

Photochemistry and  
continuous flow:

# FROM LABORATORY PROMISE TO INDUSTRIAL REALITY



## PHOTOCHEMISTRY ENGINEERED FOR INDUSTRIAL IMPLEMENTATION

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**UNLOCK INNOVATION.**  
**UNLEASH POTENTIAL.**

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Source: Ajinomoto Sustainable solutions



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*How continuous flow is transforming photochemistry from laboratory promise into sustainable manufacturing reality.*

## Ajinomoto Sustainable Solutions, powered by Ajinomoto Omnicchem

Photochemistry is experiencing a renaissance. Across pharmaceutical, specialty chemical, agrochemical and materials development, R&D teams are exploring light-driven transformations to access new reaction pathways, improve selectivity and simplify synthetic routes. For scientists, the appeal is clear: photons can activate chemistry that is difficult to achieve thermally. Yet relatively few photochemical processes successfully reach industrial manufacturing. The challenge is translating promising laboratory reactions into robust, scalable and economically viable production processes.

For many organisations, an initial photochemical proof of concept can be achieved quickly. The real challenge emerges during development and scale-up. **Photochemical performance depends not only on kinetics, mixing and heat transfer, but also on the delivery of photons to the reacting molecules.** As reactor dimensions increase, light penetration changes. Residence-time distributions can shift. Solids, viscosity effects, deposition and fouling introduce complications that may not be visible during early screening. Photochemical scale-up is therefore fundamentally different from scaling traditional batch chemistry.

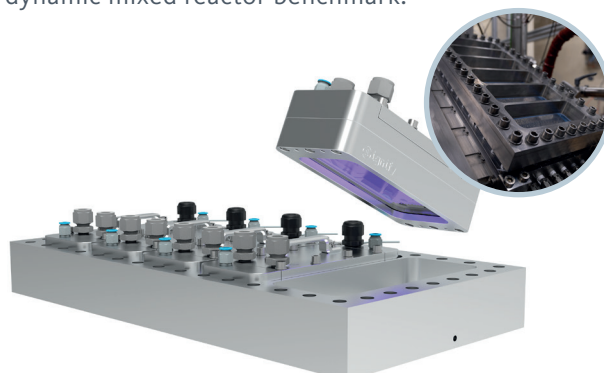
**This is where continuous flow can change the development logic.** Instead of simply increasing reactor volume, flow processing allows critical process parameters to be maintained while throughput is increased. Reactor geometries can be designed to preserve controlled light paths. Mixing, heat transfer and residence time can be engineered with precision. For photochemical reactions, this creates a powerful combination: photon management, mass transfer, thermal control and downstream thinking can be developed as one coherent process system.

At Ajinomoto Sustainable Solutions, we view photochemistry through this industrial lens. Our objective is not merely to provide access to photochemical equipment. We help customers determine whether photochemistry can unlock a better route to their target molecule and, if so, how that route can be translated into a scalable manufacturing process. This reflects our broader role as a partner in sustainable chemistry: combining scientific expertise, process development, engineering know-how and manufacturing discipline to turn promising ideas into practical solutions.

**The HANU™ photoflow platform**, co-developed by Ajinomoto Omnicem and Creaflow, was designed around that philosophy. Its plate-reactor architecture **combines continuous processing, oscillatory flow and static mixing concepts to address key challenges associated with photochemical scale-up**. A controlled channel depth supports consistent light penetration, while pulsation controlled mixing improve residence-time distribution, refresh the irradiated reaction zone and allow even slurries and viscous mixtures processing. The platform is also designed with industrial requirements in mind, including cleanability, wetted material selection/ flexibility, pressure and temperature control and flexibility in light source(LED modules).



A recent collaboration with Signify illustrates the value of structured photoflow development<sup>1</sup>. In a pharmaceutically relevant Wohl-Ziegler benzylic bromination, a Signify multi-colour light engine was combined with the HANU reactor to screen multiple wavelengths rapidly. A first screen at 365, 395, 420 and 450 nm identified 395 nm as the preferred wavelength under the tested conditions. The selected condition was then operated continuously for four hours. During that run, stable conversion was observed, with high in situ product yields. The study reported no specific clogging, no brown oily film deposition on the reactor wall contrary to previous reports by Pratley et al<sup>2</sup>. It also reported an isolated product output of 16.36 g per hour in a 5 mL reactor and a space-time yield based on isolated yield approximately 3.3 times higher than the dynamic mixed reactor benchmark.



- <sup>1</sup> [https://www.ajisustainablesolutions.com/wp-content/uploads/2025/05/Ajinomoto\\_AOCSignify\\_applicationnote-FINAL.pdf](https://www.ajisustainablesolutions.com/wp-content/uploads/2025/05/Ajinomoto_AOCSignify_applicationnote-FINAL.pdf)
- <sup>2</sup> Cassie Pratley, Youssef Shaalan, Lee Boulton, Craig Jamieson, John A. Murphy, Lee J. Edwards; Development of a Horizontal Dynamically Mixed Flow Reactor for Laboratory Scale-Up of Photochemical Wohl-Ziegler Bromination. Org. Process Res. Dev. 2024; 28 (5): 1725-1733. <https://doi.org/10.1021/acs.oprd.3c00348>

For an R&D audience, the broader message is more important than the individual reaction. Photoflow enables faster and more structured learning. Wavelength, intensity, residence time, concentration, mixing behaviour and operational stability can be investigated in a development framework that already reflects future scale-up questions. Instead of optimising chemistry first and addressing manufacturability later, chemists and engineers can evaluate both together. This reduces uncertainty and helps identify earlier whether a photochemical route deserves further investment.



The value extends beyond reaction performance. For process-development teams, structured photoflow screening can test route control, scalability and impurity strategy. For technical operations, it supports thinking around scale-up, cleanability, safety and plant fit. For sustainability and quality stakeholders, it links reaction improvement with energy input, solvent use, recovery, recycling, waste-treatment considerations and repeatable operating windows.

Photochemistry is not the answer to every manufacturing challenge, and continuous flow is not a universal replacement for batch. **But when the right molecule, mechanism and business case come together, photoflow can unlock possibilities that conventional approaches struggle to realise.** It can bridge the gap between discovery chemistry and industrial reality by aligning scientific innovation, process engineering, operational excellence and sustainability from the start.

For R&D teams exploring the next generation of sustainable chemical processes, the question is no longer simply whether photochemistry works. The more relevant question is: what becomes possible when photochemistry is designed for industrial implementation from day one? That is the opportunity continuous flow is helping to unlock. It is also where Ajinomoto Sustainable Solutions aims to create value: transforming promising science into scalable, reliable and sustainable manufacturing solutions.



**IF YOU ARE LOOKING  
FOR FLOW, YOU KNOW  
WHERE TO GO.**

## Contact details and links, Ajinomoto Sustainable Solutions

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