

Study of Overall Heat-Transfer Coefficient

Practical 03 | Pharmaceutical Engineering

Aim

To study Overall Heat-Transfer Coefficient, and interpret the recorded observations.

Principle

- A heat exchanger transfers energy across an area driven by a temperature difference. Flow arrangement determines the terminal differences used in the log-mean temperature difference.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

Materials and Apparatus

- Assigned heat exchanger, temperature probes and flow-rate measurement.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

Observation / parameter	Record / finding
Hot/cold inlet and outlet temperatures	_____
Mass flow	_____
Heat-transfer area	_____
Heat balance	_____

Calculations and Interpretation

- $Q = \text{mass flow} \times \text{heat capacity} \times \text{temperature change}$.
- $\text{LMTD} = (\Delta T_1 - \Delta T_2) / \ln(\Delta T_1 / \Delta T_2)$.
- $U = Q / (A \times \text{LMTD})$. When terminal differences are equal, LMTD equals that common difference.

Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: _____

Conclusion: _____

Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

Viva Questions

1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

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