armfield

BASIC WATER COOLING TOWER

UOP6
issue 9

The Armfield Basic Water Cooling Tower has been designed to give students an appreciation of the construction, design and operational characteristics of a modern evaporative cooling system. The unit is also an excellent example of an 'open system' through which two streams of fluid flow (water and air) and in which there is a mass transfer from one stream to the other.

Convincing energy and mass balances are obtained and students can quickly investigate the effects of:

- *air flow rate*
- *water flow rate*
- *water temperature*
- *cooling load*
- *packing density*

on the performance of a cooling tower.

Heat and Mass Transfer Unit Operations

UOP

MEASUREMENT AND INVESTIGATION CAPABILITIES

- *observation of water flow pattern and distribution with different packing arrangements and with various water and air flow rates*
- *measurement of all 'end states' and the rate of flow of air, water and 'make-up'*
- *plotting of 'end states' on a psychrometric chart and the application of the steady flow equation to draw up energy balances*
- *Investigation of effect of packing surface area/volume ratio on:*
  - *approach to wet bulb temperature at inlet*
  - *pressure drop across packing*
- *Investigation of performance at:*
  - *a range of process cooling loads*
  - *a range of inlet temperatures*

DESCRIPTION

The Armfield Basic Water Cooling Tower is completely self-contained and includes both the simulated heating load and the circulating pump. It has much the same configuration as a full size force draught cooling tower, has the same characteristics and stabilises quickly.

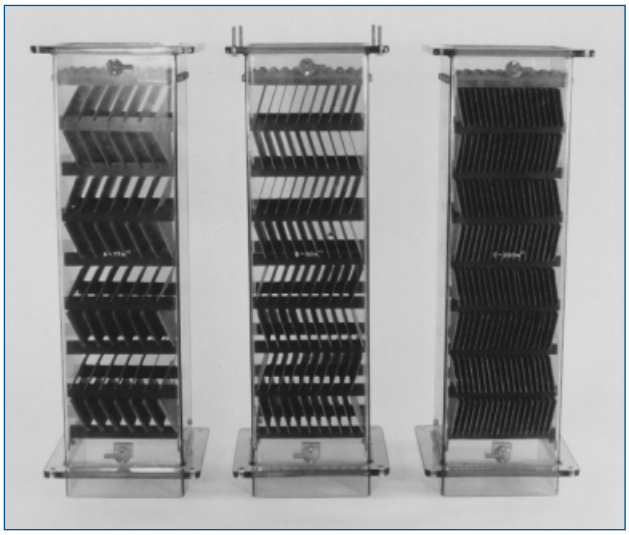
In this unit a fan is placed at the base of the tower to drive air upwards through the packing. Natural buoyancy assists the fan and helps dissipate the humid air from the top of the tower.

The packing in the cooling tower breaks the water into thin films or droplets which present a large surface area to the air stream and thereby assist the cooling process. The water is cooled largely by evaporation and, to a small extent, by direct contact cooling. Due to the evaporation of some of the water into the air stream, a continuous supply of fresh water must be added to the system. This 'make-up' is normally less than 5% of the cooling water flow rate. A float valve is provided to allow accurate measurement of 'make-up'. When the cooled water falls to the load tank it is reheated before circulation.

Three packed columns, having different surface/area volume ratios are available and can be quickly interchanged without using tools.

All the structural components are made from clear PVC or blue GRP, allowing students to observe the water flow through some parts of the system.

Instrumentation is supplied.



The three optional packed columns

TECHNICAL SPECIFICATION

Maximum working temperature: 50°C

Centrifugal fan, maximum air flow:

0.06kg/s^{-1}

Packed columns:

150mm x 150mm x 600mm high

Variable area flow meter:

