Pump*Action*

ISSUE 43 AUGUST 07

Welcome to the 43rd edition of Pump Action

In this edition, we highlight that Viking Pump has once again won a readers' choice award where respondents provided feedback through a chemical processing magazine. This is something that Viking Pump and Kelair take quite seriously as it reflects the general perception of the actual users of the pumps against the efforts being put in by Viking Pump and its international distribution network.

The case study demonstrates an interesting application where Kelair was able to provide a complete solution including pump and controls to help in a fairly specific application at a customer's site.

In Pump Clinic this month we cover, in some detail, how to read a system curve. Even those of us who do this every day may find something interesting in here as we go from the system curve to how it may affect pump selection.

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CASE STUDY

LaBour does the hard yards at Aussie hardboards plant

Sales Engineer Rudi Jahrig (QLD)

Australian Hardboards Limited is the sole Australian manufacturer of 100% all natural thin hardboards, producing 13,000,000m² per year of hardboard (enough to lay a one-metre-wide track around Australia).

The company's constant commitment to improve manufacturing required the upgrade of the existing pump which transfers the thermo-eucalyptus mechanical pulp wood fibres to the process machine.

Australian Hardboards' engineering manager, Wayne Chilton contacted Kelair's sales engineer Rudi Jahrig for a solution.

After collecting all necessary technical information and understanding the process and equipment set-up Rudi selected a LaBour Taber LVA chemical process pump which was perfectly suited for the harsh application. The pump was to be controlled via a variable frequency drive to ensure the delivery of various quantities of wood fibres according to the production demand. (For example, the thickness of the hardboard).

Being at the heart of the manufacturing process, the pump had to be able to deliver various consistencies of wood fibre in suspension so reliability was paramount as too, durability.

The LaBour Taber LVA-ANSI process centrifugal pump was selected due its rugged design, which includes large shaft diameter (D) and short impeller overhang (L), resulting in the lowest "shaft flexibility factor (L3/D4)" in the industry.

The LVA series of LaBour Taber pumps combines high efficiency, maximum performance, lower vibration and shaft deflection resulting in extended MTBF (mean-time-between-failure) for reduced maintenance cost.

The pump has now been thoroughly tested and has passed all duties with flying colours.

Australian Hardboards' Wayne Chilton says that he is impressed with the pump's performance.

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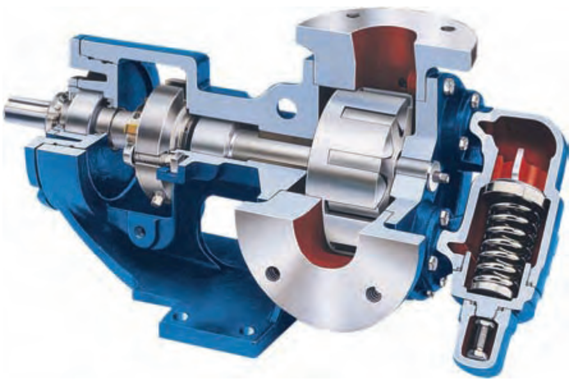
NEWS

Viking Pump named 2007 'Chemical Processing's Readers' Choice'

For the fourth straight year, Viking Pump has earned the Readers' Choice Award in the category of Positive Displacement Pumps.



This is a yearly survey administered by Chemical processing Magazine which asks respondents to name the technology leader across 47 different product categories.

23% of respondents indicated that Viking Pump is the technology leader for positive displacement pumps beating the next closest manufacturer by 10%.

It should be noted that these names do not come from a pre-selected list. All votes are typed in starting from a blank form.

"product build up" on the piping walls, filters, strainers, valves, elbows, heat exchangers, etc., making the published numbers somewhat inaccurate.

