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Semester 3 - Practical Notes

Pharmaceutical Engineering

Complete Subject Manual

13 practicals and activities. Use the PDF bookmarks to move between practicals. Page numbers restart within each practical; the page counts below exclude the promotion pages.

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Study of Radiation Constant of Surfaces

Practical 01 | Pharmaceutical Engineering

Aim

To study Radiation Constant of Surfaces, and interpret the recorded observations.

Principle

- Radiative power depends on absolute temperature and surface emissivity. A material-dependent fitted coefficient is not the universal Stefan-Boltzmann constant.
- 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

- Brass, iron and painted/unpainted glass demonstration apparatus with heat-loss readings.
- 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
Surface	_____
Area A	_____
Temperature T	_____
Surrounding temperature Ts	_____
Corrected radiative power P	_____

Calculations and Interpretation

- $P = \epsilon \times \sigma \times A(T^4 - T_s^4)$, with temperatures in kelvin.
- Effective coefficient = $P/[A(T^4 - T_s^4)]$ after the assigned non-radiative corrections.

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.

Study of Steam-Distillation Efficiency

Practical 02 | Pharmaceutical Engineering

Aim

To study Steam-Distillation Efficiency, and interpret the recorded observations.

Principle

- Define recovery efficiency separately from thermal efficiency; both require an explicit measured basis.
- 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

- Steam-distillation teaching apparatus, feed and recovered-material mass records.
- 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
Initial recoverable target mass	_____
Recovered target mass	_____
Collection interval	_____
Steam/energy records	_____

Calculations and Interpretation

- Recovery efficiency = recovered target mass / initially recoverable target mass $\times$ 100.
- A thermal efficiency needs a separate energy balance and cannot be inferred from recovery alone.

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.

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.

Study of Drying Curves for Calcium Carbonate and Starch

Practical 04 | Pharmaceutical Engineering

Aim

To study Drying Curves for Calcium Carbonate and Starch, and interpret the recorded observations.

Principle

- A drying curve follows moisture content with time. The constant-rate and falling-rate regions depend on the material and drying conditions.
- 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 drying demonstration, balance, timer and temperature records.
- 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
Time	_____
Wet mass	_____
Dry-solid mass	_____
Moisture content	_____
Drying interval	_____

Calculations and Interpretation

- Dry-basis moisture $X = (\text{wet mass} - \text{dry-solid mass}) / \text{dry-solid mass}$.
- Approximate drying rate = $-\text{dry-solid mass} \times \Delta X / (\text{area} \times \Delta t)$.

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.

Study of Moisture Content and Loss on Drying

Practical 05 | Pharmaceutical Engineering

Aim

To study Moisture Content and Loss on Drying, and interpret the recorded observations.

Principle

- Loss on drying measures mass lost under the assigned conditions and may include volatile substances other than water.
- 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 material, weighing vessel, balance and specified drying apparatus.
- 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
Vessel tare	_____
Initial material mass	_____
Mass after drying	_____
Constant-mass checks	_____

Calculations and Interpretation

- $\text{LOD (\%)} = (\text{initial material mass} - \text{final material mass}) / \text{initial material mass} \times 100$.
- State the method and basis; LOD is not always water-specific moisture.

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.

Study of Air Humidity by Wet/Dry Bulb and Dew Point

Practical 06 | Pharmaceutical Engineering

Aim

To study Air Humidity by Wet/Dry Bulb and Dew Point, and interpret the recorded observations.

Principle

- Wet-bulb depression reflects evaporative cooling. Psychrometric interpretation depends on air pressure and the appropriate measurement conditions.
- 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

- Wet/dry bulb demonstration, pressure record and psychrometric chart or supplied dew-point data.
- 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
Dry-bulb temperature	_____
Wet-bulb temperature	_____
Pressure	_____
Dew point	_____
Relative humidity	_____

Calculations and Interpretation

- Relative humidity = actual water-vapour pressure / saturation vapour pressure at the dry-bulb temperature $\times 100$.
- Use the chart/calculation matching the stated pressure and ventilation.

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.

Study of Pharmaceutical Machinery: Construction and Working

Practical 07 | Pharmaceutical Engineering

Aim

To study Pharmaceutical Machinery: Construction and Working, and interpret the recorded observations.

