scale-X™ carbo bioreactor system

Intensified fixed-bed technology for cost-effective & scalable viral production

UNIVERCELLS
Bench-scale automated cell culture system for expression and concentration of viral drug substance, suited for rapid process development and cost-effective clinical production. The scale-X™ carbo system features a modular, scalable, fixed-bed bioreactor designed for enhanced upstream processing of viral products.

**Cost-effectiveness**
Low-footprint integrated system delivering high cell densities & viral titers
» Optimized capital investment & production costs

**Reliability**
Homogeneous cell distribution throughout the fixed-bed
» Provides consistency within & among batches
» Automated process control

**Scalability**
Predictable cell & product behavior
» Reduced risk in process transfer
» Simplified process development
» Seamless scale-up

**Applications**
» Viral vaccines
» Viral vectors
» Oncolytic viruses

**Scales**
» 10 m² and 30 m² of available growth surface
» Suited from R&D to clinical production
Automated Process Control

**Controller**
Advanced process control functionalities for protocol execution & standard parameter monitoring

**Benchtop system**
Ease of use in laminar flow or biosafety cabinet, docking slots for single-use components

**Sensors**
- pH, Dissolved Oxygen, temperature, pressure and fluid levels

**Sampling**
- Fixed-bed and media sampling for cells and metabolite profiling

**Quick access screen**
- Key parameters display & manual pump control

**High-density fixed-bed bioreactor**
- Single-use bioreactor with novel structured design for reliable & scalable production

**Growth surface**
- Treated micro-fabric with alternate spacer netting, assembled as spiral-wound structure
  - Rapid & homogeneous cell entrapment
  - Homogeneous media flow & nutrients availability

**Scalability by design**
- Constant linear velocity of fluids and even distribution through the fixed-bed ensure a smooth scale-up
- Bubble-free aeration mechanism provides high gas mass transfer coefficient while minimizing stresses

**In-line concentration**
- Delivering continuously concentrated harvest for simplified purification

**Hollow fiber tangential flow filtration**
- Plug-and-play, 1300 cm² cartridge & pre-assembled manifolds
- Automated process control

**Operations supervision**

**Mobile workstation & Wonderware® system platform**
- Process protocol upload
- Data recording & reporting
- Operates one or two controllers in parallel

**Manifolds & bottles**
- Complete set of consumables for media circulation, automated adjustment and sampling
- Tubing manifolds pre-assembled on bioreactor for easy set-up
Delivering intensified production

The scale-X carbo bioreactor offers a significant increase of the surface/volume ratio compared to conventional technologies:

- 10 m² growth surface in 1.8 L working volume
- 30 m² growth surface in 4.2 L working volume

A broad range of solutions from discovery to commercial stage

The scale-X family is designed to ensure seamless scalability from early process development to commercial manufacturing. The fixed-bed structure provides a high surface area available for cell culture in a very low footprint, while delivering similar fluid conditions at all scales, thus ensuring predictable cell & product behavior.

scale-X carbo is the perfect tool for R&D activities and clinical material production

Benefiting from a low footprint, the scale-X carbo system can be used in a laminar flow or biosafety cabinet, providing production capacity for R&D to clinical applications.

- 800 x 300 x 500 mm for a total 0.24 m² footprint

Chaining scale-X nitro to downstream processing

in the NevoLine™ biomanufacturing platform, delivering concentrated bulk product for clinical and commercial manufacturing.

