



# Industrial Water Supply.

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## Introduction:

Pump operations often play an important role in providing an optimum running production with the highest output at the lowest production costs. This is both when it comes to water consumption, waste water discharge and energy use, so all in all Industrial Water Supply or liquid infrastructure plays an important part of a company's "green profile".

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## Purpose:

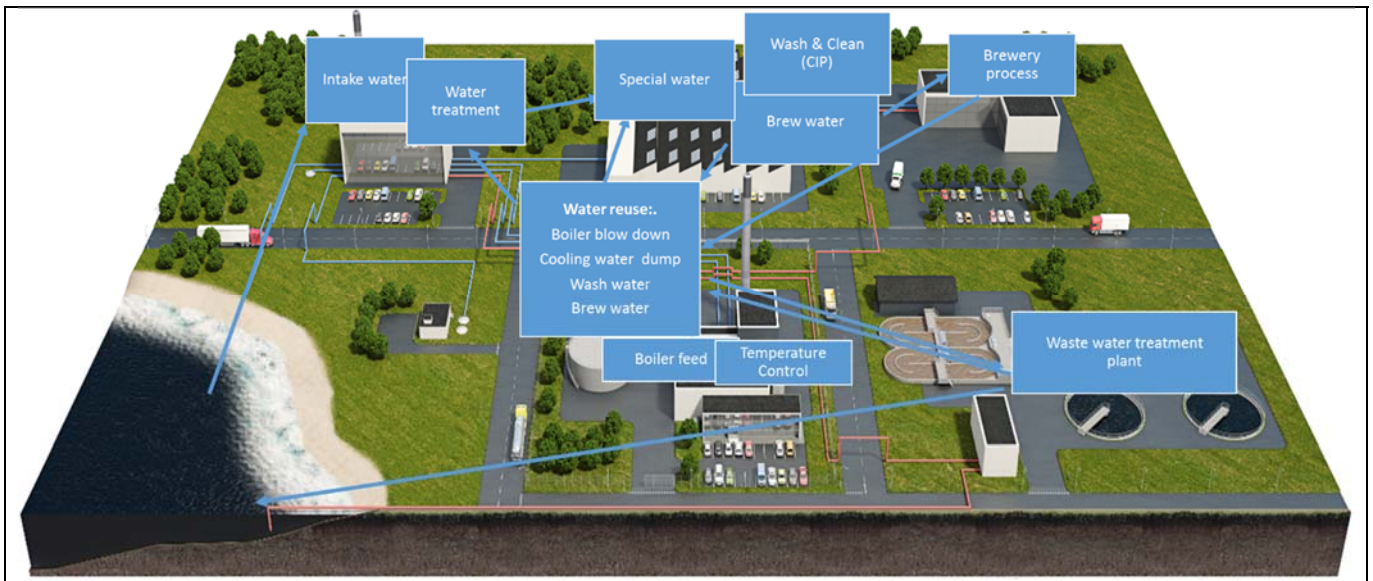
The purpose of this White Paper is to present and explain what we in Grundfos mean when we say Industrial Water Supply.

Different pump operations and tasks will be explained so it gives you a good possibility to make the perfect liquid infrastructure at your production facility.

## Industrial Water Supply

Industrial water supply is a very wide topic covering many different applications. So in general, Industrial Water Supply should be seen more as a mind set for making the perfect liquid infrastructure on your site than a specific application. The problem with pumping infrastructure operating on bigger sites is often that so much is going on that it can be difficult to gain an overview. It is normally not a problem with the overview of specific OEM-supplied equipment like a boiler, a cooling compressor or other process equipment, but all the rest is more challenging. And if you don't have the full picture, it is difficult to operate the pumps and make the different loops efficient. Furthermore, if you do not have an overview, fault-finding when breakdowns occur becomes very complicated. Therefore, it is first necessary to get an overview, and a good way to do that is to "get in touch" with your pumps.

So if you have a system like the one below where a lot of pumping is happening between different parts of the factory, you should connect the pumps to your Scada or BMS system.



On the next page is an example of how it could look if you had connected your pumps so you could see what was going on.



Besides the overview, you are able to see alarms, look at trend curves and event logs and so on to have good understanding on what is going on. Moreover, you will often be able to react to wear and tear in the system before an emergency breakdown and production stop. Therefore, there are many advantages of having a good infrastructure with an easy overview.

