CLAIMS

1. A method for controlling a heated process of a heater, the method comprising:

obtaining a setpoint variable indicating a target temperature of the heater;

identifying an energy profile for the heater based on the setpoint variable, wherein the energy profile provides a defined magnitude of initial electrical energy to be applied to the heater to have a temperature of the heated process reach the target temperature;

obtaining a process variable indicating a performance characteristic of the heated process; and

providing electrical energy to the heater based on at least one of the energy profile and the process variable.

2. The method of Claim 1, wherein providing the electrical energy to the heater further comprises:

providing the defined magnitude of initial electrical energy to the heater; and

reducing the electrical energy to the heater in response to the process variable indicating that the temperature of the heater is within a temperature approach band of the target temperature of the heater, wherein the performance characteristic includes the temperature of the heater.

3. The method of Claim 2, wherein the electrical energy is reduced to a steady state electrical power based on a natural time constant.

4. The method of Claim 2, wherein the electrical energy is reduced to a steady state electrical power based on a proportional-integral control.

5. The method of Claim 1 further comprising determining whether the temperature of the heater is less than the setpoint variable, wherein:

in response to the temperature of the heater being less than the setpoint variable, the electrical energy provided to the heater is based on the identified energy profile and is equal to the defined magnitude of initial electrical energy, and

in response to the temperature of the heater being greater than the setpoint variable, the method further comprises:

turning-off electrical energy to the heater;

obtaining the process variable indicating the performance characteristic of the heater, wherein the performance characteristic includes the temperature of the heater; and

increasing the electrical energy to the heater to a steady state electrical power in response to the temperature of the heater being within a temperature approach band.

6. The method of Claim 5, wherein the electrical energy is increased from zero to the steady state electrical power based on a natural time constant.

7. The method of Claim 5, wherein the electrical energy is increased from zero to the steady state electrical power based on a proportional-integral control.

8. The method of Claim 1 further comprising:

determining whether the temperature of the heater is equal to the setpoint variable; and

controlling the electrical energy to the heater based on a temperature control model for maintaining the temperature of the heater at the setpoint variable.

9. The method of Claim 1, wherein the performance characteristic includes at least one of a voltage of the heater, a current of the heater, and a temperature of the heater.

10. A system for controlling a heater, the system comprising:

a processor configured to execute instructions stored in a nontransitory computer-readable medium, wherein the instructions comprise:

obtaining a target temperature of the heater and a temperature of the heater;

controlling the heater in one of an energy-based control mode and a temperature control mode based on the target temperature and the temperature;

identifying, during the energy-based control mode, an energy profile for the heater based on the target temperature, wherein the energy profile provides a defined magnitude of initial electrical energy to be applied to the heater to have the temperature reach the target temperature;

providing, during the energy-based control mode, electrical energy to the heater based on the energy profile; and

selectively providing, during the temperature control mode, the electrical energy to the heater based on the temperature.

11. The system of Claim 10, wherein the instructions for providing, during the energy-based control mode, the electrical energy to the heater based on the energy profile further comprise:

providing the defined magnitude of initial electrical energy to the heater;

determining whether the temperature of the heater is within a temperature approach band of the target temperature of the heater; and

reducing the electrical energy provided to the heater to a steady state electrical power in response to the temperature of the heater being within the temperature approach band of the target temperature of the heater.

12. The system of Claim 10, wherein the instructions for selectively providing, during the temperature control mode, the electrical energy to the heater based on the temperature further comprise:

turning off electrical energy to the heater;

determining whether the temperature of the heater is within a temperature approach band of the target temperature of the heater; and

increasing the electrical energy provided to the heater to a steady state electrical power in response to the temperature of the heater being within the temperature approach band of the target temperature of the heater.

13. The system of Claim 10, wherein the instructions further comprise:

determining whether the temperature of the heater is equal to the target temperature; and

controlling the electrical energy provided to the heater based on a temperature control model for maintaining the temperature of the heater in response to the temperature of the heater being equal to the target temperature.

14. A method for learning an energy profile of a heater, the method comprising:

obtaining a setpoint variable indicating a target temperature of the heater;

providing electrical energy to the heater, wherein the electrical energy has a calibration magnitude;

obtaining a process variable indicating a temperature of the heater; and

when the process variable indicates that the temperature of the heater is equal to the target temperature:

determining a response time of the heater;

selectively adjusting gain values of a controller based on the response time; and

generating an energy profile based on the gain values and the setpoint variable, wherein the energy profile correlates the setpoint variable to a predetermined value of electrical energy.

15. The method of Claim 14, wherein the energy profile further defines a steady state electrical power that is applied to the heater in response to the temperature of the heater being within a temperature approach band of the target temperature.

16. The method of Claim 15 further comprising defining the temperature approach band of the target temperature based on a mathematical model.

17. The method of Claim 14, wherein the energy profile further defines a duration of time to provide the predetermined value of electrical energy to the heater to have the temperature of the heater reach the target temperature.

18. The method of Claim 14, wherein selectively adjusting the gain values based on the response time further comprises adjusting the gain values based on a Ziegler-Nichols tuning routine in response to the response time being greater than a threshold response time.

19. The method of Claim 14, wherein the energy profile is further based on the calibration magnitude.

20. The method of Claim 14 further comprising selectively adjusting the calibration magnitude when the process variable indicates that the temperature of the heater is equal to the target temperature.