July 2016 / Vol. XXXIX Issue 7

Arab Water World
عالم المياه العربي

www.awwmag.com

Centrifugal Pumping Stations:
The Heart of Precision Irrigation

Centrifugal Pumping Stations: The Heart of Precision Irrigation

The concern of the pioneers of irrigation in the seventies was to install some kind of "centrifugal pump", generally driven by a farm tractor or a diesel engine. The aim was simply to supply water under pressure for sprinkling. Today, the term "pumping station" is used and we speak of precision irrigation basically because, with techniques having developed, nowadays they offer operators the following advantages: optimization of water applications with the best energy efficiency; automation of the system to reduce manpower (pressurized system); safer system design (multi-pump solution); and control and analysis of the system (remote control - supervision). The pumping station represents the heart of the system responsible for taking water from the source and delivering it under pressure through a network to the sprinkling system (drip - micro-spray - hose-reel - center pivots). All too often overlooked in the preparatory stage of a global project, it has a direct impact on the performance of the system; reliability; flexibility of control and ease of use; and energy cost. The most commonly used centrifugal pumps are, electric pumps, the choice of which will depend on the environment in which the electric pump is installed, and, above all, on the origin of the water to be withdrawn: surface water, groundwater, hill reservoirs, and replacement reservoirs.

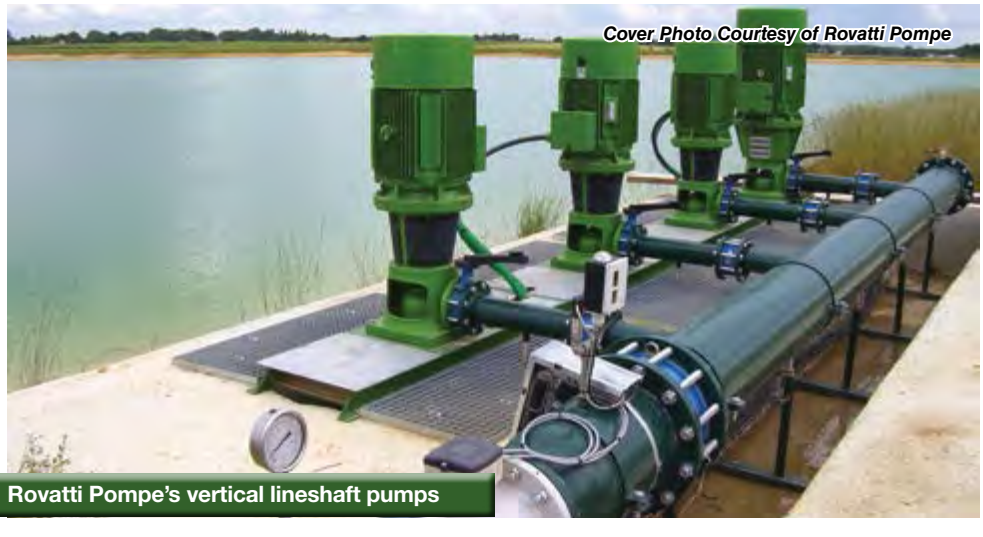
Submerged electric pumps or borehole pumps

Submerged electric pumps or borehole pumps are used for drawing groundwater from deep wells or boreholes. They are, therefore, by definition submerged in the water and suspended in the rising main. The electric supply is provided by a special submersible cable. It is not unusual to install pumps at a depth of 70 m to draw the water and bring it to the surface. The pump must always be positioned in the borehole above the main inflows of water, so that this flow of water circulates around the motor in order to cool it before reaching the pump strainer. There are two possible functions. The function of the submersible electric pump is to bring the water up to the surface in order to supply a surface pump (or booster unit), in which case it is referred to as a feeder or lift pump. It will generally be of low power, from 7,5 kW to 45 kW according to the flow-rate. The submersible electric pump may also simultaneously carry out both the function of pumping the water to the surface and boosting its pressure, in which case it will need to be of an appropriate power of ≥ 55 kW.

"The function of the submersible electric pump is to bring the water up to the surface in order to supply a surface pump"

Monobloc multi-stage surface electric pumps

These pumps have been available on the market for twenty years in a horizontal or vertical position for maximum flows of 200 m^3/h. On account of their modularity and simplicity, they offer an excellent alternative to the previous generations of more cumbersome chassis-mounted pumps, for which service operations are more difficult to carry out, with the need to align the motor/pump after each intervention. In the majority of cases these pumps suck up the water, the suction head being limited by the NPSH value of the pump and the resulting flow rate. Pumping professionals are well aware, when this type of pump is being installed, that the size and quality of the pump intake are crucial for proper operation.


