Energy efficient Hydraulic lifts

New hydraulic pump unit WITTUR HI driven by inverter from Wittur Hydraulic Drives

The application of an inverter is not new in the elevator field: this device has been applied both on traditional gears as well as on gearless drive solutions to optimize performance and power consumption.

The WITTUR Group, leader in the supply of components for the lift industry, has always committed itself to implementing energy saving solutions. Today the WITTUR Group is pleased to present the new inverter- driven hydraulic pump unit WITTUR HI.

Designed, manufactured and guaranteed by Wittur Hydraulic Drives, the WITTUR HI pump unit combines the best performance of the inverter technology with more than 50 years of experience in the field of hydraulic lift solutions.

Easy to use, the WITTUR HI pump unit completes the well-known and reliable range of Wittur Hydraulic Drives pump units, including the mechanical pump unit WITTUR HM and the recently introduced electronic pump unit WITTUR HE.

With this new product WITTUR Hydraulic Drives is able to meet every type of application requirements.

Thanks to its specific configuration the pump unit WITTUR HI is already compliant with the new EN 81-2 pr.A3 standards, which will come into force in 2010, and offers today an ideal product especially suitable for the modernization of existing lift installations.

No additional device or sensor must be mounted in the shaft: everything is controlled through the software that has been expressly designed for hydraulic systems. The user interface is extremely simple and all adjustments can be modified using a comfortable keyboard. The installer can easily fine-tune each system to offer the best travelling comfort in every plant condition and meet any client requirements.

Thanks to the new valve concept of WITTUR HI pump unit and the strong partnership with an accredited expert company in the field of inverter technology, this product offers the following features:

- Reliability
- Energy Efficiency
- Easy and quick installation

The pump unit WITTUR HI integrates advanced and innovative functionalities such as:

- Adjustment by microprocessor of the installed power, which can be reduced to a minimum
- Control of all upwards and downwards car movements through microprocessor

- Compliance with the EN 81-2 pr.A3 Standards
- Minimum oil heating (less than 50% compared to conventional pump units); in most applications the cooling system is no longer necessary

At the same time it allows the following higher class performances:

- Permanent adjustment of the car speed up to 1 m / s
- Floor levelling accuracy and integrated micro levelling function.
- Operations are fully independent from cabin load and oil temperature variation

If we take these features into account, it is then easy to demonstrate that units such as WITTUR HI pump unit are today the most effective and profitable investment for hydraulic lifts modernization. This is an exemplary case in which high added value and drastic cut of operating costs fully embrace the concept of environmental sustainability.

European nations, more and more sensitive towards environmental issues, are distributing ever greater government and community contributions to promote environmental sustainability, while citizens take benefit from an easier investment amortization.

Reduction of energy consumption means a lighter electricity bill.

The WITTUR HI pump unit is the only unit currently on the market that is able to control the car movement through an inverter only. In this way the motor efficiency is optimized at any moment of the lift operation. This can be demonstrated by comparing the power factor. The value measured in a traditional pump unit normally varies between 0.69 and 0.78 (full load) during motor operation, having a 0.85 data plate. The WITTUR HI pump unit has a constant power factor of 0.99.

Apart from possible loss of power due to Joule effect, the *power factor* represents the ratio between the power actually converted into mechanical functioning by an electric motor and the power available from the network. The so-called *reactive power* is instead required to power the magnetic field of the electric motor in the hydraulic pump unit. While minimizing the reactive power, the adoption of an inverter raises the overall system efficiency.

Table 1 shows that the pump unit WITTUR HI can replace traditional hydraulic pump units, with the advantage of electricity saving, i.e.:

- -28% of power utilization
- -31% of energy demand from the network
- -16% of active energy used for car movement

The WITTUR HI pump unit offers the possibility to profit from the most advantageous power supply fees when different fees are applied according to maximum power required. It is in fact possible to determine the maximum power that the lift should not exceed (by setting the car movement speed according to the lift system load capacity) and then sign for a lower total power supply contract.

Oil heating reduction

The WITTUR HI pump unit uses a motor controlled by a microprocessor that reduces oil heating in the tank to the minimum. The new valve has been designed to allow an optimum flow of oil through the pipes to minimize pressure drop and to avoid additional cooling systems.

The example below demonstrates that a significant quantity of heat is transmitted to the oil during the downwards movement of the cabin.

