How to optimize cycles in your Lab Washer to minimize energy consumption?

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Learning Objectives

- Learn about basic principles of washing
- Understand how to adjust cycle parameters to minimize the use of energy
- Learn about common energy saving features
Applications

Cleaning and Drying of typical Laboratory Glassware and Plasticware
Basic Washing Principles

Parameters that can have an impact on cleaning efficacy?

**TACCTS**
- Temperature
- Action (mechanical)
- Chemistry
- Coverage
- Time
- Soil
Soil(s)

Understand the nature and condition of the soil(s)

- Organic
  - Fat, oils, waxes, blood, organic acids, sugars, proteins, etc...

- Inorganic
  - Minerals, carbonates, metal oxides, etc...
Temperature

• Temperature and soil (pre-wash phase)
  – (82C, 180F) for fats, oils, greases
  – (65C, 150F) for minerals
  – (21C, 70F) for proteins, glucoses

• Temperature and detergent (wash phase)
  – Typical range: 140-180F (60-82C)
  – Optimum: 150-160F (65-71C)

• Hot rinse reduces dry time
• Optimum temperature results in shorter cycle time
Mechanical Action

• Degree of turbulence

• Level of impingement

• Pressure, force applied on the surface of load items

• Flow
Chemistry

pH

- 0 is acidic
- 7 is neutral
- 14 is alkaline

Solubility vs pH

![Graph showing solubility vs pH for Aluminium Asprin](image)
Formulated cleaners

- Surfactants
  - Wetting effect
  - Ability to displace particles
  - Penetrate soil and surface irregularities
  - Emulsification
- Dispersants, prevent reaggregation of particles
- Chelating agents break down complex metals
Chemistry

- **Acidic detergent**
  - Minerals
  - Inorganic soils
  - Alkaline soils

- **Alkaline detergent**
  - Proteins
  - Organic soils
  - Acidic soils

- **Neutral detergents**
  - PH sensitive items

- **Concentration**
  - Based on quantity of soil
  - Condition of soil
  - Typical 1 - 2 oz/gal (8-16 ml/L)

- **Watch outs:**
  - No foaming
  - Material compatibility
  - Neutralization issues
Coverage

• Ensures that cleaning solution reaches all internal and external surfaces
  • Items with small opening (ex. Volumetric flasks)
  • Canulated items (ex. Pipettes, needles)
  • Hoses
• Requires sophisticated accessories
• Can be verified with a coverage test using Riboflavin and UV light
## Coverage

Follow supplier’s recommendations for selection of accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Volumetric Flasks</th>
<th>Erlenmeyer Flasks</th>
<th>Graduated Cylinders</th>
<th>Beakers</th>
<th>Carboys and Bottles</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-2 Spindle Header</td>
<td>500 mL to 2,000 mL</td>
<td>500 mL to 6,000 mL</td>
<td>500 mL to 2,000 mL</td>
<td>--</td>
<td>4 L to 20 L</td>
</tr>
<tr>
<td>M-5 Spindle Header</td>
<td>500 mL to 2,000 mL</td>
<td>500 mL to 6,000 mL</td>
<td>250 mL to 2,000 mL</td>
<td>--</td>
<td>500 mL to 20 L</td>
</tr>
<tr>
<td>M-8 Spindle Header</td>
<td>500 mL to 2,000 mL</td>
<td>500 mL to 1,500 mL</td>
<td>250 mL to 2,000 mL</td>
<td>--</td>
<td>500 mL to 4 L</td>
</tr>
<tr>
<td>M-18 Header</td>
<td>Spindle 10 mL to 250 mL</td>
<td>250 mL to 400 mL</td>
<td>50 mL to 100 mL</td>
<td>--</td>
<td>200 mL to 400 mL</td>
</tr>
<tr>
<td>M-32 Header</td>
<td>Spindle 100 mL to 250 mL</td>
<td>250 mL to 400 mL</td>
<td>50 mL to 100 mL</td>
<td>--</td>
<td>200 mL to 400 mL</td>
</tr>
</tbody>
</table>
Coverage

Follow supplier’s recommendations for positioning of components on accessories
Time

- Based on quantity of soil
- Condition of soil
- Temperature
- General rules
  - 1-2 min. pre-wash
  - 5-10 min. wash
  - 1 min. rinse(s)
Washing Functions

• How to adjust those parameters to obtain an efficient cleaning procedure?
• Follow a step by step process including:
  • Pre-wash
  • Wash
  • Rinse
  • Final rinse
  • Drying
Pre-Wash

– Remove gross soil
– Use lower quality water
– Enough time to saturate the soil
  • Typical 1 minute
– Temperature
  • Cold for proteins
  • Hot for others

Centrifuge
Wash

- Remove all soil from the surface
- Select temperature based on nature of soil
- Adjust time based on quantity and condition of the soil
  - Typical: 5-10 minutes
Rinse

- Remove detergent residues
- Can use lower temperature unless sanitization is required. High temperature increases cycle time
- Can be performed with lower quality water
- One or two rinses are typically sufficient
- 1-2 minutes maximum
Final Rinse

- Remove all remaining residues
- Usually performed at higher temperature to accelerate subsequent drying
- Use high quality water (Reversed Osmosis, Water for Injection)
- One or two rinses are typically sufficient
- Non-Recirculated rinses are recommended (single pass)
Drying

- Eliminate moisture on load, chamber, accessories and piping
- High temperature
  - Up to 240F (115C)
  - Or lower for heat sensitive items
- System shall force air inside components to accelerate drying
Energy Saving Features

- Laboratory Glassware Washers can use a huge amount of water, steam, electricity and chemicals
- Modern Washers can be equipped with various energy saving features
- Some of these features can be retrofitted on existing washers
Energy Saving

• Use the full capacity of the chamber
  – May require additional Loading Accessories
• « Smart Filling » technologies
• « Smart Drying » technologies
Energy Saving

Single Pass Final Rinses
- Reduces the number of rinses
- Increases productivity by shortening cycle time
Energy Saving

Exhaust Heat Recovery

- Recovers heat from exhaust to pre-heat incoming drying air
- Air coming out is cooler, so less water required for condenser
Energy Saving

Effluent Heat Recovery

• Heat from effluent is recovered and used to preheat the cold water used for the next treatment

• **No cold water is wasted** for effluent cooling (typical cycle)

• No need to supply Hot Water utility
  – Saving $$$ on installation and utilities
Conclusion

• Understanding basic principles of washing is necessary to optimize cycle parameters
  – Reduce energy consumption
  – Increase productivity
• Laboratory glassware washers can be equipped with systems that can significantly reduce energy consumption
QUESTIONS?
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