With coordinated mobile hydraulics to high performance and profitability

Efficient System Solutions for the Electrification of Mobile Machines
Electrification Has Become a Trend

Just a passing phenomenon?

Sustainability and urbanization are two megatrends that will continue to drive the electrification and efficiency of mobile machinery. In the coming decades, this will further increase the demand for innovative solutions.

Current challenges

- Reducing CO₂ emissions in the EU by at least 60% (by 2030) ¹
- Reducing energy needs and using renewable energies, see "Energy Efficiency Strategy 2050" of the German Federal Government ²
- "Zero-emission" as a goal for a positive ecological footprint

As a strong partner, Bucher Hydraulics supports its customers with innovative and efficient system solutions.

¹ European Parliament (2018); Reducing CO₂ emissions; EU-climate objectives and provisions
² Climate Action Plan 2015 (2016); Climate protection political principles and objectives of the Federal Government BMU
The main topic

Smart Electrohydraulics as a Success Factor

Increased efficiency with optimal hydraulic systems

In the electrification process, many machine manufacturers focus on the traction drives, but often pay too little attention to the existing hydraulics. Classic hydraulic drive and control solutions for mobile machines are often designed to reduce initial costs rather than efficiency. This provides an opportunity to offer energy-saving potential of up to 60%.

Benefits thanks to coordinated system components:

- Savings potential for battery and operating costs due to the reduced energy demand of fine-tuned hydraulic systems
- New application possibilities thanks to reduced noise emissions
- Greater range and longer operating times with the same battery size
- High energy efficiency and durability serve as a basis for successful electrification

All these advantages have a positive effect on life cycle costs.

Conventional hydraulics

Advanced electrohydraulics
System architecture

High Efficiency Thanks to Suitable System Selection

Impact of the system architecture on the energy demand

In order to achieve high cost-effectiveness, longer service life as well as reduced energy consumption, efficient, coordinated hydraulic components are of crucial importance.

We offer you innovative solutions for the electrification of mobile machines.

System comparison: number of possible cycles (lifting & lowering) with battery capacity of 20 kWh.

- **Throttling control**
- **Displacement control without recuperation**
- **Displacement control with recuperation**
- **Displacement control with recuperation and highly efficient AX-pump**
Approach based on HELAX

HELAX – The Solution for Decentralized Drive Concepts With High Efficiency

Massive energy savings thanks to recuperation with AX piston pump

In the following application example of a reach stacker, the existing load-sensing hydraulics shows enormous savings potential compared to a new pump control system based on the AX pump.

Savings potential resulting from:
- Simple recuperation of energy while lowering due to innovative system architecture
- Highly efficient AX pump
- Reduction of the required battery energy
- Longer operational availability without battery charging

We cater to your individual requirements and needs and work with you to determine the maximum possible savings potential.
Electrohydraulic overall system

Possibilities and Solutions Based on Directional Control Valves

The perfect module combination

To combine electric drive technology and hydraulics, various modules are combined, resulting in an electrohydraulic system solution with demand-based volume flow control.

Typical module combination of a Flow-on-Demand system solution

Main components:
- Electrohydraulic pump (EHP) with suitable inverter
- Valve technology with Flow-Sharing principle
- Electronic control unit (ECU) with Flow-on-Demand software

The foundation of a unique, optimally tuned system architecture produces a decisive increase in efficiency and cost-effectiveness.
Individual System Analysis –
Our Strong Point

Increased efficiency with coordinated system architecture

Bucher Hydraulics provides support with new, electrohydraulic system architectures, which are ideally matched according to technical and economic criteria.

Optimal system analysis though:
- Recording the current state incl. the economic and technical requirements
- Accurate analysis and precise evaluation thanks to specially developed design software
- Best-fit approach for your machine

Comprehensive range of services:
- The optimization potential is checked directly on your machine using a functional model
- Supervised commissioning
- Support for series start-up after prototype release
- On-time, flawless delivery of your harmonized system solution

Our customers can rely on Bucher Hydraulics’ decades of proven expertise.
High-tech at the highest level

**Key Component: AX Pump**

**Revolutionary technology**

The combination of a tuned inverter, electro motor, and a Bucher Hydraulics axial pump all work together to form the foundation for a high efficiency "Power on Demand" hydraulic power supply. Previous problems such as pressure pulsations, low speeds at high pressure and high power dissipation are solved with the unique AX pump.

