perform homogeneous catalyst recovery at a large scale because it requires highly active mixing to keep the two liquids in contact. Even at small scale, homogeneous catalysis is rarely used because it poses problems with catalyst recovery via phase separation. Zaiput's separator offers an easy and flexible way to separate the two phases and recover the catalyst.

## Separation of hazardous materials after in-situ generation



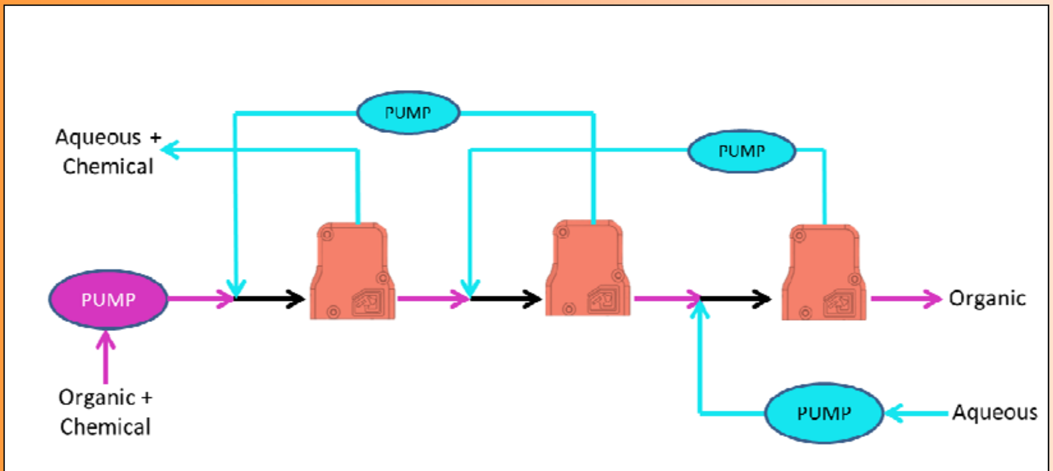

Flow synthesis can be very useful for handling hazardous intermediates because the compounds can be consumed directly into another flow synthesis without isolation.
Examples include preparation of diazomethane (that requires a Zaiput-based separation at the end of the synthesis). Other examples of Zaiput's SEP include in-line extraction of hazardous intermediates in order to avoid a potentially unsafe off-line/batch-wise workup.

## Continuous product isolation after chromatography




Aqueous work-up for product isolation is tedious and cumbersome, especially in preparative chromatography. In-line single- or multi-stage extraction with a Zaiput device streamlines operation, simplifying solvent recovery.

# Multistage extraction (co and counter-current)




Complex extraction requiring multistage operation can be quickly accomplished.

The scalability of the technology allows seamless processing from the laboratory to the production scale.

Zaiput can assist in the development and implementation of this application. Examples include pharmaceutical applications and nano-particle purification.

# *Available Models*

| Part | Total flow rate (ml/min) | Wetted parts | Max pressure | Dead volume | Dimensions (mm) |
|---|---|---|---|---|---|
| SEP-10 | 0-12 | Perfluorinated polymers | 2MPa | ~400µl | 77 x 71 x 29 |
| SEP-200-SS | 20-200 | Stainless Steel 316 Perfluorinated polymers | 2MPa | ~30ml | 206 x 196 x 26 |
| SEP-200-HS | | Hastelloy C276 Perfluorinated polymers | | | |
| SEP-3000 | 200-3000 | *Coming soon* | | | |

## Selected publications

Please ask us or find on our website a comprehensive list of publications with different examples.


**Liquid-liquid extraction/in-line workup**

Adamo A et.al., On-demand continuous-flow production of pharmaceuticals in a compact, reconfigurable system ***Science*** April 2016.

Lamborelle N et.al., Continuous-Flow Thermolysis for the Preparation of Vinylglycine Derivatives ***Org. Biomol. Chem.*** Nov 2015.

Sagamanova I. et.al., Translating the Enantioselective Michael Reaction to a Continuous Flow Paradigm with an Immobilized, Fluorinated Organocatalyst ***ACS Catal.*** Sept 2015.

Leibfarth FA et.al., Scalable synthesis of sequence-defined, unimolecular macromolecules by Flow-IEG ***Proc. Natl. Acad. Sci.*** Aug 2015.

**Biphasic reaction or quenching system**

Leforestiera B. et.al., Safe Generation and Direct Use of Chlorine Azide in Flow Chemistry: 1,2-Azidochlorination of Olefins and Access to Triazoles ***Synlett.*** June 2016.

Glöckner, S. et.al., The rapid synthesis of oxazolines and their heterogeneous oxidation to oxazoles under flow conditions ***Org. Biomol. Mol.*** Oct 2014.

**Solvent switch (between reactions)**

Hamlin, T et.al., A Continuous-Flow Approach to 3,3,3-Trifluoromethylpropenes: Bringing Together Grignard Addition, Peterson Elimination, Inline Extraction, and Solvent Switching. ***Org. Process Res. Dev.*** Aug 2014.

**Homogeneous catalyst recovery**

Peer M et.al., Biphasic catalytic hydrogen peroxide oxidation of alcohols in flow: Scale up and extraction ***Org. Process Res. Dev.*** Aug 2016.

Guerra J et.al., Visible-Light Photoredox Catalysis using a Macromolecular Ruthenium Complex: Reactivity and Recovery by Size-Exclusion Nanofiltration in Continuous Flow ***Catal. Sci. Technol.*** Feb 2016.