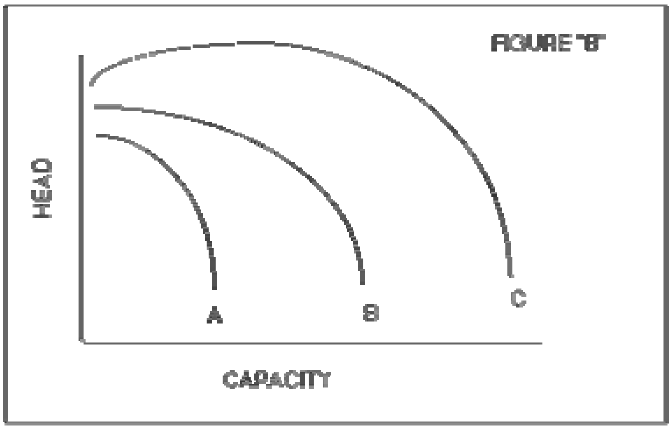
A general "rule of thumb" says that the friction loss in clean piping will vary approximately with 90% of the square of the change in flow in the piping, and 100% of the square with the change of flow in the fittings and accessories. You calculate the change in flow by dividing the new flow by the old flow and then square the number. As an example:

> At 45m³/hr the piping resistance, calculated from published charts (not included) is twenty-three metres (23m). What will it be at 67.5m³/hr?
>
> $\frac{67.5}{45} = (1.5)^2 = 2.25 \times 23m = 51.75 \times 90\%$ of the change = 46.58m of resistance head
>
> In other words, when we went from 45m³/hr to 67.5m³/hr the piping resistance increased from 23m to 46.58m
>
> The loss through the fittings and hardware was calculated at 7.6m. What will the new loss be?
>
> $\frac{67.5}{45} = (1.5)^2 = 2.25 \times 7.6m = 17.1 \times 100\%$ of the change = 17.1 new metres of head

In the original application system, loss was a combination of the loss through the piping and the loss through the fittings for a total of 30.6 metres at 45m³/hr. When we increased the flow to 67.5m³/hr our system head changed to a total of 63.68m (46.58 + 17.1). This change would have to be added to the static and pressure heads to calculate the total head required for the new pump.

Please note that the pump is pumping the difference between the suction head and the discharge head, so if you fail to consider that the suction head will be either added to or subtracted from the discharge head, you will make an error in your calculations. The suction head will be negative if you are lifting liquid from below ground or if you are pumping from a vacuum. It will be positive if you are pumping from a tank located above ground. If the suction head is pressurized, this pressure must be converted to head and subtracted from the total head required by the pump.

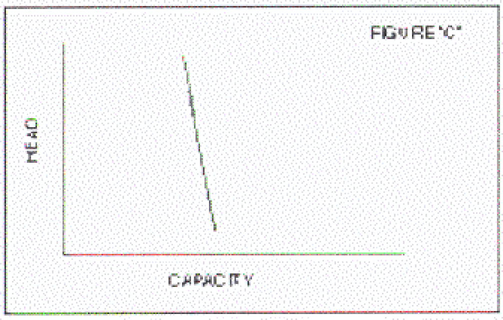
A centrifugal pump will create a head/capacity curve that will generally resemble one of the curves described in figure "B" The shape of the curve is determined by the Specific Speed number of the impeller.



Centrifugal pumps always pump somewhere on their curve, but should be selected to pump as close to the best efficiency point (B.E.P.) as possible. The B.E.P. will fall some where between 80% and 85% of the shut off head (maximum head).

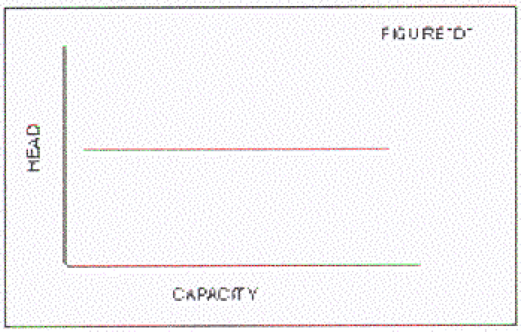
The manufacturer generated these curves at a specific R.P.M.. Unless you are using synchronous motors (you probably are using induction motors on your pumps) you will have to adjust the curves to match your actual pump speed. Put a tachometer on the running motor and record the rpm. difference between your pump and the speed shown on the pump manufacturer's published curve. You can use the pump affinity laws to approximate the change.

