POWER OPTIMAL PUMP SEQUENCING

UNMATCHED **ENERGY PERFORMANCE**
WITH GRUNDFOS CONTROLS

GRUNDFOS iSOLUTIONS | A SMART SOLUTION FOR YOU

be
think
innovate

GRUNDFOS

Today multi pump systems utilizing the CU352 include a sequencing algorithm purely based on pump-speed. Thus, the number of pumps running is based on the speed of the pumps – e.g. in a set with the running pumps exceeding 85% speed an additional pump is cut in to share the load (flow) and thus reduce the speed of the running pumps. The former stems from the fact that at a given constant differential pressure the flow is dependent on pump speed, and furthermore, the flow for each running pump is equal to the total flow divided by the number of running pumps.

However, for the Grundfos CRE pump a power optimal sequencing is available but limited to that particular pump type. With speed-based sequencing the pumps cannot be guaranteed to run power optimal and since the existing solution only applies for CRE pumps a method applying for all centrifugal pumps in a pump-set consisting of 2 or more equally sized pumps driven by VFD's is presented next. The new Grundfos way for all pump types uses pump characteristics to evaluate whether it is beneficial to increase or decrease the number of pumps running at any given time as illustrated on figure 1.

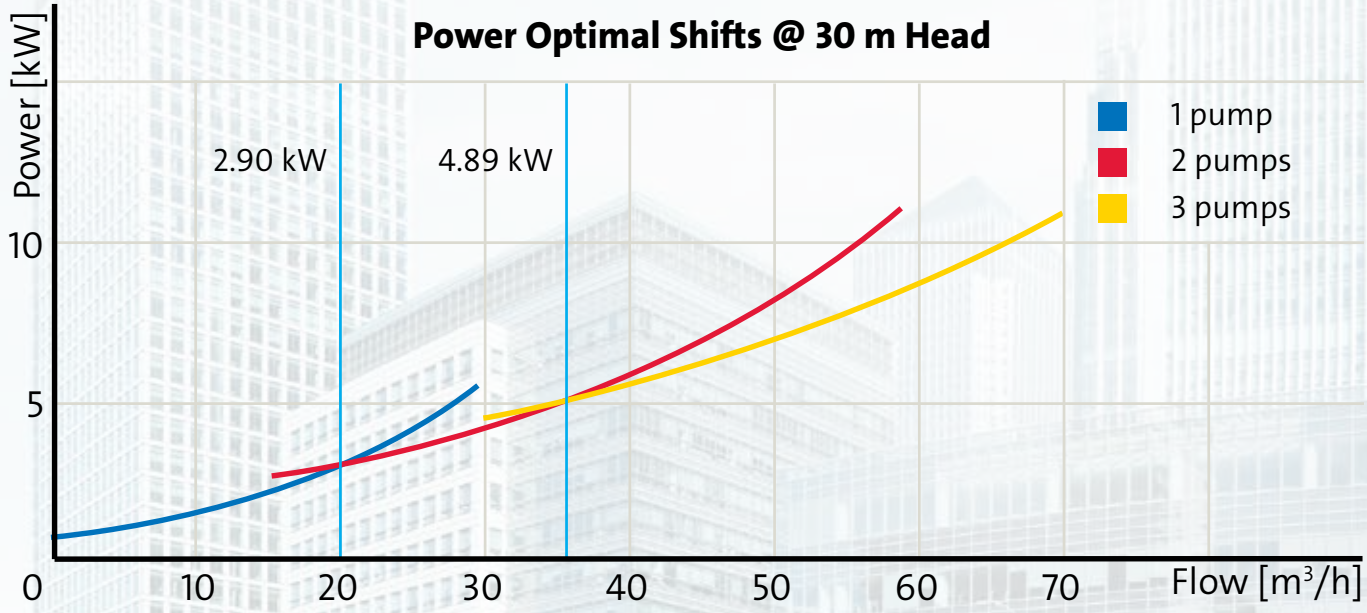

Figure 1: Power is mapped versus flow at a given head for CRE 20-5 pumps in a booster setup. The resulting curves are a product of varying speed. Intersections are the optimal points to shift.