- Process intensification and chaining enable containment in 10 m² isolators or biosafety cabinets, for rapid deployment of low-CAPEX facilities

### Consumables

<table>
<thead>
<tr>
<th>Growth surface/unit</th>
<th>scale-X carbo</th>
<th>Roller bottle</th>
<th>RB</th>
<th>HS36</th>
<th>CF40</th>
<th>STR</th>
</tr>
</thead>
<tbody>
<tr>
<td>m²</td>
<td>30</td>
<td>64</td>
<td>355</td>
<td>12</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

### Hardware

<table>
<thead>
<tr>
<th># units</th>
<th>1 bioreactor</th>
<th>64 g microcarriers</th>
<th>355 RB</th>
<th>12 CF40</th>
<th>16 HS36</th>
</tr>
</thead>
</table>

### Consumables & Equipment footprint (m²)

<table>
<thead>
<tr>
<th>scale-X carbo</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB</td>
<td>4,400 cm²/g</td>
</tr>
<tr>
<td>HS36</td>
<td>850 cm²/RB</td>
</tr>
<tr>
<td>CF40</td>
<td>25,280 cm²/CF40</td>
</tr>
<tr>
<td>STR</td>
<td>18,000 cm²/HS36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>scale-X carbo</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB</td>
<td>2.4 m²</td>
</tr>
<tr>
<td>HS36</td>
<td>10 m²</td>
</tr>
<tr>
<td>CF40</td>
<td>30 m²</td>
</tr>
<tr>
<td>STR</td>
<td>200 m²</td>
</tr>
</tbody>
</table>

**Cost-efficient & reliable operations**

- Reduced consumables, media & utilities consumption
- Simplified manual operations

**Optimized capital investment**

- Simplified equipment & infrastructure

### Scenarios

- **Screening / R&D / Pilot**
  - Hydro: 2.4 m²
  - Carbo: 10 m²
  - Nitro: 30 m²

- **Clinical Ph. I / II / III**
  - Carbo: 200 m²

- **Commercial**
  - Carbo: 600 m²
## Control unit

**Controller**
- **Description**: PLC-based Siemens® TIA S7-1200 control system with a local HMI control
- **Automation design**: Developed and tested according to Gamp5 standard
- **Dimensions (W x D x H)**: 800 x 300 x 500 mm
- **Net weight (empty)**: 30 kg
- **Net weight (including largest consumable liquid filled)**: 40 kg
- **Material**: Painted stainless steel
- **Heating**: Heating docking station
  - Bioreactor heating range: room temperature to 37°C
- **Agitation**: Magnetic agitation plate (0-1500 RPM)
- **Pumps & flow rate range**:
  - Bioreactor IN: Watson-Marlow™ 114; 0-141 mL/min
  - Bioreactor OUT: Watson-Marlow 114; 0-141 mL/min
  - Base: Watson-Marlow 114; 0-42 mL/min
  - TFF: Watson-Marlow 313; 0-900 mL/min
- **Dissolved oxygen**: 1 x Hamilton® VisiFerm® DO Arc probe (autoclavable)
  - 120 mm (carbo 10 m²), 225 mm (carbo 30 m²)
- **pH**: 1 x Hamilton EasyFerm® plus HB Arc probe (autoclavable)
  - 120 mm (carbo 10 m²), 225 mm (carbo 30 m²)
- **Temperature**: 1 x PT-100 Temperature probe (0-50°C)

### Probes & sensors
- **Quick access screen (HMI)**: 4” color touch screen HMI (Human Machine Interface) for parameters visualization & sampling command
- **Communication**: Ethernet port RJ45 connected to the controller
- **Location**: Outside of BSC/LAF, within a 2-meter distance
- **Materials of construction**: Painted steel
- **Dimensions (W x D x H)**: 300 x 160 x 600 mm
- **Weight**: 15 kg
- **Gas**: Gas Process air, CO₂ and O₂ (up to 200 mL/min)
- **Utility requirements**:
  - **Electrical supply**: 110 to 230 V
  - **Power consumption**: 650 W

### Mobile workstation (SCADA)
- **Description**: Mobile workstation with Wonderware SCADA software interface; PLC-based control system Siemens S7 Tia Portal
- **Automation design**: Developed and tested according to Gamp5 standard
- **Network compatibility**: Network connection available for Company network
- **Data export**: SQL-based structure, CSV format data export
- **Power, data & gas management box**
  - **Location**: Outside of BSC/LAF, within a 2-meter distance
  - **Materials of construction**: Painted steel
  - **Dimensions (W x D x H)**: 300 x 160 x 600 mm
  - **Weight**: 15 kg
  - **Gas**: Gas Process air, CO₂ and O₂ (up to 200 mL/min)

