Biologic manufacturing capacity expansion with single-use technologies

Key variables to consider
The following presentation is based on a simulation of a 2 × 2000 L mAb process. The simulation compares a single-use process train (SU) with a comparable stainless steel-based process train (SS), both modeled in a traditional, stick-built facility. Are you interested in a simulation of your biomanufacturing process? With our range of simulation tools, we can assist in this, whether it is for scale up/down, “de-bottlenecking”, process intensification, transition from stainless to single use, or general optimization.
Manufacturing setup simulation for 2 × 2000 L mAb process

<table>
<thead>
<tr>
<th>TITER</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 × 500 L</td>
<td>28</td>
<td>42</td>
<td>56</td>
</tr>
<tr>
<td>2 × 1000 L</td>
<td>56</td>
<td>84</td>
<td>112</td>
</tr>
<tr>
<td>2 × 2000 L</td>
<td>112</td>
<td><strong>168</strong></td>
<td>224</td>
</tr>
<tr>
<td>4 × 2000 L</td>
<td>224</td>
<td>336</td>
<td>448</td>
</tr>
</tbody>
</table>

Assumptions: 70% recovery through purification of 20 batches per year, per reactor
Time to market and capital expenditure

**Single-use vs stainless steel technologies**

<table>
<thead>
<tr>
<th></th>
<th>Time to market</th>
<th>CAPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SU</strong></td>
<td>9–12 months</td>
<td>52%</td>
</tr>
<tr>
<td><strong>SS</strong></td>
<td>24 months</td>
<td>100%</td>
</tr>
</tbody>
</table>

**CAPEX** = capital expenditure

**Stainless steel technologies** take longer to procure, source, qualify, and validate. The initial cost is also higher.

**Single-use technologies** provide faster time to market at lower capital expenditure.
Operating expense

Single-use vs stainless steel technologies

<table>
<thead>
<tr>
<th>OPEX</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SU</td>
<td></td>
<td>70% *</td>
</tr>
<tr>
<td>SS</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPEX — labor</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SU</td>
<td></td>
<td>68%</td>
</tr>
<tr>
<td>SS</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

* Industry reports vary from 70% to 120%
OPEX = operational expenditure

Single-use technologies allowed 32% reduction in labor, based on elimination of cleaning and sanitization in place (CIP, SIP), and related testing.
Changeover and output

Single-use vs stainless steel technologies

**Changeover**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Changeover Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-use (SU)</td>
<td>1–2 days</td>
</tr>
<tr>
<td>Stainless steel (SS)</td>
<td>5–10 days</td>
</tr>
</tbody>
</table>

**Output**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Output Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-use (SU)</td>
<td>44 batches per year</td>
</tr>
<tr>
<td>Stainless steel (SS)</td>
<td>40 batches per year</td>
</tr>
</tbody>
</table>

Example:

- **mAb_01**: batch 1
  - Changeover duration: 2 days
  - Output: 1 batch
- **mAb_01**: batch 2
  - Changeover duration: 2 days
  - Output: 1 batch
- **mAb_02**: batch 1
  - Changeover duration: 2 days
  - Output: 1 batch
Footprint

Single-use vs stainless steel technologies

- **Single-use technologies** enable smaller facility, less cleanroom space — resulting in lower utilities and HVAC costs.

**HVAC** = central heating ventilation and air-conditioning

**DSP** = downstream processing

**Equip. prep.** = equipment preparation

**Inoc./prep.** = inoculation/preparation
Cytiva’s single-use technologies

Across the entire bioprocess workflow
Medium preparation:
Xcellerex™ XDUO 100 to 2500 L mixers, HyClone™ cell culture media

Cell culture seed train
ReadyToProcess WAVE™ 25 system
Xcellerex XDR 200 L bioreactor
Xcellerex XDR 500 L bioreactor

Cell culture production
Xcellerex XDR 2000 L bioreactor
ReadyToProcess™ filter for CFF

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Fluid management
ReadyToProcess portfolio
ReadyCircuit™ bag and filter assemblies
ReadyToProcess bins and ReadyCircuit bags
ReadyMate™ aseptic connectors

Fast Trak Services
Process development
Bridge Manufacturing Services
Training and education

Buffer preparation:
Xcellerex XDUO 100 to 2500 L mixers, HyClone buffers and process liquids

Harvest operations
FlexFactory™ harvest
BioProcess™ NFF Pump System

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Virus reduction
Xcellerex XDUO mixers

Purification operations
ÅKTA™ ready system
ReadyToProcess chromatography column
ReadyToProcess filter for CFF

Virus filtration
FlexFactory viral clearance
BioProcess NFF Pump System

Virus filtration
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Virus filtration
FlexFactory viral clearance
BioProcess NFF Pump System

Bulk formulation and sterile filtration
Bulk fill equipment

NFF = normal flow filtration        UF/DF = ultrafiltration/diafiltration        CFF = crossflow filtration