

Unistat® 425w

Controlling an exothermic reaction of 200 W, 300 W and 500 W

Requirement

The purpose of this test is to demonstrate the capability of the Unistat 425w to bring under control an exothermic reaction simulated by turning on an immersion heater placed inside the reactor.

Method

The Buchi Glas Uster 20-litre reactor and Unistat 425w were connected together with insulated "M38x1.5" hoses. The HTF circuit (reactor, Unistat and hoses) was filled with DW-Therm and the reactor was filled with a Huber HTF "M90.055.03".

The Unistat 425w was set up in "process control" mode and a set-point of 20 °C was entered.

Once the system stabilised at 20 °C a simulated exothermic reaction was initiated by turning on a controlled immersion heater placed inside the reactor and immersed in the M90.055.03.

When the system had re-stabilised under the new heat load the immersion heater was switched off.

The test was complete once the system had stabilised again at 20 °C.

Results

The results can be viewed in the following graphics.

As soon as the process temperature starts to rise the jacket temperature is rapidly cooled to 0 °C generating a wide ΔT bringing the process temperature back to 20 °C within 10-minutes. The process temperature increases by a maximum of 1.9 °C above the set-point during the "reaction". A similar response can be seen when the immersion heater is turned off (ending the "reaction").

In both curves it can be seen that the process is returned to the set-point exactly with no over or under shoot.

Setup details

Buchi Glas Uster reactor:

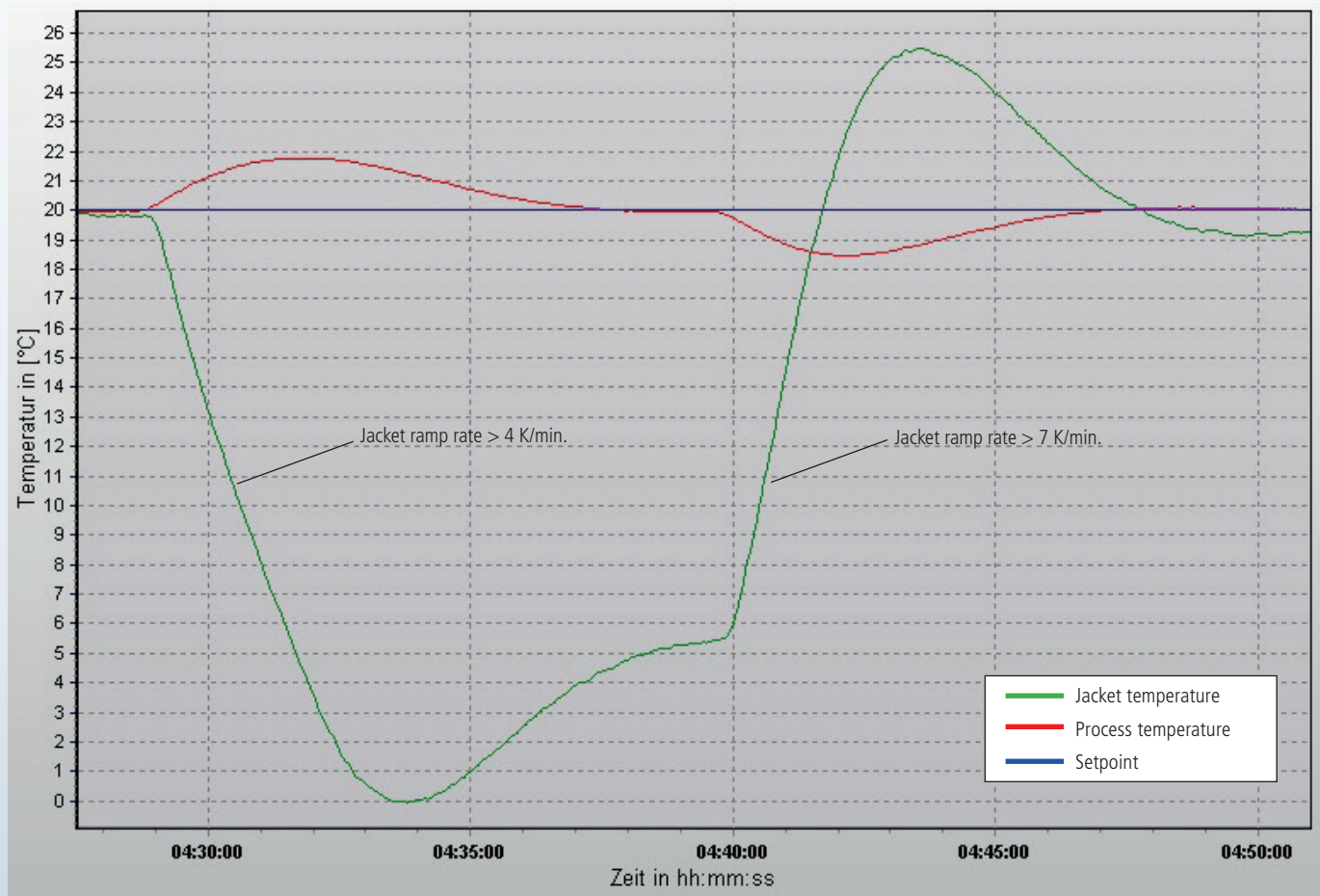
Size: 20 litre
 Type: jacketed glass reactor
 Contents: 15 litre M90.055.03 (#6259)
 specific heat capacity of 0.36 cal / kg °C
 Stirrer speed: 200 rpm