**Advantages of the innovative AX pump:**

- 94% overall efficiency
- 99% start-up efficiency
- No minimum speed limit
- Low pulsations
- Low noise level
- Compact dimensions
- Low temperature increase

The unique AX pump opens up new possibilities for the electrification of mobile applications and is an ideal component in the modernization of your mobile equipment.

**Technical data**

<table>
<thead>
<tr>
<th>Type</th>
<th>Displacement [cm³/U]</th>
<th>Continuous pressure max. [bar]</th>
<th>Peak pressure [bar]</th>
<th>Max. speed [U/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXFP</td>
<td>18-76</td>
<td>450</td>
<td>500</td>
<td>&lt;1...3600</td>
</tr>
</tbody>
</table>

**Flow rate – ranges of AX pumps**

**Power – ranges of AX pumps**
Adaptability and optimal control

Valve Technology and Electronic Control Units

Valve technology

For decades, Bucher Hydraulics has been successfully positioning itself as a global player in the field of valve technology. With our directional valves, we offer an adaptable and comprehensive modular system to implement new innovative solutions.

Advantages of our directional valves in terms of electrification:

- Reduced energy consumption and precise positioning thanks to stepper motor drive
- Directional valves that can be combined together for flexible adaptation to various requirements
- Extremely precise control, even when operated simultaneously
- Considerably reduced energy consumption due to low pressure losses

### Technical data

<table>
<thead>
<tr>
<th>Type</th>
<th>Flow rate (l/min)</th>
<th>Inlet pressure (bar)</th>
<th>Actuator pressure (A + B) (bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDSx4</td>
<td>70...180</td>
<td>280...300</td>
<td>320...350</td>
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<tr>
<td>LVS</td>
<td>50...180</td>
<td>250...300</td>
<td>280...320</td>
</tr>
<tr>
<td>L.8S</td>
<td>50...150</td>
<td>250...315</td>
<td>280...315</td>
</tr>
</tbody>
</table>

Inverter, controller and software

Bucher Hydraulics has the necessary electronics and software expertise to successfully implement application-optimized system solutions. We use control and power electronics components from the Bucher Group as well as products from our partners. The result is an application-specific, optimized power-on-demand drive system that can be easily controlled and integrated into the machine concept.

### Technical data

**Controller**
- Supply voltage: 8...32 VDC
- Communication: analog voltage 0...5 V, analog current 0...20 mA, CANopen, J1939
- Protection class: IP65

**Inverter**
- Supply voltage: 200...848 VDC
- Power range: 11...30 kW
- Communication: CANopen, J1939
- Protection class: IP65...IP6K9K
Success factors

Energy efficiency, noise emission, uprating and total operating costs depend largely on the system architecture as well as on the components used. Bucher Hydraulics has several Power-on-Demand system architectures such as Flow-on-Demand, Negative-Flow-Control or Negative-Bypass-Control.

Compared to conventional valve control, Flow-on-Demand system solutions offer many advantages:
- Simple integration into existing machine concepts
- Rapid acceleration and precise load control
- No susceptibility to oscillation of actuators
- Less heat loss and thus reduced cooling efforts
- Low noise emissions (in conjunction with AX pumps)

Together we will find a customized solution for your needs. You will be convinced by the main benefits such as increased efficiency, noise reduction and system stability. Combining your system with our AX pump can drive the electrification of your mobile machines forward.
Outlook: the future of "Electric-Hydraulic Hybrid"

The Electrified Machine

Increased energy efficiency by using the right drive

The transition from the traditional to the electrified machine must be cleverly planned and well-conceived. The right technology and our know-how will enable your mobile equipment to meet the requirements in terms of efficiency, dynamics and ruggedness.

We are prepared to offer future-oriented solutions by:
- Capturing and analyzing relevant system data
- Disclosing sources of loss
- Identifying highest possible energy saving potentials and utilizing the best system solution

We fulfill the high demands of various manufacturers. As a strong partner, Bucher Hydraulics can provide innovative and efficient electrohydraulic system solutions.
Should you have any further questions, please do not hesitate to contact us.

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