In addition to the overview there are of course also some basic pump setups which are important to know so you can optimise the individual loops and pump jobs to get an even better performing infrastructure. The typical pump issues or tasks are:

- Pressure boosting
- Level control
- Filtration
- Liquid transport

All of the above things are matters that Grundfos iSOLUTIONS deals with. A Grundfos iSOLUTION is a way to simplify and optimise the systems where pumps are installed by using Grundfos products more intelligently. This is because a pump does not exist in isolation, but is always part of a larger system, working together with a whole range of other components. That is why we think beyond the pump and take the entire system into account when developing new solutions.

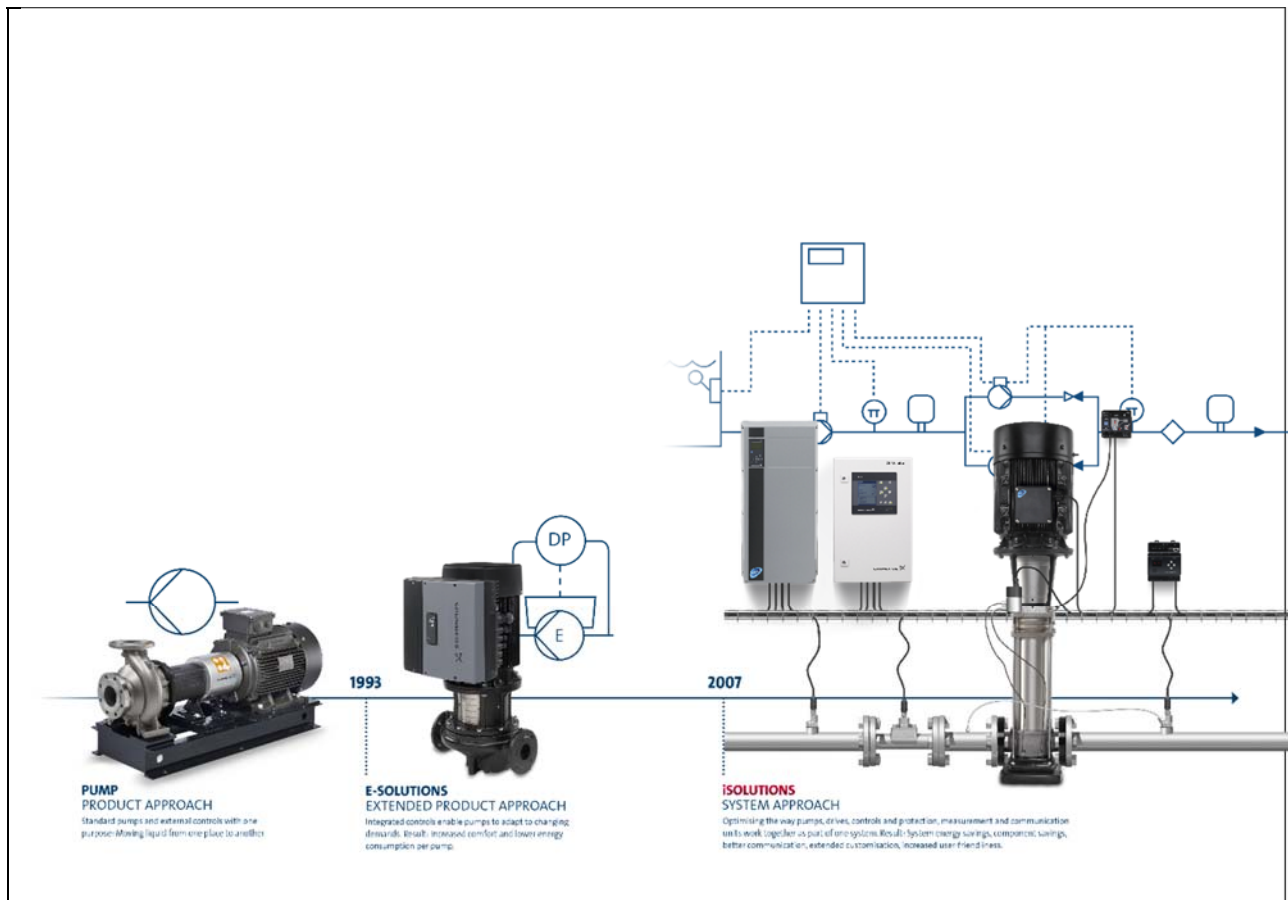
Our E-solutions and Grundfos iSOLUTIONS are both testimony to that.

