

TECHNICAL REPORT



TEMPERATURE CONTROL IN THE CHEMICAL INDUSTRY

As a supplier to almost all manufacturing companies, the chemical industry relies on efficient and safe processes to meet its production requirements. Since most chemical reactions are either exothermic and release heat, or endothermic and absorb heat, a reliable temperature control application plays a central role in the chemical industry. Precise and consistent temperature control of individual process steps is of decisive importance, especially in process engineering. The use of temperature control solutions in process engineering ranges from laboratory benchmark in the development of new materials and processes to the temperature control of large industrial plants.

APPLICATIONS AND PROCESSES IN PROCESS ENGINEERING

Process engineering is an interdisciplinary engineering science. By definition, it deals with the “technical and economic execution of all processes in which substances are modified according to type, property, and composition.” Process engineering uses chemical, biological, or physical processes to initiate material changes and forms an interface between the natural sciences and production.

In addition to the development of new techniques and materials, the optimization of process steps of established methods also falls within the scope of process engineering. Recycling and, thus, the recovery of valuable resources is also becoming increasingly important.

TEMPERATURE CONTROL IN PROCESS ENGINEERING

In the chemical industry in general and in process engineering in particular, numerous process sequences are bound to one temperature or can be supported by a specific temperature control application, and thus made more efficient. An example of the latter is the continuous temperature control of casting media. To maintain the necessary viscosity, the material pipes, pumps, and dosing unit can be heated in addition to the storage tank. Optimum temperature control of the casting material throughout the entire process not only makes it easier and faster to process – but it also simplifies the ascent and exit of air inclusions, which reduces production times and rejects, and improves quality. The temperature control systems used must be able to react continuously and quickly to changes and stabilize the process. Ideally, their performance is directly coupled to the viscosity of the casting medium, for example, and automatically adjusted to the optimum range using adaptive temperature changes.

However, the dynamic compensation of exothermic or endothermic chemical reactions poses far greater challenges to the temperature control systems. Especially if the reactions take place in extreme temperature ranges, the temperature control systems have to provide for fast compensation. This not only ensures an efficient and consistent result but also ensures the safety of the process.

REACTOR TEMPERATURE CONTROL

In both chemical and biological processes, the conversion of substances often takes place in reactors, which make it possible to create consistent conditions and a safe space for the reactions. This requires temperature control systems with fast and precise compensation and a wide temperature range. Therefore, temperature control systems are used, which react highly dynamically to temperature changes inside the reactor, compensate these quickly and reliably, and automatically adjust back to the optimum range. The reactor type, its size and the material (e.g., glass or metal) as well as the wall thickness, and the thermal conductivity associated with the material are, among other things, decisive parameters which, in addition to the process to be temperature-controlled, themselves influence the choice of the temperature control system. Pump capacity, pressure build-up, heat exchange rates, and the efficiency of the components in the temperature control system must precisely cover the respective requirements to guarantee process reliability and effective material conversion. If requirements deviate from the standard, specially developed temperature control solutions are also taken into consideration. In many cases, however, this is not necessary because temperature control systems available on the market can be easily and efficiently adapted to individual requirements.



FROM LABORATORY BENCHMARK TO LARGE-SCALE PLANT

The requirements for temperature control systems also depend on their range of application. When developing new procedures in the laboratory, not only performance and reaction speed but also a wide working temperature range, as well as a simple and flexible change between applications, are of decisive importance for the selection of a temperature control system. The temperature control systems can, therefore, be used in a wide variety of applications without any problems. Aspects such as the size and mobility of the device, water or air cooling as well as a sophisticated positioning of connections and vents make the decisive difference as to how suitable the temperature control systems are for everyday practical use. In large-scale industrial applications, consistent performance with low maintenance requirements and high energy efficiency are the main priorities. Since the units are usually only used for temperature control of a single process, a lower dynamic range may be sufficient.

CONCLUSION

In chemical reaction and process engineering, a precise temperature control application has a decisive influence on production output, product quality, and process reliability. The requirements placed on temperature control systems are strongly application-related. JULABO temperature control systems can be individually adapted to most applications thanks to the extensive range of accessories, the wide temperature range, and the extraordinary dynamics. Nevertheless, the development of an individual solution specially adapted to your application is possible at any time.

Our temperature control specialists in the field of process engineering and reactor temperature control will be pleased to advise you and develop a temperature control solution with you that is perfectly designed for your application in all parameters.