Principle

- Compare compression in a rotary tablet press, coating in a fluidized bed, gas-driven size reduction in a fluid-energy mill and moisture removal in a dehumidifier.
- The construction and operating principle determine the function of the equipment.
- The practical distinguishes the input, working zone, controlled variables and output.
- Rotary tablet press: a feeder supplies dies on a rotating turret; punches perform filling, compression and ejection. Application: repeated tablet compression.
- Fluidized-bed coater: controlled air suspends the particles while an assigned spray deposits coating. Air distribution, atomization and drying balance affect the coat.
- Fluid-energy mill: high-velocity gas creates particle impacts/attrition in the milling chamber. The assigned classification arrangement separates the suitable product fraction.
- Dehumidifier: a condensation or desiccant system removes water vapour from air. Air temperature, moisture load and airflow affect its performance.

Materials and Apparatus

- Labelled demonstrations or schematics of the four specified machines.
- Assigned equipment demonstration, labelled schematic or manufacturer-approved training material.
- Observation sheet and any instructor-supplied performance readings.

Method

1. Identify the major components on the actual equipment or training diagram.
2. Trace the material, energy or signal path through the system.
3. Observe the instructor demonstration and note the purpose of each control.
4. Record the operating variables and the output relevant to the exercise.
5. Relate the equipment principle to its pharmaceutical application.
6. Summarize the variables that influence performance and the checks required before operation.

Observation Record

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

Observation / parameter	Record / finding
Machine	_____
Major components	_____
Material path	_____
Operating variable	_____
Pharmaceutical application	_____

Calculations and Interpretation

- Calculate a performance metric only when a suitable set of demonstration readings is supplied.

Result

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

Finding: _____

Conclusion: _____

Precautions

- Use equipment demonstrations and trained operation for moving, hot or pressurized components.
- Do not bypass guards, interlocks or the assigned operating limits.
- Distinguish operating performance from the appearance of the machine.

Viva Questions

1. Why trace the material or energy path?

It connects the equipment construction to the process it performs.

2. Why are operating variables recorded?

They are needed to explain or reproduce the observed performance.

Study of Sieve Analysis and Particle-Size Frequency Curves

Practical 08 | Pharmaceutical Engineering

Aim

To study Sieve Analysis and Particle-Size Frequency Curves, and interpret the recorded observations.

Principle

- A sieve stack separates a powder/granulation into size fractions. Distribution plots must state whether size is number-, mass- or another weighted basis.
- 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 granulation, sieve stack, balance and sieve shaker.
- 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. Record the granulation mass and each sieve opening.
2. Observe sieving under the assigned conditions.
3. Weigh retained fractions and check the mass recovery.
4. Calculate each retained percentage on a consistent denominator.
5. Construct frequency and cumulative plots using the specified size convention.
6. Explain the principal size range and the meaning of the distribution weighting.

Observation Record

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

Observation / parameter	Record / finding
Sieve opening	_____
Retained mass	_____
Percent retained	_____
Cumulative fraction	_____
Mass recovery	_____

Calculations and Interpretation

- Percent retained = $\text{retained mass} / \text{total recovered mass} \times 100$.
- Cumulative percentages are obtained by adding successive fractions on a stated retained/passing basis.

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.

Study of Ball-Mill Size Reduction and Milling Laws

Practical 09 | Pharmaceutical Engineering

Aim

To study Ball-Mill Size Reduction and Milling Laws, and interpret the recorded observations.

Principle

- Kick, Rittinger and Bond relate energy to different size measures and ranges. Mill critical speed describes the idealized balance between centrifugal and gravitational effects.
- 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

- Ball-mill demonstration, feed/product size records and power/energy data.
- 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
Feed size d1	_____
Product size d2	_____
Net energy	_____
Mill diameter D	_____
Ball diameter d	_____

Calculations and Interpretation

- Kick: $E = KK \ln(d1/d2)$.
- Rittinger: $E = KR(1/d2 - 1/d1)$.
- Bond-form relation: $E = KB(1/\sqrt{d2} - 1/\sqrt{d1})$; keep the coefficient and size units together.
- Ideal critical speed in rpm: $N_c = (60/2\pi)\sqrt{2g/(D - d)}$, with lengths in metres and g in m/s^2 .

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.