### **Grundfos E-solutions – integrated intelligence**

A Grundfos E-solution features pump, motor and frequency drive all in one product. As the frequency drive constantly adapts pump speed according to demand, it is possible to achieve significant pump energy savings.

## Grundfos iSOLUTIONS – optimising your pump system

Grundfos iSOLUTIONS comprises the latest addition to the Grundfos portfolio and takes system intelligence to a new level. Where an E-solution primarily focuses on the product, iSOLUTIONS will extend savings to the entire system, optimising the way pumps, drives, controls, protection, measurement and communication units work together.



## Pressure boosting.

A pressure boosting system is designed to increase low pressure in a liquid system in order to achieve sufficient water flow and pressure where needed. Pressure boosting is one of the most commonly used forms of regulation when we talk about pump regulation.

Pressure boosting systems generally consist of one or more pumps that are installed in a parallel booster system to increase the pressure in a system to a certain point independent of flow and inlet pressure.

When you want to operate pumps in parallel there are some things you must consider before choosing the pumps in your booster set. There is seldom any clear answer when discussing booster sets; -which pump type is the best and how many should there be in parallel, it all depends on the application. A few of the things to be considered are listed below:

- How is the load profile for the booster set? This is important because it will tell you something about the number of pumps in parallel. For example, you need to be able to provide max flow but on the other hand, it is also smart if the pumps are sized to only operate at low load.
- What is the minimum flow?
- Do you need a standby-pump always or is it okay if it takes part in the boosting when max flow has to be reached?

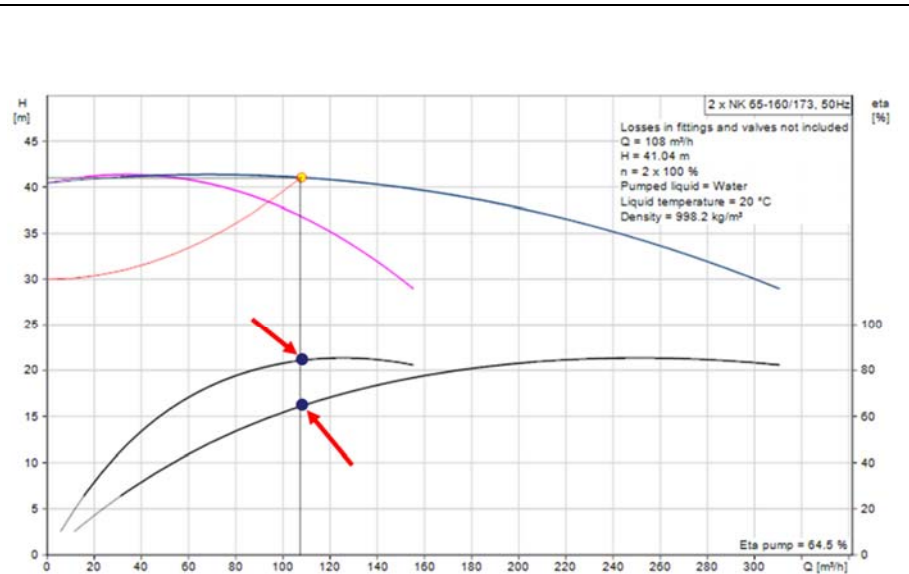
- How is the installation, is it better with inline or end-suction? This is often decided by looking at where the pipes come from to the booster set and where they go when leaving the booster set. When you know that, it often becomes obvious if it should be an inline pump or a norm with angular inlet and discharge.
- If you already have spares for some pump types then it could be smart to choose the same pump type for the booster set if possible.
- Do you have specific motor sizes on stock?
- Maintenance issues. Some pumps are more maintenance-friendly than others; on the other hand they are normally also more expensive.

These questions require plenty of consideration but when answered, they normally give a good idea about which pump type to choose and also how many pumps you should have in parallel.

When operating parallel-coupled pumps, there are also things that you need to know to have an optimum and efficient operation.

First of all, how or when do you switch in the next pump when higher flow is required? This is of course already taken care of if you have bought a booster set complete with controls, but if you provide the control or programming on site in the local Scada system, you need to know what to do.