POSITIVE DISPLACEMENT PUMPS have a different shaped curve. They look something like Figure "C".



The capacity, of a positive displacement pump, will remain almost a constant as long as you do not alter the pump speed. Run it faster and it will pump more. The maximum head is determined by the strength of the pump casing and the horsepower (K.W) available.

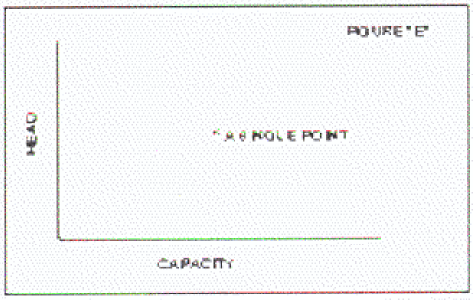
Surprisingly there are only a few system curve shapes that you will encounter. Figure "D" describes the first one:



In this system, the head remains a constant as the capacity varies. This is a typical application for:

- A boiler feed pump that is supplying a constant pressure boiler with a varying steam demand. This is a very common application in many process systems or aboard a ship that is frequently changing speeds (answering bells).
- Filling a tank from the top and varying the amount of liquid being pumped, is the normal routine in most process plants. The curve will look like this if the majority of the head is either static or pressure head.

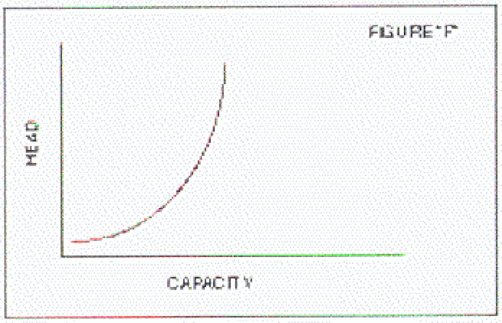
The second system is the ideal one, Figure "E" describes it:



In this system the head and capacity remain a constant as long as the pump is running, the perfect pump application! We find this condition in a couple of places

- A boiler circulating pump—where the suction and discharge are at the same pressure. Most tank circulating pumps have a single point rather than a system curve.
- A steady state, power generating boiler is another example
- A steady state process pump operates at a single point also

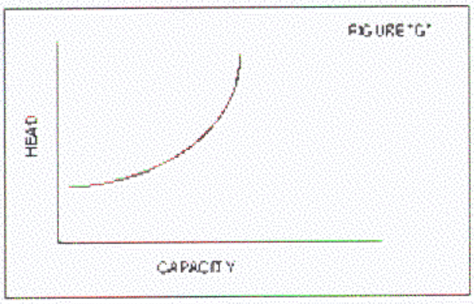
Figure "F" describes the next one. We call this an exponential curve.



In this system the entire head is system head so it will vary with the capacity. Look for this type of curve in the following applications:

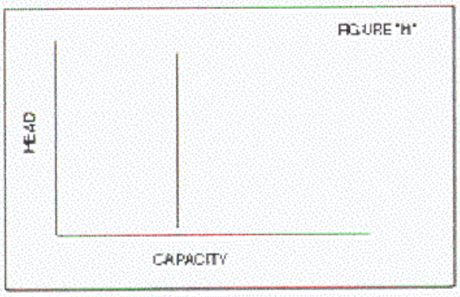
- A circulating hot or cold water heating/ cooling system.
- Pumping to a non pressurized tank, a long distance from the source with little to no elevation involved. Filling tank cars is a typical application.

System curve "G" is a common one. It is a combination of static, pressure and system heads.



This curve is generated if we are pumping to an elevated tank, a long distance from the source—and the amount we are pumping varies due to the system demands.