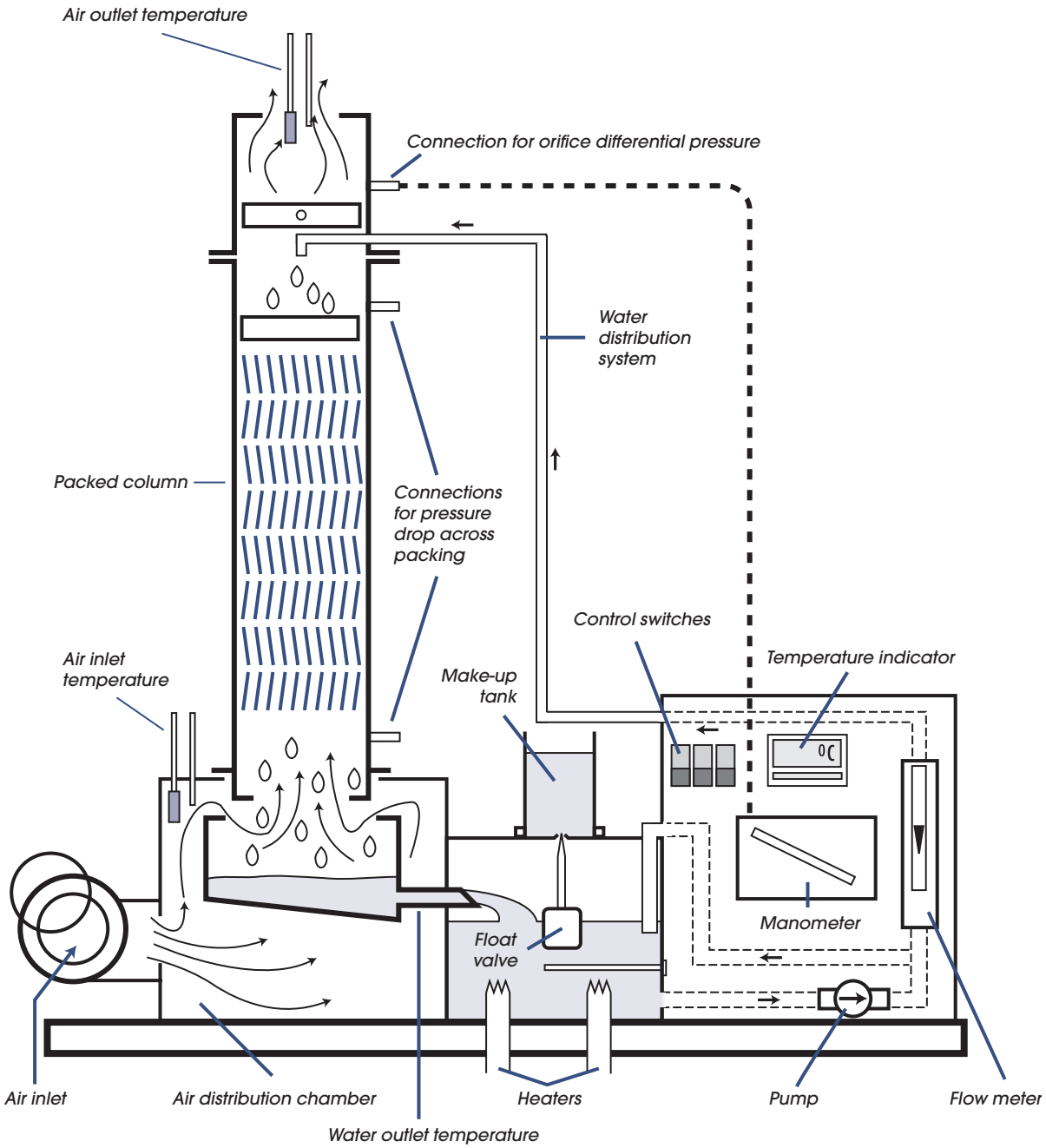
0 - 50g/s^{-1} with control valve for water flow rate to packings

Temperature measurement using Type K thermocouple displayed on 199.9 digital meter to measure terminal water temperatures and wet and dry bulb air temperatures

Inclined tube manometer:

0 - 40mm H_2O to measure orifice differential pressure or packing resistance

UOP6: Basic water cooling tower flow diagram



ORDERING SPECIFICATION

- *Bench top unit to demonstrate operation of a forced draught cooling tower, comprising tower base with air circulation, water reservoir with heater and make-up tank, and a control console with recirculation pump and instrumentation*
- *Supplied with one standard packed column, dimensions 150mm x 150mm x 600mm, comprising 10 plates giving 110m²/m³*
- *Three additional columns are available as options for comparison (bare column, 7 plates and 18 plates)*
- *The columns are manufactured from clear plastic to allow viewing of water flow through the system*
- *The columns are easily interchangeable without the use of tools*
- *Instrumentation includes:*
  - *Thermocouple with digital readout for measuring water temperature and wet and dry bulb temperatures*
  - *Variable area flow meter with control valve*
  - *Inclined tube manometer*
- *Experimental capabilities:*
  - *Observation of water flow pattern and distribution with different packing arrangements and with various water and air flow rates*
  - *Performance and flow measurements*
  - *Use of psychrometric charts, application of the steady flow equation, energy balances*
  - *Investigation of the effect of the packing surface area/volume ratio*
  - *Investigation of performance for different loads and different temperatures*

ORDERING OPTIONS

UOP6-10: *Basic Water Cooling Tower with 10 plate column giving 110m²/m³*

Additional Columns:

UOP6-20: *7 plate column giving 77m²/m³*
UOP6-21: *18 plate column giving 200m²/m³*
UOP6-22: *Bare column only*
UOP6-23: *Packing characteristics column*

SERVICES REQUIRED

Electrical supply:
UOP6-10-A: *220-240V/1ph/50Hz*
UOP6-10-B: *120V/1ph/60Hz*

Water supply:
2 L/hr distilled or demineralised water (in containers)

OVERALL DIMENSIONS

Height:	*1.20m*
Width:	*0.95m*
Depth:	*0.60m*

SHIPPING SPECIFICATION

Volume:	*0.70m³*
Gross weight:	*130kg*

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