



Shrink-fit manufacturing

Modular paintmaking unit occupies a floorspace of only 30 m²

Contact:

Ralf Hohmann
Hemmelrath Lackfabrik
GmbH
T +49 9372 136-195
r.hohmann@hemmel-
rath.de

Ralf Hohmann
Hanspeter Seeger
Stefan Klapper

The compact “modular paint factory” concept developed some years ago has now been extended with the introduction of a smaller unit suitable for product and process development and as a production unit for small batches ranging from 300 to 5,000 litres.

Inspired by the large scale prototype, the “Modular Paint Factory” (“MoFa”), the “Mini-MoFa” represents a new trend for production facilities in the chemical and paint industry. With this unit, the manufacture of multi-functional, semi-finished products, pre-formulation and the actual finished product reaches high levels of flexibility and quality.

Aspects such as industrial design, functionality, user-friendliness and cleaning efforts, which were sometimes considered only peripheral until now, have been completely redeveloped and reconstructed.

The new compact unit satisfies all crucial parameters whether used as a development/research module for new kinds of formulations, as a “scale-up monitor” for

large batch production, as an indicator for determining production costs or as a production unit in its own right.

Standard production procedures summarised

Modern production processes, which are based on state-of-the-art dissolver technology, are mostly semi-automatic procedures. The level of automation can usually be considered as 75 % at most. With large production batches, batch size ranges between 5,000 kg and 15,000 kg. Solids are dosed via sacks, big bags or silos. This is a time-consuming procedure where dust deposits and hard agglomerates can form in the headspace of the vessel. These may contaminate the product when the vessel is being emptied.

Dispersion, wetting and homogenisation are statistical methods, which is to say that they show a great variation of results and thus quality characteristics. A fundamental problem with waterborne systems is the considerable aeration due to vortex formation during the dispersion process. Consequently, the dissolver must be operated at different dispersion speeds, which in turn has an effect on the particle size and particle distribution.

This is then followed by a grinding process, with a throughput capacity of approximately 1,000 kg/h. This process is combined with a classical agitator technology. All this leads to poor flexibility and to a small process window.

Advantages of the modular production concept

In comparison to the so-called standard procedures, the degree of automation is higher with modular production, where fully automated processes can be achieved. Another advantage is that there is no batch size limit and currently an amount of up to 50 tonnes can be considered to be normal. The handling of solids is much easier. Silos are no longer necessary, as silo trucks can be unloaded directly. Investment costs are therefore lower.

With the modular production system, dispersion is no longer a statistical model, but a forced dispersion. There is no or hardly any aeration during the mixing and dispersing process. Volume flow rates of up to 10,000 kg/h are possible with the grinding technique used.

All these aspects provide a significantly larger process window and possibilities for considerable cost reduction. The modular system only requires half the space and 30 % of the energy costs of other standard procedures. The product quality is also significantly better and more consistent.

Modular production now suits every batch size

The "MoFa" concept is now available in different sizes. The original series has been available for seven years



Figure 1: The compact layout of the "Modular Paint Factory" ("MoFa")



Figure 2: The "Mini-MoFa"

Results at a glance

- »» The concept of the modular paint factory, "MoFa", was introduced successfully several years ago in the form of systems to produce large batches. The new compact paint factory or "Mini-MoFa" occupies only 30 m² and is designed for batch sizes of 300 l – 5,000 l.
- »» It may be used as a production unit for small batches, and for various evaluation and scale-up tasks.
- »» Relative to conventional dissolver technology, it offers shorter production times, more flexible batch sizes, faster cleaning and stable production parameters. The dispersion unit avoids aeration while the mixer permits production of "high solids" products with a density of > 2.5 kg/dm³.
- »» Additive levels in the formulation can be reduced due to increased efficiency and only one employee is required to operate the unit.
- »» Smaller units have also been designed for batch sizes of 2 l – 300 l, in both lab scale trials and very small production batches.



Figure 3: The first "Micro-MoFa"

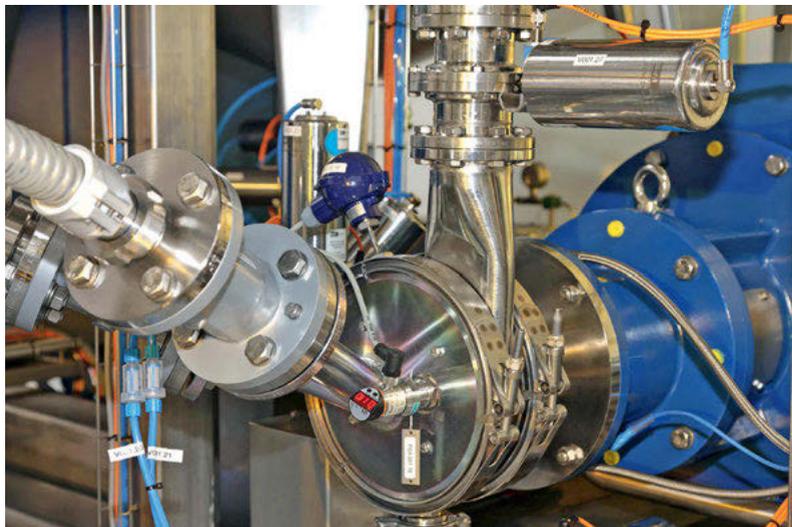


Figure 4: The "Conti-TDS" central dispersion unit

with capacities ranging from production batch sizes of 5,000 l up to 50,000 l (Figure 1).

