

A new technology platform: processes in flow

Ehfeld Mikrotechnik BTS GmbH (EMB), a 100% subsidiary of Bayer Technology Services GmbH is a leading supplier of microreaction technology products such as micro- and millireactor equipment and related devices for lab and production applications. With a metal-based technology platform placed on an integrated scale-up concept, EMB is offering standardized lab solutions with its Modular MicroReaction System (MMRS) and scale-up solutions with FlowPlate® Microreactors, ART® plate reactors and Miprowa® high performance reactors for flow rates up to 10 m³/hour. Among the range of hardware products, EMB trains, consults and guides customers during their evaluation and implementation of the technology platform micro- and millireactors from lab to production scale.



Let's enter into details of what EMB is doing to develop the market and establish this technology platform in process industries by interviewing Dr.-Ing. Joachim Heck, managing director.

What is the actual status of the market?

Since nearly 20 years, microreactors are known as new and innovative tools for continuous synthesis in process development. In the last two decades a very good theoretical foundation has been laid, among other criteria for the selection of reaction systems that would benefit from microreaction technology (MRT). Currently the industry is looking forward to overcome the unrealized hurdles to establish the technology platform in their processes. One hurdle is the paradigm change batch-to-conti. A clear signal of change is, that a number of renowned chemical and pharmaceutical companies have introduced this technology into their research and production by forming research and technology groups. A second hurdle are missing or not published references in production scale. In the past there were missing scale-up concepts and deficient robust equipment for production applications which are nowadays available.

To overcome the hurdles, publications and press releases about production applications, as well as announcements of success stories are needed. I'm convinced that attractive lighthouses will be visible in process industries in the near future.

In addition research work of universities is required for demonstrating how to proceed to implement attractive applications. Meanwhile various reaction classes have been experimentally studied in lab scale; for many of them higher yields/space-time-yields compared to batch have been measured and confirmed.

I conclude, establishing of the technology platform is on a good track.

Under rising commercial pressure, European companies are carefully looking for innovative process solutions, which can replace or complement established reactor technologies. At the same time Chinese players are more open-minded to step into this technology platform for the reason of missing track record during the last 150 years. Based on the market status described above EMB is developing the market.

What are the key characteristics a company should have to achieve a commercial success?

Understanding the market situation is one key fundament to map strategic targets and to turn them into tactic measures to meet the market demands. Customer wishes and values are the best guidance system for a company to succeed. Beside this, a strong IP basis is mandatory, furthermore technically skilled, experienced staff and an international background to serve customers worldwide in their business. With our mother company Bayer Technology Services, we are rightly shaped to serve global market demands, which are highly sophisticated from the technological point of view.

How do you cooperate with your customer?

We have different models of cooperation with customers:

- For scientific users, a hardware purchase with or without training is the typical offering
- Industrial customers usually expect to be convinced by Proof of Principle experiments about the performance of the technology before they step in. Mostly the next step is a first hardware purchase as test balloon, training and further support concerning guidance / consulting during process development and scale-up, which we can offer on-site, in our labs or with partners.

What do you do to help customers to be more competitive?

Based on our conclusions of the market interpretation, we have elaborated a strategic concept for multinationals or mid-sized companies. The prerequisite is, that the senior management is committed to introduce the technology in



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the enterprise with an intensive support regarding evaluation and implementation of the technology platform. We call it: "Strategic Partnership Principle".

Can you comment on your Strategic Partnership Principle?

After the decision of a senior manager to step into the technology platform, concrete process development projects are defined and set up together with the customer – to ensure that the "test balloon" was not a flash in the pan. Target is a fast run through the experience curve for evaluation and implementation from lab to production scale. During such projects EMB guides the client how to use the equipment effectively for concrete process demands based on the equipment know-how of EMB. Customers who have agreed on such strategic contracts are much faster with their learning curve for implementing successful applications (lighthouses) in production scale. Thereby they are able to significantly shorten time demand for scaling up, which means in consequence time-to-market and to reach the beneficial threshold much earlier compared to companies with single test isles.

Does your company help industrial customers to realize a (chemical) factory in the future? Do you serve the market or change the market with your products?

We are one puzzle piece in process intensification and help our customers with innovative solutions and know-how, e.g. to turn batch processes into continuous flow, to master challenging reactions with compact reactors and finally to be on the pulse of the time in terms of effectivity, efficiency and competitiveness. It will change infrastructures of facilities by demanding not so much space, raw materials, solvents and energy for downstream processing – finally said: the companies will save costs and achieve a high level of cost efficiency.

What type of reactors and mixers are you offering, what kind of concept stands behind your product portfolio?

Starting with the modular approach of the Modular Micro Reaction System (MMRS), users can benefit from a flexible development platform in their labs to cover a broad range of different reaction types in a continuous mode. Initial trials in these micro mixers and micro reactors give in short times the basis and the parameter set to scale-up reactions in a very fast way.

Plate-type reactors are the preferred ones for Pharma customers, because they are addressing the consistency in ratios of the chemicals under GMP conditions by applying one-channel concept. Multi-injection points and multi-step synthesis are already provided by the plate reactor concept. The plate-type reactors "FlowPlate® Microreactors" and "ART® plate reactors" are licensed products from the companies Lonza and Alfa Laval, which we exclusively manufacture and sell worldwide. For Specialty Chemicals business, Miprowa® high-performance reactors with parallel rectangular channels and static mixing inserts, are the best choice to gain high scale-up factors. Fast exothermic reactions for liquid and liquid/gas flow are the right jobs for this reactor type originating from a classical tube bundle heat exchanger. Now, in comparison to the past, hardware is available to scale-up MRT-based processes.

What are outstanding applications that have proved to be successful thanks to this set of equipment?

Ehrfeld assessed the following applications as highly attractive:

- Peroxide synthesis – explosive reactions
- Sulfonations/Alcoxylation (Ethoxylation) – very fast reactions
- Precipitation reactions – fast mixing and uniform conditions for precipitation, e.g. formation of nanoparticles/catalyst precursor
- Al/API – multistep synthesis (pathways in one process step); fast reactions like Organometallic reactions (Lithiations, Grignard reactions), Nitrations, etc.