### Single-use components

#### Fixed-bed bioreactor
- **Carbo 10**
  - **Vessel**: Available growth surface (m²) 10
  - **Dimensions (D x H)**: 209 x 166 mm
  - **Vessel total volume (L)**: 1.8
  - **Vessel working volume (L)**: 1.6
  - **Materials**: Disposable single-use casing
  - **Sterilization**: Autoclavable
  - **Agitation**: Impeller
  - **Recommended agitation speed**: 250 rpm
  - **Ports**
    - Liquid and gas connections
      - 1 x Liquid IN (1/4”)
      - 1 x Alkali (1/8”)
      - 1 x Liquid OUT (1/4”)
      - 1 x Gas IN (1/4”)
      - 1 x Gas OUT with pressure sensor (1/4”)
  - **Monitoring**
    - 1 x port for pH probe
    - 1 x port for DO probe
    - 1 x port for temperature probe
  - **Liquid sampling**: Via syringe on media OUT line
  - **Manifolds**
    - Tubing manifolds pre-fitted with vessel
- **Carbo 30**
  - **Vessel**: Available growth surface (m²) 30
  - **Dimensions (D x H)**: 209 x 341 mm
  - **Vessel total volume (L)**: 4.2
  - **Vessel working volume (L)**: 3.3
  - **Materials**: Disposable single-use casing
  - **Sterilization**: Autoclavable
  - **Agitation**: Impeller
  - **Recommended agitation speed**: 450 rpm
  - **Ports**
    - Liquid and gas connections
      - 1 x Liquid IN (1/4”)
      - 1 x Alkali (1/8”)
      - 1 x Liquid OUT (1/4”)
      - 1 x Gas IN (1/4”)
      - 1 x Gas OUT with pressure sensor (1/4”)
  - **Monitoring**
    - 1 x port for pH probe
    - 1 x port for DO probe
    - 1 x port for temperature probe
  - **Liquid sampling**: Via syringe on media OUT line
  - **Manifolds**
    - Tubing manifolds pre-fitted with vessel

#### Concentration via Tangential Flow Filtration – Optional
- **Cartridge**
  - **Description**: 1300 cm² Hollow Fiber Tangential Flow Filtration cartridge
- **Materials**: Cartridge: modified polyethersulfone; Cartridge housing: polysulfone
- **Manifolds**
  - **Description**: Tubing, connectors and single-use pressure sensors for automated process control, 5L bottle
  - **Materials**: Manifolds: C-Flex© tubing; Connectors: PC, PVDF and polysulfone; Bottle: PET

### Manifolds & bottles
- **Bottles**
  - **1** Bottle kit (readily sterilized)
    - 1 x Inoculation bottle (1 L)
    - 1 x Harvest bottle (5 L)
    - 1 x Alkali bottle (500 mL)
  - **1** Set of bottle caps pre-fitted with the required tubing, connectors and filters
    - 1 x Inoculation bottle cap manifold
    - 1 x Harvest bottle cap manifold
    - 1 x Alkali bottle cap manifold
- **Manifolds**
  - **Base manifold**: 1/8” C-Flex, CPC connector
  - **Media IN manifold**: 1/4” C-Flex, sterile connector
  - **Media OUT manifold**: 1/4” C-Flex, sterile connector with filter vents (0.22 μm)
    - 1 x foam trap bottle
    - 2 x in-line liquid sampling ports with closed system transfer device
  - **Bioreactor vents**: 1/4” C-Flex, PendoTECH™ pressure sensor, 0.22 μm filters
- **Cell counting kit**
  - **Lysis solutions**: 500 mL of lysis solution, solution A
  - **500 mL of lysis solution, solution B**