Finding the intersections on figure 1 requires knowledge of pump characteristics. POPS (Power Optimal Pump Sequencing) will determine pump characteristics QH and QP without prior knowledge of the pump characteristics - allowing the algorithm to work with any type, model and brand of centrifugal pump.

OPTIMAL SEQUENCING OF PUMPS

The optimal sequencing of the pumps is done based on pump characteristics derived during a pump parameterization and is done automatically for each pump.

The algorithm will calculate power consumption with one additional pump in operation and with one pump less in operation, thus determining what operation condition that is most energy efficient.

The pump characteristics estimated during the parametrization phase is used to make those calculation and by looking at the differential pressure over the pump, it is possible to determine if a pump cut-in/out will result in less power consumption, while maintaining the required discharge pressure(flow)

Before a new pump is cut-in the algorithm will calculate at what speed the pump will deliver flow, the required flow and ensure that the pump is ramped quickly up to that speed.

Since it is known at which speed it is expected of a pump to deliver the required flow it will also be possible to raise a warning if a pump is not delivering flow.

SIMULATION:

The simulation is initiated with speed based sequencing and after around 30 minutes pump parameter recognition is started. When parameters have been obtained a shift to power optimal sequencing is made.

Approximately 30 minutes into the simulation pump parameter recognition is started and 10 minutes later the POPS is started as is evident from 40min. on fig. 3 towards the 90min mark.

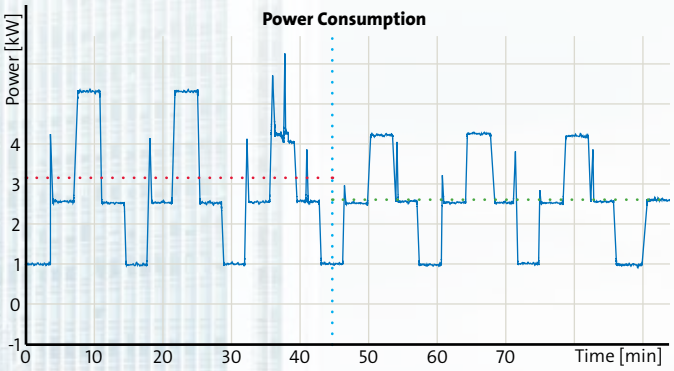

Figure 2: power consumption comparison

Before POPS the avarage power consumption is 2,74kWh and with POPS activated it is 2,45kWh, which is a saving of 10,5%

PREREQUISITES:

To find the parameters required for determining the pump characteristics the following is required (The prerequisites apply up to 6 pumps):

- Input pressure measurement(or fixed inlet)
- Output pressure measurement
- Input on individual pump power(kWh)
- Control of individual pump speeds(Hz)
- Pumps are the same size

It is assumed that the pump set is running outlet or differential pressure control and that the pumps are of equal size, placed in parallel and with spring loaded check valves on their individual outlets. If other control modes are used like Constant Temperature or Flow a differential or outlet pressure sensor will have to be connected for the function to work.

The flow will have to be stable during the estimation and has to be so high that it is possible for the algorithm to cut-in a second pump.

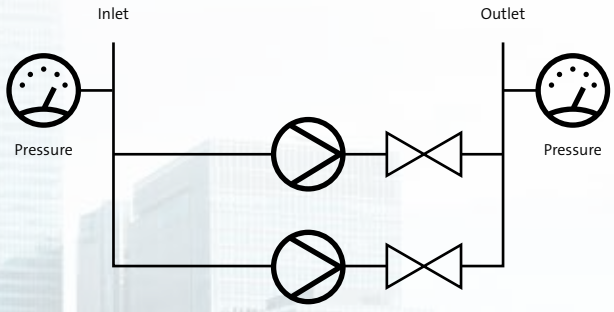

Figure 3: System pricip

Industry/4011802-BrandBox

GRUNDFOS Holding A/S
Poul Due Jensens Vej 7
DK-8850 Bjerringbro
Tel: +45 87 50 14 00
www.grundfos.com

GRUNDFOS