System figure "H" occurs if you are filling a tank from the bottom or attempting to use the centrifugal pump as an accumulator. If the capacity is below 20 gallons per minute (4,5 M^3/hr) you really should be using a positive displacement pump in this application.



Once the pump manufacturer has a clear idea as to the shape of your system curve, and the head and capacity numbers needed he can then select the proper centrifugal pump. The shape of his curve will be pretty much determined by the specific speed number of the impeller.

In addition to specific speed he can select impeller diameter, impeller width, pump rpm., and he also has the option of series or parallel operation along with the possibility of using a multi-stage pump to satisfy your needs.

The sad fact is that most pumps are selected poorly because of the desire to offer the customer the lowest possible price. A robust pump, with a low L3/D4, is still your best protection against seal and bearing premature failure when the pump is operating off of its best efficiency point. Keep the following in mind as you select your pump:

- A centrifugal pump will pump where the pump curve intersects the system curve. This may bear no relationship to the best efficiency point (B.E.P.), or your desire for the pump to perform a specific task.
- The further off the B.E.P. you go, the more robust the pump you will need. This is especially true if you have replaced the packing with a mechanical seal and no longer have the packing to act as a support bearing when the shaft deflects. Shaft deflection is always a major problem at start up.
- When you connect pumps in parallel, you add the capacities together. The capacity of a pump is determined by the impeller width and r.p.m. The head of a centrifugal pump is determined by the impeller diameter and rpm. If the heads are different, the stronger pump will throttle the weaker one, so the impeller diameters and rpm's must be the same if you connect pumps in parallel. Check the rpm's on these pumps if you are experiencing any difficulties.

- If you connect the pumps in series, the heads will add together, so the capacities must be the same or one of them will probably cavitate. You could also have a problem operating too far to the right of the best efficiency point with a possible motor "burn out".
- When you vary the speed of a centrifugal pump, the best efficiency point comes down at an angle. The affect is almost the same as changing the diameter of the impeller. This means that the variable speed motor will work best on a system curve that is exponential (Figure "F"). Unfortunately most process and boiler feed pump system curves are not exponential.
- Pump curves are based on a speed of 1450, 1750, 2900, 3500, rpm. Electric induction motors seldom run at these speeds because of "slip". You can estimate that a 2% to a 5% slip is normal in these pumps with the "slip" directly related to the price of the motor.
- You should also keep in mind that if the motor is running at its best efficiency point that does not mean that the pump is running at its B.E.P.

Since you will be using pumps that were supplied at the lowest cost, you can do the following to resist some of the shaft displacement:

- Use a solid shaft. Sleeves often raise the L3/D4 number to over 60 (2 in the metric system), and this is too high a number for reliable seal performance.
- Try to keep the mechanical seal as close to the bearings as possible. It is the mechanical seal that is the most sensitive to shaft deflection and vibration.
- Once the seal has been moved closer to the bearings, you can install a sleeve bearing in the packing space to support the shaft when the pump is operated off of its B.E.P. This is especially important at start up, or any time a pump discharge valve is operated.
- Stop the cavitation if you are experiencing any.
- Balance the rotating assembly.
- Check that the shaft is not bent or the rotating assembly is not out of dynamic balance.
- Use a "C" or "D" frame adapter to solve pump motor alignment difficulties.
- A centre line design wet end can be used if pipe strain, due to temperature expansion, is causing an alignment problem.

Do not trust the system prints to make your calculations. The actual system always differs from that shown on the print, because people tap into the lines, using the pumped fluid for a variety of purposes and after having done so forget to change or "mark up" the original system print. You are going to have to "walk down" the system and note the pipe length, the number of fittings, etc., to make an accurate system head calculation.

Do not be surprised to find that the discharge of your pump is hooked up to the discharge of another pump further down the line. In other words, the pumps are connected in parallel and no body knows it. Pressure recorders (not gauges) installed at the pump suction and discharge is another technique you can use to get a better picture of the system or dynamic head. They will show you how the head is varying with changes in flow."