

Development of a Scalable Continuous-Flow Photoreactor

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With the full support of regulatory agencies, continuous-flow chemistry continues to cement its position in the chemical industry. With its groundwork in place, the focus has been shifted to the realization of the first commercially scalable flow processes, and with the focal point on handling of continuous multi-phase processes and implementation of alternative energy input (e.g. photochemistry). To address these unmet needs we have recently developed a truly scalable continuous-flow photoreactor, capable of performing photochemistry from the lab- to production-scale (Figure 1) [1].

The HANU reactor is a pulsating-flow plate reactor which contains static mixing elements that induce a split-and-recombine flow path, and is equipped with a large window for maximum light exposure. The synergetic use of the reactor geometry with a pulsatile flow regime results in plug flow-like behavior combined with intense mixing, regardless of its net flow rate. The innovative design allows the user to operate the reactor at both short and very long light exposure times, without compromising the mixing efficiency or the need for flow recirculation.

Thanks to the innovative design, the HANU reactor can be linearly scaled. Production-scale photochemistry is now readily accessible by simply widening its process channel, while the critical process characteristics, such as mass- and energy-transfer, residence time distribution and pressure drop are not influenced. In addition, the pulsatile flow expands the window of operation to heterogeneous reaction processing (e.g. metallaphotoredox catalysis using inorganic bases, heterogeneous photocatalysts). Furthermore, the window lid allows visual inspection as well as application of non-invasive, through-window inline spectroscopic PAT.

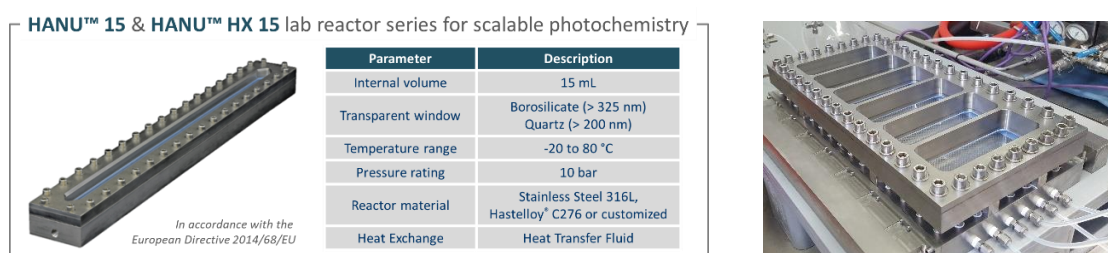


Fig. 1. A) Lab-scale HANU™ 15 reactor characteristics. B) HANU™ 150 reactor at the Ajinomoto Bio-Pharma Services' pilot plant in Belgium

To demonstrate its potential, a series of (multiphase) photochemical applications will be demonstrated which display the capacity of this reactor technology, delivering kilogram quantities utilizing photochemistry.

References

- [1] Gemoets, H. *Speciality Chemical Magazine* **2019**, 39 (8), 67-69.