

1. Modular platform for high-throughput formulation of highly viscous fluids and powders

1.1. Overview of the High-throughput Workflow

A modular platform for high-throughput formulation of highly viscous fluids and powders was developed under the scope of the Flamac - HTE collaboration. Using weight based dispensing technologies, liquids and powders can be formulated for a diverse range of applications, such as coatings, inks and catalysts. The platform is designed for a throughput of at least 200 formulations per day, where an individual recipe may easily consist of more than 10 dispense steps (liquids and powders) as well as a number of process steps (stirring at a certain speed for a certain time) with a well-defined sequence.

1.2. Platform Design

The platform, in its initial state, consists of four individual modules performing the necessary chemical functions, namely a fluid dispensing module, a solid dispensing module, a stirring module and a logistics module (sample storage and barcode reading). These modules are connected by a robotic handling system that performs all transfer tasks of the individual sample vials within the platform.

Among the major design goals were flexibility and extensibility, as high-throughput experimentation projects tend to vary significantly over time requiring important changes to the initial workflows. Therefore, the platform is flexible with regard to sample size (approximately 5–80 g of formulation) which can be formulated in a broad range of different vials. Additionally, the individual liquid dispense amounts cover four orders of magnitude, i.e. from 50 mg to 50 g, while using the same, newly developed dispense principle. This principle is applicable for low-viscosity liquids such as solvents, highly viscous substances (tested up to 10 Pa.s) as well as stirred dispersions.

Furthermore, the robotic handling system is designed in a way, that the individual modules can be exchanged or re-grouped around the handling system, as well as new modules performing different functions can be added which makes future extensions to the platform possible.



Figure 1.1: Modular platform for high-throughput formulation of highly viscous fluids & powders.

1.3. Software

The platform is fully automatically operated by hteControl, an advanced process control application, combining proprietary and newly developed equipment as well as commercial components. Additionally, the operation of the platform is supported by our data management system myhte, which provides the necessary experimental design features (recipe generation and DoE), workflow integration functions and data analysis capabilities.

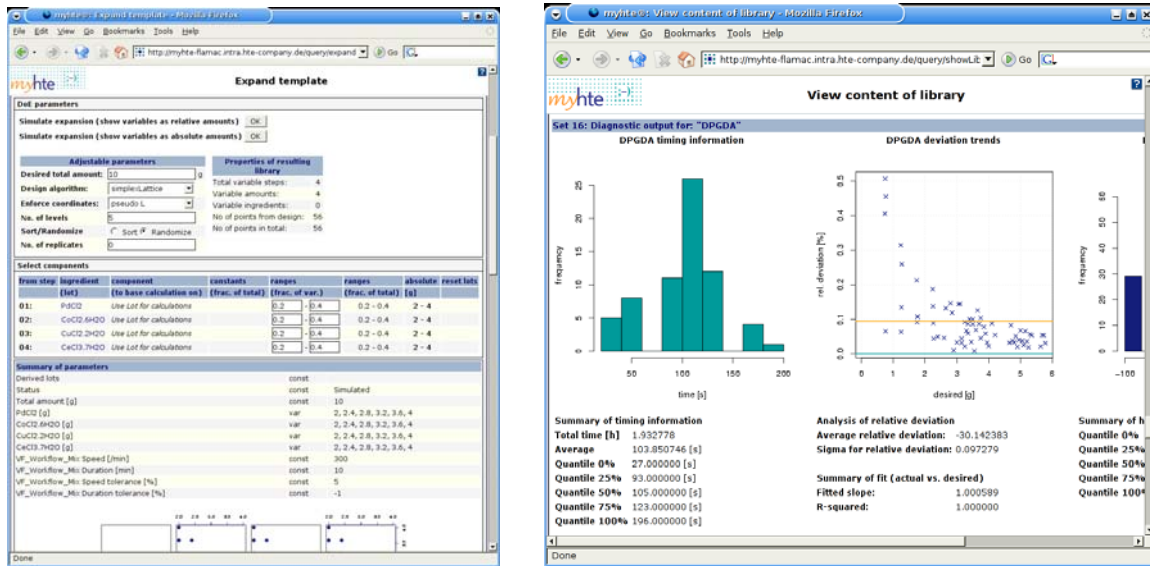


Figure 1.2: Myhte[®] software for design of experiments and data analysis.