Cover Photo Courtesy of Rovatti Pompe

Rovatti Pompe's vertical lineshaft pumps

Vertical lineshaft pumps

This type of pump was initially designed to draw water from deep aquifers before the development of the submersible electric pump. The pump is submerged and driven by a transmission shaft which is located inside the rising main, with a guide bearing every three meters. Thus the depth of installation is adjusted by adding three meter sections, with a limit close to 100 meters, according to the model. Initially, the pump was driven by a combustion engine thanks to an angle gear at the well head. They benefit from legendary reliability and are very widely used today. In fact, with the popularization of electric energy, the angle gear has been replaced by a control unit at the wellhead, capable of receiving a standardized surface electric motor. In this configuration, it offers an excellent alternative that combines the submersible electric pump and the surface electric pump, since it will incorporate the advantages of both:

being submerged, it eliminates the risks of the pump draining empty and the need to prime; and while keeping the motor above the surface, thus facilitating maintenance operations. Nowadays, it is widely used for pumping from tanks, reservoirs or wells, in agriculture but mainly in industry, where the low position of its strainer or suction basket enables the water level to be kept to a minimum. Today many users are rediscovering the advantages of this type of pump, given its lack of operating constraints.

Other centrifugal pumps

• Pumps driven by a tractor's PTO (power take-off) offer the advantage of simple operation and an extreme versatility in agricultural tasks.

• Flange-mounted pumps, meant for creating thermal pumping sets which have the advantage of offering a mobile pumping solution. These pumps are fixed directly to the engine flange, which facilitates maintenance operations and offers a compact package. To reduce their noise nuisance level, nowadays these sets can be equipped with a sound-proof casing.

Choice of the pump

The flow-rate must meet the demand of the sprinkling system. The pressure will depend on the design of the network (pipe diameter), geographical constraints (difference in level or height), the operating pressure of the sprinkler devices and the various head losses in the accessories (bends, stop-cocks, valves). The one parameter that can be altered in order to reduce pressure and, therefore, energy consumption, apart from the choice of sprinkler system, is the pipe network. Hence the need to have a suitable design and pipe size in order to save as much energy as possible.

The centrifugal pump and its surroundings

The pumping station incorporates one or several centrifugal pumps; its necessary accessories: stop-cock, non-return valve, pipes connecting to the network; its safety and control cabinet; and a regulating device, the most popular today being the frequency controller with a user-friendly control interface, to facilitate its totally independent control by the operator. The frequency control regulator today allows for the set pressure to be adapted according to the flow-rate required by the system, which considerably reduces the energy consumption of the pumping station and offers flexibility for the system to run smoothly. Unlike the traditional system of regulating with the use of motorized valves, where an artificial head loss was created to reduce the pressure, the pumping station is automatically adapted to the required network performance. This means that the energy consumed by the pump or pumps is directly related to the system demand.

"The pumping station represents the heart of the irrigation system and directly affects its performance"

Conclusion

The pumping station represents the heart of the irrigation system and directly affects its performance. Like any sensitive component of a production process, it requires in-depth research for its design, as well as regular monitoring in order to ensure that it remains reliable over time. This is why, when installing or updating, it is entirely in the user's interest to approach a specialist installer who has a solid technical team at his disposal, with the means available to guarantee a quality service; and to choose a pump manufacturer recognized in the field of irrigation for his professionalism and responsiveness during the season to supply pumps or emergency spare parts. Nowadays, the updating or modernization of pumping stations represents a source of comfort or convenience and energy saving for the irrigation user, which contributes directly towards a reduction in his operating costs. This measure falls within the framework of a policy of sustainable development that can lead to energy performance certification. ■

Rovatti Pompe's borehole pump

Rovatti Pompe
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كان هاجس الرواد في مجال الري في السبعينات هو تثبيت نوع من أنواع "المضخات النابذة" المستخدمة عادة في تشغيل الجرارات الزراعية أو محرك الديزل. وكان هدفهم بكل بساطة هو إمداد المياه بواسطة الضغط لاستخدامات الري. واليوم، يتم استخدام مصطلح "محطات الضخ" ونتحدث هنا تحديدًا عن الري الهادف، لأنَّ تطور التقنيات في عصرنا هذا قد منح المشغلين مزايا مثل تحقيق أقصى فائدة من المياه بأفضل كفاءة لاستهلاك الطاقة، وأتمتة النظام لخفض القوى العاملة (نظام مكيَّف الضغط)، وتصميم نظام أكثر أمانًا (تقنية المضخات المتعددة)، وضبط وتحليل النظام (التحكم عن بعد - الإشراف). وتمثل محطة الضخ محور النظام المسؤول عن سحب المياه من المصدر وتسليمه بواسطة الضغط من خلال شبكة إلى نظام الري (تقطُّر- الري الصغير- بَكَرَةٌ خُرْطُوم- ري محوري). وغالبًا ما يجري إغفاله في مرحلة إعداد مشروع عالمي هو الفعالية ومرونة التحكم وسهولة الإستخدام وتكاليف الطاقة. وتعتبر المضخات الكهربائية من المضخات النابذة الأكثر شيوعًا، ويعتمد هذا الخيار على البيئة التي تم تركيب المضخة الكهربائية فيها، وقبل كل شيء على مصدر سحب المياه: المياه السطحية، المياه الجوفية، مياه الخزانات المحفوظة في الهضاب، أو مياه خزانات الإستبدال. تقوم شركة (Rovatti Pompe) في المقال أعلاه بالتطرء في حديثها عن هذا الموضوع.