The pump curves show two standard pumps in parallel. If you operate them at a flow of around 100m<sup>3</sup>/h you will see with one pump you have an efficiency that is around 20% better than having it split between two pumps. (The upper blue dot shows the efficiency for one pump and the lower blue shows the efficiency for two pumps.) As the curve shows, you have to be very close to full flow on pump 1 before you switch in number 2 to have the best efficiency for the system at all times. When two or more pumps are switched in and operated with frequency converters the pumps should always follow each other. This means that you cannot have one pump operating for example at 90% speed and another one only a 60% speed. Best efficiency is always achieved when all pumps in the booster set run at the same speed.

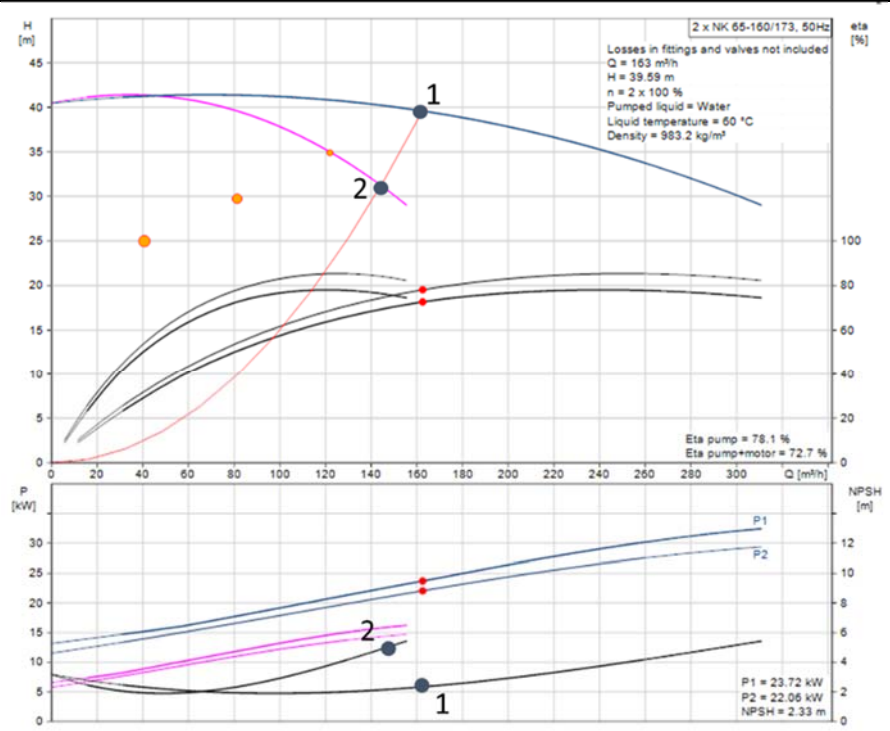


When we want to couple one of the pumps out again, there are a number of things that are nice to know. They don't relate to efficiency but to the NPSH value instead.

If you have a duty point that is at 1 on the Q/h curve, then the NPSH value at that flow will be around 2 metres.

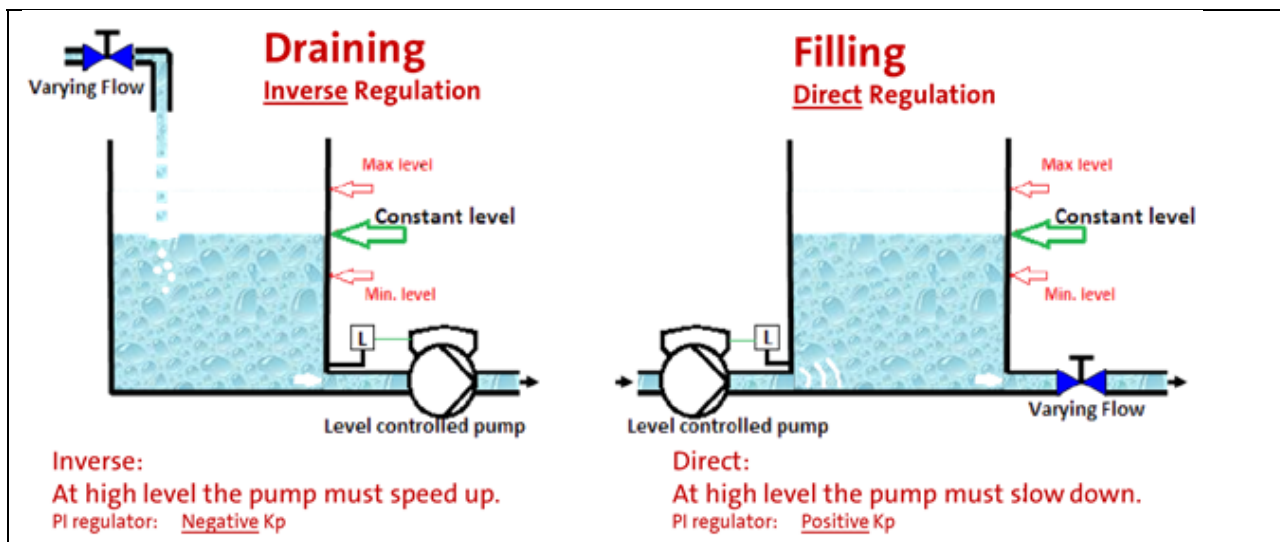
If you just switch one pump out the duty point will jump to 2 at the Q/h curve for only one pump. The NPSH will do the same where there is more than the double NPSH value (around 5 metres).