The latest version is the "Mini-MoFa" series for production batch sizes ranging from 300 to 5,000 l, available in five different sizes (Figure 2). It occupies a floor space of only 30m². The "Micro-MoFa" series for production batch sizes ranging from 2 l - 300 l, available in five different sizes, is suitable for laboratory scale trial batches and very small batches. Figure 3 shows the first of these units.

The original concept was designed for large-scale solutions. It is adapted to the construction-related infrastruc-



Figure 5: The integrated jet stream mixer

ture and integrated in such a way so that an optimised production process is ensured. Batch sizes of less than 5,000 l are not suitable for this type. For that, the smaller units have been designed and developed as the world's most compact paint factory. This type of facility has a specially designed, integrated cleaning module. Thus, the product can be changed from black to white without problems.

Thanks to its way of organising product formulation, the small version works without producing waste. The facility is constructed in modules and can be completely assembled within one week. All components are fitted on installation frames, thus reducing any high investment costs for construction infrastructure. Only the necessary energy sources have to be added: electricity and compressed air.

How air entrainment is avoided during dispersion

The central dispersion unit is a "Conti-TDS" (Transport and Dissolving System), a rotor/stator machine that works according to the centrifugal principal (Figure 4). During the pumping process, the special design of the rotor helps to create a vacuum where solids and liquids are sucked in. Due to the high vacuum, the dispersion unit transports the powder in a dense phase, so that no additional conveying air is required.

The air attached to the powder itself (apparent as the difference between powder density and specific gravity) is removed during the wetting and deagglomeration process. The result is an almost air-free product. The separation of the air and the complete forced wetting takes place in the vacuum range of the dispersion zone.

The dispersion unit basically works as a "side-line" wetting and dispersion machine. For this reason, important production parameters, i.e. dispersion speed and production rate (throughput) remain stable for all batch sizes.

The jet stream mixer (Figure 5) built into the process tank will lead to an intensive, air-free and homogeneous mixing of the entire contents of the container, regardless of batch size, viscosity and flow property of the products which are to be produced. These functional properties allow the production of products with a specific gravity of more than 2.5 kg/dm³ ("high solids products"). The additives used are distributed directly into the entire contents of the container.

Ingredients added without dust or waste

The dust-free dosage of solids is carried out from specially developed reusable vessels. A bulk container has a capacity of 50 l - 1,500 l and a small quantity container 1 l - 70 l. Both types are connected by self-sealing systems. They are pre-weighed and then emptied via the vacuum of the dispersion unit. The handling of containers within the production unit is carried out via an integrated crane system.

There are two different ways to dose fluids. Fluid raw material dosages from containers with a filling volume of up to 1,000 l (such as an IBC or stainless steel container) are automatically dosed by the integrated crane system with its built-in weighing device.

Amounts of up to approximately 20 kg may be added via the funnel designed for small quantities. Both flows are

injected into the volume flow of the dispersion unit via a feed pump. This technology guarantees a fine distribution of the injected raw material into the basic liquid in the vessel. The unit is also designed in such a way that large components can be taken from the container without dripping (Figure 6).

Cleaning integrated across the entire unit

A cleaning concept for the whole unit has been designed, based on the demand for frequent product and colour changes (including black-white). All unit components necessary for cleaning are part of the modular unit and do not have to be adapted to it. Containers / vessels, product conducting pipelines and hose lines, transport routes for powders and additives are all included in the cleaning process.

The central dispersion unit is used for the input of mechanical cleaning energy. All surfaces and pipe connections are designed so that residue-free removal of the products is guaranteed. The cleaning process is based on the cascade technique and is matched to individual requirements.

Automated control includes maintenance advice

The whole unit is operated by a Programmable Logic Controller (PLC) via a touch screen monitor (Figure 7). The operator chooses between semi-automatic and automatic operation. Maintenance and repair services are performed during service operation. The process flow is carried out via formulations with a user guide. All possible process variations for production and cleaning are stored in the controller.

After the end of the process, a batch protocol with all relevant process data is issued. Then the complete process unit is weighed, which serves as an additional weight check for the added components. Thus a continuous verification check is possible during the whole manufacturing process. An externally adapted pearl mill is also normally operated and monitored via the controller.

The controller checks all wear parts of the unit by monitoring operating hours and switching cycles. A maintenance plan for these components can be found in the controller. Prior to the maintenance interval, the controller indicates which unit components should be serviced and to what extent. Thus, the time consuming effort of monitoring maintenance activities is made obsolete.

Production technologies compared

In comparison to conventional dissolver technology, modular production offers several advantages, such as:

- » Reduction of production times by up to 80 % and energy costs by up to 70 %;
- » Reduction of labour cost of up to 80 % since one employee can operate the unit;
- » Up to 100 % higher capacity and more flexibility in batch sizes with as many product changes as desired;
- » Reduction of trial costs by increasing batch capacity up to 50 %;



Figure 6: Drip-free dosage of fluids

- » Additive levels can be reduced by up to 25 % due to increased efficiency;
- » Better dispersion with the "Conti-TDS" and constant production parameters (line quality);
- » Prevention of aeration during the production process with reduction of odour emissions and improved work hygiene and cleanliness.

Future prospects

The "Mini-MoFa" has advantages in respect of efficient production, product quality, work hygiene, work safety and design. It may be used as:

- » A development module for new formulation variations;
- » A production facility;
- » A scale-up monitor for larger batch production;
- » An indicator for determining production costs.

The units which are currently in operation satisfy all their specifications. ◀



Figure 7: The process is controlled via touch screen