Chapter as follows: Ø boiling chamber Ø test

CHAPTER 3EXPERIMENTAL SETUP3. 1 GENERAL DESCRIPTIONTheexperimental setup is designed and fabricated as per the requirement. It ismade in such a way that the bottom part of the boiling chamber has an openingwhich allows fixing of different test surfaces to perform the experiment. Following point were kept in mind during the design of the setup: Ø Thevolume of the boiling chamber should be kept small to prevent the setup frombeing too large. Ø Thewater vapour formed during the experiment must be condensed completely tomaintain the same level of water in the chamber at all times. Ø Theboiling chamber should give clear visual access of the heater surface toobserve all the phenomena taking place at the heater surface. Ø Thenumber of cartridge heaters and their rated power should be as per the heatingsurface area. This means that the power supplied must be enough to heat theheating surface till critical heat flux is reached.

Ø Properinsulation of the test surface and the heater block must be ensured to minimisethe heat loss in radial direction. Ø Thesetup must be free from any leakage. Theindividual components of the experimental setup are as follows: Ø BoilingchamberØ TestsurfaceØ HeaterblockØ Refluxcondenser with cooling coilØ AutotransformerØ ThermocouplesØ DataloggerØ ThermostatØ SealantThecomplete setup is shown in the figure that follows: Figure 3.

1: Experimental setup3. 2 BOILING CHAMBERTheboiling chamber is cylindrical in shape with the top and bottom being coveredwith steel plates. The bottom plate has an opening at the centre which allowsfixing of the various test surfaces on which experiments are to be carried out.

In addition to the central opening, there is an additional opening in thebottom plate where the auxiliary heater of 150 W is fixed. The chamber iscompletely transparent allowing visual access of the ongoing experiment. Openings, if any, were sealed using high temperature gasket sealant. Thechamber is made up of pyrex glass with diameter 7. 5 cm and height 29 cm and avolume of 1281.

2 cm3. At the bottom of the chamber drain pipe isprovided to drain the liquid after experiment. The boiling chamber is shown inthe figure that follows: Figure 3. 2: Boiling chamber 3. 3 TESTSURFACEThreetest surfaces namely, plain, sand paper roughened and acid etched coppersurface were used. All the test surfaces were prepared from the same copperblock using milling operation. The following figure shows the test specimen: Figure3. 3a: Test specimen Figure3.

3b: Specifications of test specimen 3. 3 HEATER BLOCKHeaterblock is made up of copper. Due to its high thermal conductivity, copper waspreferred over other materials. Two cartridge heaters are embedded at thebottom of the heater block. The sum total of the rated power of the heaters is700 W. The cartridge heaters are connected to an autotransformer for powersupply. The entire block is enclosed with teflon to minimise the heat loss inradial direction.

3. 4 REFLUX CONDENSER WITH COOLING COILSAreflux condenser along with copper cooling coils, is used to condense the watervapour. Most of the vapour is condensed by the copper coils and the remainingwhich escapes the copper coils gets condensed in the reflux condenser. Coolingwater is

used to condense the water vapours passing through reflux condenser. The water vapour passes through the inner glass column and is cooled by thejacket of water present in the outer glass column and condenses. The refluxcondenser is fixed at the top of the boiling in an opening in the top plate ofthe boiling chamber. The reflux condenser also helps to maintain the pool ofboiling liquid under atmospheric pressure as the outer glass column of thereflux condenser is open to atmosphere.

The reflux condenser is shown in thefigure that follows: Figure 3. 4: Reflux condenser3. 5 AUTOTRANSFORMERThepower supplied to the heater block can be adjusted by an autotransformer. Theautotransformer used in this experimental setup is having specifications of 240V and 20A. Figure 3. 4: Auto transformer3. 6 THERMOSTATThepower supply to the auxiliary heater is provided via.

a thermostat. Thethermostat maintains the bulk temperature of DI water inside the boilingchamber at saturation temperature corresponding to atmospheric pressure. It hasan automatic switch on/switch off function which switch on the auxiliary heaterwhen DI water temperature falls below saturation temperature and switch off theheater when the water reaches the saturation temperature. The thermostat usedin this setup is shown in the figure below: Figure3.: Thermostat3. 7 DATA LOGGEREightchannel data logger manufactured by Masibus is used to record the temperaturereadings which is displayed on a digital readout.

All the three thermocoupleswere connected to different channels of the data logger and the channel numberof each thermocouple is noted. The data

logger is shown in the figure thatfollows: Figure3.: Data logger3. 8 THERMOCOUPLETemperaturemeasurement is an important aspect of this experiment.

Four thermocouples areused in this setup. Three thermocouples measure the temperature at threedifferent locations of the test surface. The distance between each of the threethermocouples is kept same. The fourth thermocouple measures the bulktemperature of DI water in the boiling chamber. All the four thermocouples usedwere K-type thermocouples of diameter 1 mm. The K-type thermocouples are havingvery good temperature range.

Therefore, they are most widely used fortemperature measurement. Some of the specifications of K-type thermocouple ispresented below: Materials used Chromel/Alumel Temperature range -270 to 1260°C Accuracy(standard) ±2. 2°C Melting point 1400°C Voltage output(over maximum temperature range) -6. 4 to 54. 9 mV Table 3. 1: K-type thermocouplespecifications 3. 9 SEALANTThegap between the test specimen and teflon insulation and between the heaterblock and test surface was sealed using a gasket maker red paste.

Also, thecartridge heaters end were sealed with the sealant to tightly fix it inside theheater block. Some of the properties of the sealant are given below: Specific gravity 1. 35-1. 4 Tensile strength(kg/cm2) 16-38 Service temperature -50 to 300 °C Grade A-HTRTV Red Table 3. 2: Properties of gasketmaker red paste