

Controlling Enzyme Reaction Temperature with Circulator Baths

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- Enzyme activity
- Reaction rate
- Kinetic energy

Abstract

Controlling temperature is crucial for enzyme reactions as too high a temperature can bring a reaction to a complete stop. Thermo Fisher Scientific's HAAKE Phoenix II heated circulator baths allow technicians to control temperature during enzyme reactions.

Enzyme Reactions and Temperature Control

Enzyme reaction technology is used for a wide variety of analytical applications, including life science, food and beverages, and agriculture. In addition to variables like pH and enzyme concentration, temperature control is one of the most important factors in these reactions.

All chemical reactions speed up as temperature is raised. According to Worthington-Biochem's "Introduction to Enzymes," a 10°C rise in temperature will increase the activity of most enzymes by 50 to 100%. The text goes on to add, "Variations in reaction temperature may introduce changes of 10 to 20 percent in results."

However, temperature above the enzyme's optimum (that

is, where an enzyme exhibits maximum activity) can abruptly render an enzyme ineffective. At this temperature point, the kinetic energy of the enzyme and water molecules is so great that the structure of the enzyme molecules is disrupted.

Systems used to control enzymes temperature must have the ability to:

- React quickly and accurately.
- Remain accurate at the indicated temperature over a long period.
- Have a recirculation pattern in the bath which is equal around the surface of the bath.

Controlling Temperature with Thermo Scientific HAAKE Circulator Baths

In standard temperature control bathes, the approach to reaching the correct temperature is often too fast and results in "overshoot". In a sinusoidal way, the temperature swings around the set temperature before it becomes stabilized. This overshoot may influence the performance of the reaction and may even stop it completely.

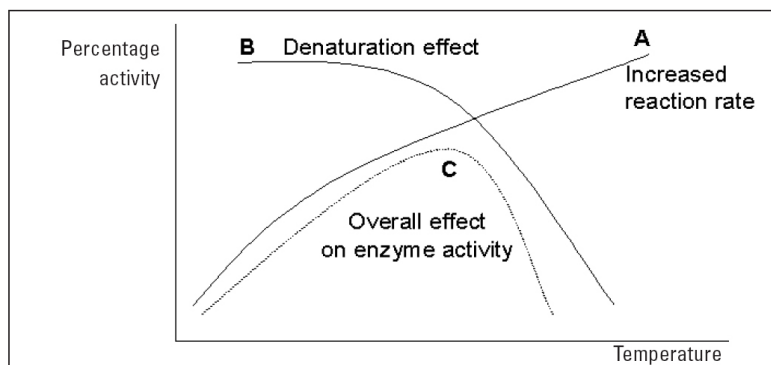
Thermo Scientific HAAKE Phoenix II circulator baths eliminate the problem of overshoot.

Basic in its design is the FuzzyStar software, which allows the cooling step and the heating step to work together. The HAAKE Phoenix II's temperature sensor is placed in the bath, allowing the different cycles react quickly to temperature changes – and preventing the bath's contents from going over the set temperature. In addition, the unit's circulation pump assures even temperature conditions throughout the bath, guaranteeing high precision and low turbulence.

The HAAKE bath's single screen display with a "wide angle" view allows users to set the system in any of six languages, including SI and common standards such PSI or °F, using a simple command structure.

Storing sample preparation data is easily accomplished via the HAAKE Phoenix II's three communication ports. The unit can be connected to a wide range of external controls via an RS232/RS485 and/or Siemens Profibus interface, allowing users to track application performance and making it easy to exclude the temperature control step as a variable when looking at the results.

The Phoenix II's compact design, user-friendly software and reliable temperature accuracy make this an ideal unit for any lab conducting enzyme reactions.



The effect of temperature on enzyme catalysed reactions: The velocity of a chemical reaction increases with increasing temper A) but because of the increasing denaturation of the protein, the proportion of the active enzyme falls (B). These two processes result in the characteristic temperature profile of an enzyme (C).

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