Study of Colloid Mill, Planetary Mixer, Fluidized-Bed Dryer and Freeze Dryer

Practical 10 | Pharmaceutical Engineering

Aim

To study Colloid Mill, Planetary Mixer, Fluidized-Bed Dryer and Freeze Dryer, and interpret the recorded observations.

Principle

- These devices illustrate shear-driven dispersion, planetary mixing, convective drying and sublimation-based drying respectively.
- The construction and operating principle determine the function of the equipment.
- The practical distinguishes the input, working zone, controlled variables and output.
- Colloid mill: a close rotor-stator working zone provides high shear for dispersion and emulsification.
- Planetary mixer: the mixing tool rotates while travelling around the vessel; this combined movement can process viscous materials.
- Fluidized-bed dryer: a gas distributor supports an agitated particle bed for convective heat and mass transfer, with suitable exhaust filtration.
- Freeze dryer: freezing precedes primary drying by sublimation under reduced pressure; secondary drying removes remaining bound moisture. The condenser collects water vapour.

Materials and Apparatus

- Instructor demonstrations or labelled working diagrams of the four devices.
- Assigned equipment demonstration, labelled schematic or manufacturer-approved training material.
- Observation sheet and any instructor-supplied performance readings.

Method

1. Identify the major components on the actual equipment or training diagram.
2. Trace the material, energy or signal path through the system.
3. Observe the instructor demonstration and note the purpose of each control.
4. Record the operating variables and the output relevant to the exercise.
5. Relate the equipment principle to its pharmaceutical application.
6. Summarize the variables that influence performance and the checks required before operation.

Observation Record

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

Observation / parameter	Record / finding
Device	_____
Working zone	_____
Energy input	_____
Controlled variable	_____
Application	_____

Calculations and Interpretation

- Calculate a performance metric only when a suitable set of demonstration readings is supplied.

Result

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

Finding: _____

Conclusion: _____

Precautions

- Use equipment demonstrations and trained operation for moving, hot or pressurized components.
- Do not bypass guards, interlocks or the assigned operating limits.
- Distinguish operating performance from the appearance of the machine.

Viva Questions

1. Why trace the material or energy path?

It connects the equipment construction to the process it performs.

2. Why are operating variables recorded?

They are needed to explain or reproduce the observed performance.

Study of Factors Affecting Filtration and Evaporation Rates

Practical 11 | Pharmaceutical Engineering

Aim

To study Factors Affecting Filtration and Evaporation Rates, and interpret the recorded observations.

Principle

- Filtration depends on pressure, viscosity and flow resistance; evaporation rate depends on heat/mass transfer and the available driving force.
- 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 filtration/evaporation demonstration and controlled comparative readings.
- 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
Test variable	_____
Filtrate/evaporated amount	_____
Time	_____
Area	_____
Temperature/pressure	_____

Calculations and Interpretation

- Rate = amount collected or evaporated / collection time.
- Compare one intended variable at a time while recording the other operating conditions.

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.

Study of Effect of Time on Crystallization

Practical 12 | Pharmaceutical Engineering

Aim

To study Effect of Time on Crystallization, and interpret the recorded observations.

Principle

- Supersaturation drives crystallization, while nucleation and crystal growth affect the number and size of recovered crystals over time.
- 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

- Instructor-selected crystallization demonstration, timed observations and mass/size records.
- 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
Time	_____
Temperature	_____
Crystal appearance	_____
Crystal size	_____
Recovered mass	_____

Calculations and Interpretation

- Plot the assigned crystallization observable against time.
- Percentage recovery = $\text{dry recovered mass} / \text{initial recoverable solute mass} \times 100$.

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.

Study of Blend Uniformity with a Double-Cone Blender

Practical 13 | Pharmaceutical Engineering

Aim

To study Blend Uniformity with a Double-Cone Blender, and interpret the recorded observations.

Principle

- Uniformity assessment compares representative locations and a suitable analyte marker. Average content can be acceptable while spatial variability remains large.
- 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

- Blender demonstration and location-specific assay records.
- 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
Blend time	_____
Location	_____
Marker concentration	_____
Mean	_____
Standard deviation	_____

Calculations and Interpretation

- $CV (\%) = \text{standard deviation} / \text{mean} \times 100$ for a nonzero mean.
- Report the course-defined uniformity index separately with its stated definition; CV is a descriptive variability metric.

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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