

EXPERIMENT 1 Boiling Regimes

Safety Precautions:

Please make sure all the equipment is in safe condition before and after conducting the experiment.

Objectives:

1. To observe and determine the different regimes in pool boiling

Introduction:

Boiling is liquid-to-vapor phase change processes that occurs at solid-liquid interface when the temperature of the surface is maintained at a temperature T_s that exceeds the saturation temperature T_{sat} corresponding to the pressure of the liquid that is contact with the surface. The objective of this experiment is to observe behaviours associated with the different regimes of pool boiling. There are 4 regimes of pool boiling namely natural convection boiling, nucleate boiling, transition boiling and film boiling as shown in Figure 1.1. This experiment also is to enhance the understanding of boiling process by the students.

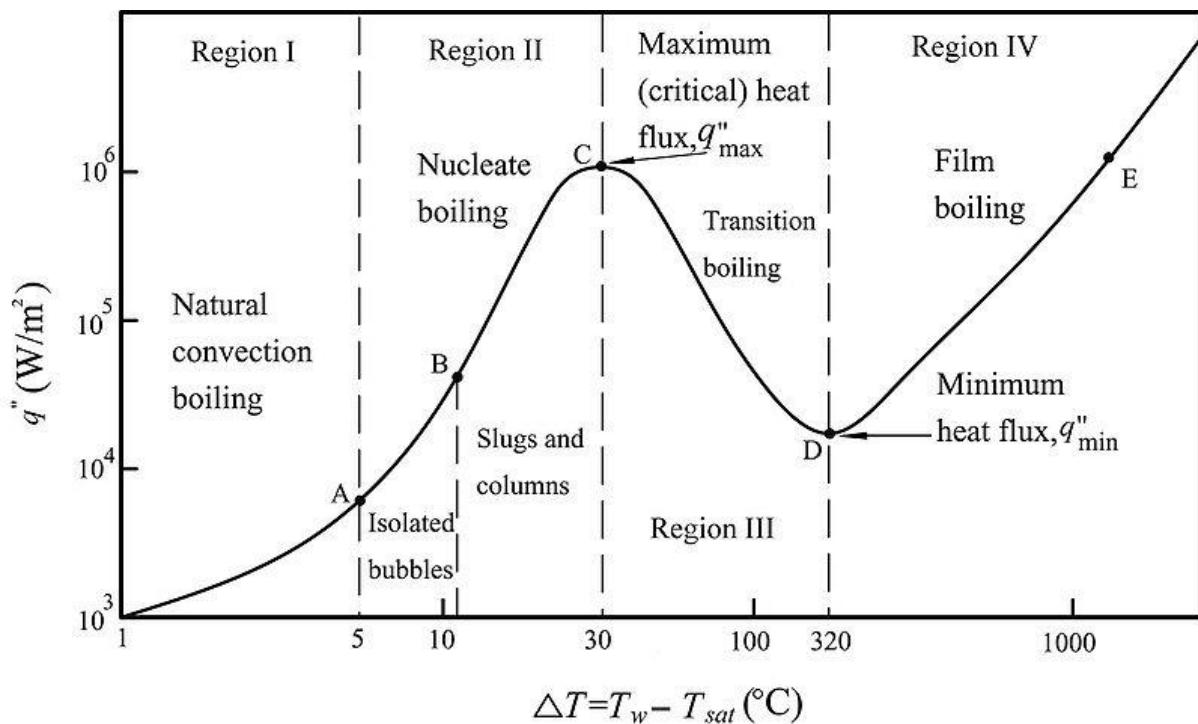


Figure 1.1 The Boiling Curve

Equipment and materials:

1. Pool boiling chamber:
 - Size: 300 mm × 300 mm × 300 mm
 - Material: Polycarbonate 8 mm thick
2. Immersion heaters:
 - Type: U type cartridge water heater continuously adjustable.
 - Material: S.S304
 - Capacity: 500 watts
 - Capacity: 1000 watts
3. Test section:
 - Copper blocks
 - Copper cover
 - Polyether ether ketone PEEK block
 - Test specimen:
 - Material: Stainless steel grade 304L
 - Size: L-25 mm × W-10 mm × T-2 mm
4. DC power supply:
 - Type: Switched mode power supply
 - Output: 0-10 volts & 1200A DC
 - Regulation: 0.5% to 1% at full load
 - Efficiency: 85%-95% at full load
 - Cooling: Forces air cooled
 - Remote control: Digital voltmeter & ammeter with 3 m flexible connection cable from main power supply unit.
5. Data acquisition device:
 - Make: National instruments
 - Model: NI USB 6001
 - Inputs: 8 analog input
 - Output: 2 analog output

Procedure:

1. Fill distilled water into pool boiling chamber up to heater levels.
2. Secure connection from pool boiling to computer.
3. Give single phase electric supply to trainer and switch on Mains.
4. Give three phase electric supply to DC power supply and switch on Mains.
5. Supply power to DC power supply and mains boiling chamber.
6. Turn on heater and heat the water until achieve saturated temperature. (start boiling)
7. Open SCITECH DAQ application to collect real time data.
8. Observe the bubbles formation at the heater.
9. Record data.
10. After completion of the experiment, let the water cool down at room temperature and switch of mains.

Data Analysis:

Table 1.1: Characteristic Zones and their Descriptions.

Observed Zones	Excess Temperature Range (°C)	Time Frame Range (minutes)	Observed Behavior
I	$0 < \Delta T_e < 5$		
II	$5 < \Delta T_e < 10$		
III	$10 < \Delta T_e < 20$		
IV	$20 < \Delta T_e < 30$		
V	$30 < \Delta T_e < 40$		
VI	$40 < \Delta T_e < 50$		
VII	$50 < \Delta T_e < 100$		