So if you have a poor inlet pressure you need to be aware of this when you switch out pumps.



## Level Control

Level control is needed anywhere in the industrial water applications where water is pumped to or from a storage tank. Level control means keeping a constant level in a tank by either adding or removing water. If a certain variation is accepted, it can be done by on/off control between a min. and max. level. If variation must be kept at a minimum, the level controlled pump needs a precise trim.



### Basics:

From a control stand point tank size is defined by inlet and discharge flow – how much time it will take to fill or drain the tank by the attached pump and valve.

$$\text{Time} = \text{Tank volume} / \text{Flow} \quad [\text{sec} = \text{m}^3 / (\text{m}^3/\text{sec})]$$

**Tank size:**

A large tank will provide stability - it will fill slowly and empty slowly.

A large tank can be used as storage

- Roof tanks on high-rise buildings are often used as emergency water supply in case of power failure and are required by the insurance companies for fire protection water storage.

**Tank shape:**

A tall slim tank will show faster change in level than a wide low tank, which impacts the level measuring equipment - sensitivity needs to be higher with the low and wide tank.

Tall slim tanks also require faster or more precise pump operation.

The filling situation where you pump water into a tank is normally an “easy” job for a pump without many complications. But you have a drainage situation you have to be careful. See more in the section ‘Liquid transport’.