Example: A cabin including pulley with a load capacity of 6 persons (450kg) has the same weight as its rated maximum load. The energy of the mechanical valve converted to oil heat during 5 stops (13 meters) is equal to the variation of potential energy during the downwards movement:

$$450 \times 2 \times 9.81 \times 13 = 114{,}777 \text{ Joule} = 115 \text{ kJoule}$$

According to Galileo's formula, the mechanical work done by an asynchronous motor moving for 27 seconds to lift the cabin with a maximum load capacity at a speed of 0.5 m/s is

$$27 \times (450 \times 2 \times 0.5 \times 9.81) = 119{,}191 \text{ Joule} = 119 \text{ kJoule}.$$

The HI pump unit keeps oil from transmitting 115kJ of heat during the downwards movement of the cabin. At the same time, it prevents oil warming during the upwards movement of the cabin caused by the motor that, if we take a mechanical pump unit with a traditional asynchronous motor into account, is at least:

$$30\ \% \times 119\text{kJ} = 36 \text{ kJoule}$$

In the case of continuous operation, the heat that would not be transmitted from oil of the WITTUR HI pump unit, compared to a hydraulic pump unit without inverter, would be equal to:

$$60 \times (115 + 36) / 4.18 = 2167 \text{ kCal/h}$$

So by using a WITTUR HI pump unit it is possible to avoid the installation of an additional cooling system to dissipate the heat transferred to oil during operation.

Fast payback of the investment

Table 1 compares the power consumption of elevators with different types of driving gears based on the known efficiency rates.

The driving gears considered include: mechanical pump unit WITTUR HM, mechanical pump unit prototype WITTUR HI, gearless drive as well as electronic valve pump unit WITTUR HE. From the test we can infer that the pump unit HI, mounted on a residential elevator performing 70 services

per day (load capacity 450 kg, 5 stops), demonstrates good performance and very low operating costs at the same level as elevators equipped with gearless drives.

The difference in power consumption between hydraulic and gearless equipped elevators increases on the average by 4% each 10 additional services; although the gearless based solution offers a lower power consumption in this case, it is important to note that the additional cost of a gearless solution for the end user is more than 3000 Euro when compared with hydraulic systems.

Experiment: 450 Kg lifts, 80 travels/day x 13m

Pump Unit	Motor Kw	Rise Speed	Single day Stand-by Energy Wh	Single day Travel Energy Wh	Total Energy Wh	Total Energy Wh/Cos φ**
Electric Gearless	3.0	1.00 (14*)	2832	726	3558	2593 (- 4%)
HI	6.0	0.50 (24*)	2040	1663	3703	3740 (reference)
*HE**	7.7	0.50	1680	2721	4401	5382 (+ 31%)
HM	7.7	0.50 (27*)	1680	2926	4606	5660 (+ 34%)

(*) Experiment made on: HM, prototype of HI, Gearless. We can apply HE a 7% energy saving vs HM travel energy.

(**) It was not possible to meter Cos φ of HM along the experiment Cos φ = 0,735 is considered for HM and HE.

40 rise travels:
- 20 empty
- 19 with 2 people
- 1 at full weight

40 down travels:
- 20 empy
- 15 with 1 person
- 5 with 2 people

Assuming:

- 80 travels per day
- Rate: 0,12 Euro / kWh (no penalty for both WITTUR HI and Gearless solution)
- Rate including penalty = 0.14 Euro/kWh for WITTUR HE and HM systems
- Same kind of power supply (3.0, 6.0 or 7.7 kW)

For each solution, annual operating costs amount to:

- Gearless operating cost = 3.55 kWh per day x 1.12 Euro/kWh x 365 days = 1451 Euro per year
- WITTUR HI operating cost = 3.70 x 1.12 x 365 Euro per year = 1512 Euro per year
- WITTUR HE operating cost = 4.40 x 1.14 x 365 Euro per year = 1830 Euro per year
- WITTUR HM operating cost = 4.60 x 1.14 x 365 Euro per year = 1914 Euro per year

WITTUR HI pump unit offers the best value for the money. Compared to WITTUR HM and HE, it allows the best saving, with a payback in less than 3 years.

The gearless solution has a much longer payback of 50 years, due to the additional system cost of 3000 Euro; on the other hand it can withstand heavy traffic, a higher number of stops and it offers a higher cabin speed.