WHITEPAPER

Unlocking System Potential



How High-Speed, High-Efficiency Pumps Redefine a Sustainable Drive Train

The drive for sustainability in industrial hydraulics is accelerating the shift from constant-speed systems to dynamic, speed-variable electro-hydraulic drives. While this shift offers inherent energy savings, true system optimization requires components designed specifically for this new paradigm.

This whitepaper introduces the Bosch Rexroth A3V pump platform, a new generation of medium-pressure variable displacement pumps engineered to maximize the potential of speed-controlled systems. We will examine how its high-speed (4000 rpm) and high-efficiency (up to 93%) design not only delivers significant energy savings but also enables a cost-saving downsizing of the entire electric drive train, including the servo motor and converter, making sustainability both achievable and economically advantageous.

THE MOTIVATION: BEYOND BASIC SPEED CONTROL

The motivation for the A3V platform stems from the strong growth of electro-hydraulic drives. Simply replacing a constant-speed motor with a variable-speed one is only the first step. True potential is unlocked when the hydraulic pump itself is optimized to leverage the motor's capabilities. Traditional pumps, when paired with high-power servo motors, often result in a mismatch: the pump's torque requirement fits the cycle, but a large portion of the motor's speed potential remains unused. This leads to oversized, expensive drive components. The A3V is designed to close this gap.

THE HIGH-SPEED ADVANTAGE

Reversing the Design Equation: In a speed-variable system, achieving a target flow (l/min) is a function of pump displacement and motor speed. The A3V is designed to operate reliably at up to 4000 rpm, +30% faster than many existing pumps. This allows it to generate the same flow with a smaller displacement. Since motor torque decreases as speed increases, this directly results in a 30% reduction in required torque. This is the first step in downsizing. The smaller torque requirement allows for the selection of a smaller, less expensive servo motor and a correspondingly smaller drive converter, directly lowering investment costs.

THE VARIABLE DISPLACEMENT ADVANTAGE

Downsizing, Twice: The second key to optimization lies in the A3V's variable displacement. For cyclic applications like presses or injection molding machines, which have long pressure-holding phases, a traditional speed-variable fixed pump must hold pressure at very low speeds and very high torque. The A3V, as a variable displacement pump, can reduce its swivel angle during these phases. This allows the motor to maintain a low, efficient torque level, even while the pump holds high pressure. This capability enables an additional 30% reduction in effective motor torque during critical cycle phases, allowing for even further downsizing of the electric drive. In essence, the system is downsized twice: once through high speed, and again through variable displacement.

BEST-IN-CLASS EFFICIENCY AND RECUPERATION

The A3V platform achieves a maximum total efficiency of 93%, five percentage points higher than previous generations. This reduces losses by up to 30% in comparable cycles. More importantly, it is a true 2-quadrant pump, capable of operating as a motor. In applications with braking or lowering phases (e.g., lowering a press die), the pump can be driven by the hydraulic medium, turning the servo motor into a generator. This recuperated energy can be stored or fed back to the grid, further enhancing the system's overall sustainability.

The A3V pump platform is not merely an incremental improvement; it is a fundamental redesign for the future of sustainable industrial hydraulics. By combining high speed, high efficiency, and intelligent variable displacement, it allows machine builders to create systems that are not only up to 80% more energy-efficient but are also less expensive to build and operate. The A3V proves that the goals of sustainability and economic viability are not mutually exclusive but can be achieved simultaneously through smarter system design.

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