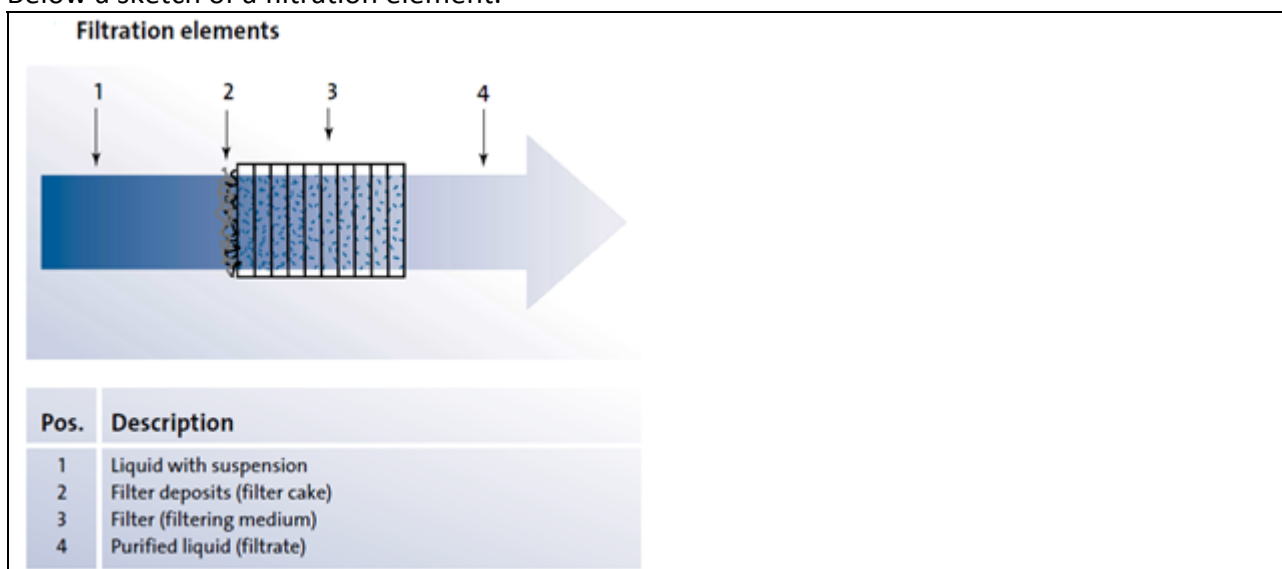
## Filtration

Delivery of water or any other liquid to a filter is a very common industrial job for a pump; the need for filtering liquids in industry is currently growing. This because there are increasing expectations of the purity of liquid/water used, regardless of whether it is used for washing or directly in the production process. The fact that water is becoming increasingly scarce in many parts of the world also creates an increased awareness of water recycling, so the liquid that previously was dumped is now filtered or treated so it can be re-used. Lastly, local communities are bringing greater focus on environmental pollution, and demanding that industrial waste water is properly treated before being dumped. So filtering tasks are increasing, which also means an increase in the need for pumps.

There are many types of filters available on the market to suit various needs. In this white paper we will not go into details with this, but just give a short overview of the different technologies. If more details are needed, please look at the Water treatment page at Grundfos.com.

Filtration is a process in which solid particles are separated from a liquid.

Below a sketch of a filtration element.



Separation in filtration is a mechanical process, as solid particles are retained by a porous filtering medium which the liquid is forced through. Driving pressure is required to “force” the liquid through the filtering medium, i.e. the system needs a pump of a certain size. There are other methods for separating solid particles from a liquid, e.g. sedimentation or distillation of the liquid. All filters -no matter the type or material- have one thing in common: once in a while they need to be cleaned, because over time a filter cake will build up. So many standard filters are designed so they can be washed and cleaned while in place (CIP process).

The CIP process or flushing out the solid material is often done by using a “cleaning liquid with some added chemicals”. Being able to clean the filters while in place is a huge advantage because it reduces the time the production needs to be stopped. Starting or stopping the backwashing or cleaning process can easily be handled by a Grundfos iSOLUTION.

## Liquid transport

Liquid transport is perhaps not a standard application like the others mentioned above, but is increasingly important due to the fact that reuse of water is a growing issue. There are some specific things to bear in mind when you want to move a liquid from A to B.

- If there are solids in the liquid, sedimentation can be an issue with insufficient flow through the pipes.
- Which end do you control, the discharge side or the inlet side of the pump? The discharge side normally doesn't create problems for the pump but if you are taking water out of a tank like shown on the picture below you have to be careful.
- Be careful with dry run or cavitation, if it is a system like the one shown below.
- Avoid vortex in the tank. If the flow through the tank is too great, sometimes a vortex is created on the liquid surface. This means that the inlet pressure is not as much as you think and you can end up with a system with periodic cavitation when vortex comes and goes.
- Avoid too much turbulence in the tank. Turbulence in the tank can make it impossible for the pump to suck enough water out of the tank. So again, even though you think you have a high water level, maybe the pump cannot get “hold” of the water due to turbulence. The priming of the tank can often create these turbulences. Especially if the priming is just is splashing down on the water surface or if the inlet to the tank is right next to the outlet of the tank.
- Avoid air bubbles in the water. Air bubbles can also create a risk that the pump will not be able to get hold of the water, and thereby won't give the performance you expect.
- Avoid excessive flow in the tank, as this can also cause turbulence.





## Conclusion

To sum up, industrial water supply or infrastructure is maybe more a mind-set than a specific application. The purpose of this mind-set is to remember to look at your total liquid infrastructure, get the overall picture, not just on what is supplied by the OEM supplier. Get every single pump in the system connected to your Scada or BMS system just as you have done with your main process equipment. When you have that overview, it is much easier to see if something can be done smarter no matter if the pump job is pressure boosting, level control, filtration or liquid transport.

The overview, and using the right control strategy for particular pump jobs will give you the following advantages:

- Energy saving
- Higher performance in your production in general.
- Less use of water
- Faster reaction in the event of breakdown, or even avoidance of breakdown due to better overview via the Scada or BMS system.
- Optimisation of spare parts if, for example, you use the same pump type or motors different places at your plant.

To get the above-mentioned advantages is where Grundfos iSOLUTIONs (intelligent solutions) comes into play. The approach goes beyond the pump to optimising the entire pumping system. Grundfos works to identify customers' needs and help them avoid situations that will be uneconomical in the long term – for example, by setting up the most intelligent and efficient pump regulation in an industrial application.

Besides this, there are several other advantages obtained from using iSOLUTIONs. You get many more possibilities for monitoring not only the pump performance but also the whole system performance, and will be able react faster if, for example the set-point needs adjusting.