Unistat® 425w:

Temperature range: -40...250 °C
 Cooling power: 2.8 kW @ 250...100 °C
 2.5 kW @ 0 °C
 1.9 kW @ -20 °C
 0.2 kW @ -40 °C
 Heating power: 2.0 kW
 Hoses: 2x1 m; M38x1.5 (#9325)
 HTF: DW-Therm (#6479)
 Control: process

Test 1:

Simulated Exothermic reaction of 200 W (47.8 cal / sec) at 20 °C



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The Unistat 425w was set up in "process control" mode and a set-point of 20 °C was entered.

Once the system stabilised at 20 °C a simulated exothermic reaction was initiated by turning on a controlled immersion heater placed inside the reactor and immersed in the M90.055.03. When the system had re-stabilised under the new heat load the immersion heater was switched off.

The test was complete once the system had stabilised again at 20 °C.

Results

A set-point of 20°C is set under "Process" control and once the process temperature is stable, the simulated reaction is started by turning the immersion heater "On". The process temperature begins to rise and immediately the jacket temperature cools and rapidly reaches approximately -9.5°C generating a wide Delta-T bringing the "reaction" under control and returning the process temperature exactly to 20°C. After a short while the heater is turned "Off" and a similar response can be observed...the rapid heating of the jacket to return and hold the process temperature exactly at its set-point.

Setup details

Buchi Glas Uster reactor:

Size: 20 litre
 Type: jacketed glass reactor
 Contents: 15 litre M90.055.03 (#6259)
 specific heat capacity of 0.36 cal / kg °C
 Stirrer speed: 200 rpm

Unistat® 425w:

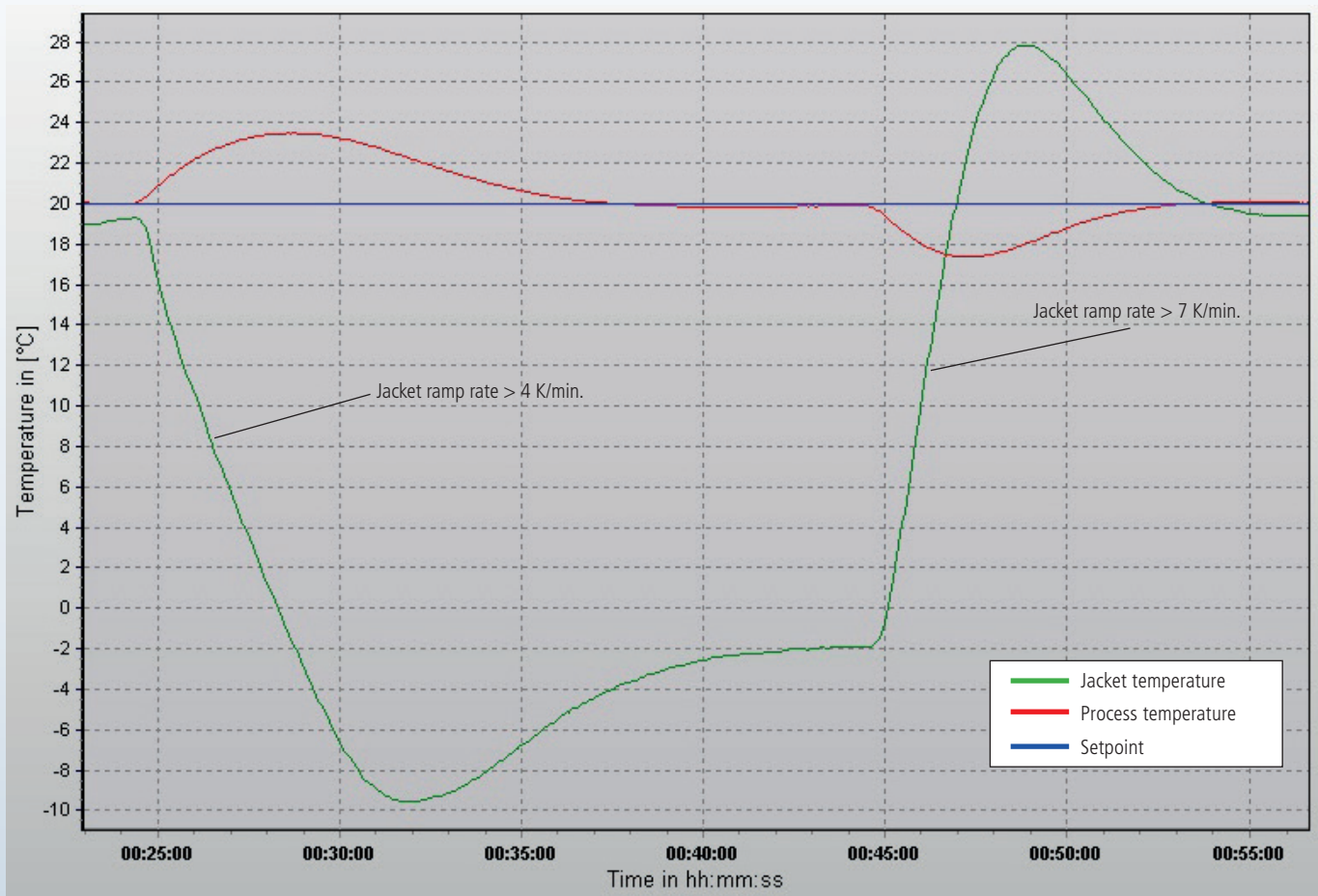
Temperature range: -40...250 °C
 Cooling power: 2.8 kW @ 250...100 °C
 2.5 kW @ 0 °C
 1.9 kW @ -20 °C
 0.2 kW @ -40 °C
 Heating power: 2.0 kW
 Hoses: 2x1 m; M38x1.5 (#9325)
 HTF: DW-Therm (#6479)
 Control: process

Test 2:

Simulated Exothermic reaction of 300 W (71.6 cal / sec) at 20 °C

Critical data:

Increase in process temperature:	1.8 K	Decrease in process temperature:	1.5 K
Time taken to return to 20 °C from initiation:	< 8 minutes	Time taken to recover to 20 °C:	< 8 minutes
Undershoot:	< 0.1 K	Overshoot:	< 0.1 K



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Method

The Buchi Glas Uster 20-litre reactor and Unistat 425w were connected together with insulated "M38x1.5" hoses. The HTF circuit (reactor, Unistat and hoses) was filled with DW-Therm and the reactor was filled with a Huber HTF "M90.055.03".

The Unistat 425w was set up in "Process control" mode and a set-point of 20 °C was entered.

Once the system stabilised at 20 °C a simulated exothermic reaction was initiated by turning on a controlled immersion heater placed inside the reactor and immersed in the M90.055.03. When the system had re-stabilised under the new heat load the immersion heater was switched off.

The test was complete once the system had stabilised again at 20 °C.

Results

The results can be viewed in the following graphics.

As soon as the process temperature starts to rise the jacket temperature is rapidly cooled to 0 °C generating a wide ΔT bringing the process temperature back to 20 °C within 10-minutes. The process temperature increases by a maximum of 1.9 °C above the set-point during the "reaction". A similar response can be seen when the immersion heater is turned off (ending the "reaction").

Setup details

Buchi Glas Uster reactor:

Size: 20 litre
 Type: jacketed glass reactor
 Contents: 15 litre M90.055.03 (#6259)
 specific heat capacity of 0.36 cal / kg °C
 Stirrer speed: 200 rpm

Unistat® 425w:

Temperature range: -40...250 °C
 Cooling power: 2.8 kW @ 250...100 °C
 2.5 kW @ 0 °C
 1.9 kW @ -20 °C
 0.2 kW @ -40 °C
 Heating power: 2.0 kW
 Hoses: 2x1 m; M38x1.5 (#9325)
 HTF: DW-Therm (#6479)
 Control: process

Test 3:

Simulated Exothermic reaction of 500 W (119.4 cal / sec) at 20 °C

Critical data:

Increase in process temperature:	7 K	Decrease in process temperature:	4.5 K
Time taken to return to 20 °C from initiation:	< 20 minutes	Time taken to recover to 20 °C:	10 minutes
Undershoot:	< 0.2 K	Overshoot:	OK

