May 2006

Pump*Action*............Issue 29

Welcome to the 29th edition of Pump Action.

The Idex Group's Viking pumps (one of Kelair's core products) are manufactured in the USA. Viking's Quality Assurance programmes maintain the traits inherent to Viking pumps - reliability, durability and dependability throughout all stages of production. All Viking manufacturing facilities are certified to the ISO-9001 quality standard. Pumps are individually produced and hand-assembled to each application requirement for unduplicated quality and enhanced pump/application interface.

In 1998, Viking Pump, Inc. received certification to ISO-14001, an Environmental Management System standard designed to help control impacts on the environment from a company's activities, products, and/or services. Viking Pump was one of the first 100 companies in the United States to receive this certification.

Watch this space for a major announcement by Kelair on Viking Pumps!

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NEWS

Viking chocolate pumps smooth the way

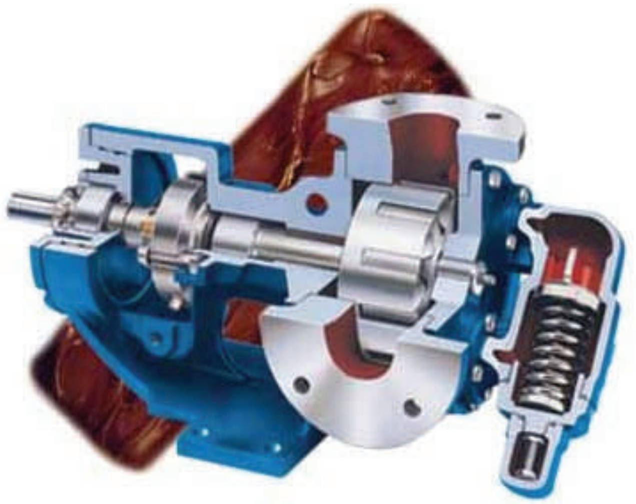
Pumping chocolate has always been a tricky proposition. The amount of chocolate liquor, fat (cocoa butter), sugar content, sugar granule size, milk products, and other additives dramatically affect the behavior of the product. Even though many formulas are used, the application is generally described as "chocolate pumping".

Viking's Internal Gear pumps have been transferring many forms of chocolate for over 50 years and the company has acquired considerable experience in constructing pump designs specifically for long term reliability in service.

Viking suggests the following guidelines:

- Additional clearances within the pump for viscosities above 16,000 cps. The additional clearances prevent the "squeezing" of ingredients out of the chocolate emulsion and reduce the possibility of any heat induced into the liquid.
- Maximum pump speed limit to prevent the chocolate from changing consistency into a caramelized state. The following speeds are recommended:

Pump Size	Port Size	Max Speed
H, HL	1½"	280 rpm
K, KK	2"	190 rpm
L	2"	125 rpm
LL, LS	3"	125 rpm
Q, QS	4"	100 rpm



- Minimize discharge pressure. Design system to reduce pump discharge pressure to approximately 700 kPa maximum.
- Drilled idlers are used to minimize build up in the idler pin and idler bush area. This design is specific to the Viking pump design and developed to introduce "fresh" and "cool" chocolate to flush and lubricate this close-running tolerance area of the pump.
- Mechanical seals are not recommended. Due to the inherent heat build-up over the seal faces, the possibility of "cooking" the sugar particles over this area causes seal face failure and subsequent leakage to the atmosphere. Packed glands are used.
- Pump casing "suck-back" holes or grooves are machined to assist moving the chocolate around the rear of the rotor area to prevent any heat build-up with stagnate flow of chocolate in this area.

• For further Viking product information visit our website www.kelairpumps.com.au

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CASE STUDY

Kelair's Goulds GIS verticals take the heat

Sales Engineer Alex Calodoukas

Recently, one of Kelair's customers in the Power Generation industry purchased a quantity of eight Goulds GIS-Series vertical sump pumps for use on remote areas of its site, accessible only to electricity.

Vertical sump pumps are still widely used throughout many industries. Self–priming pumps, centrifugal pumps with foot valves, and submersible pumps also share the same ability to pump wastewater from a pit. However, when the fluid reaches temperatures exceeding around 45ºC, that fluid is no longer capable of providing sufficient cooling for the submersible pump which sits within the fluid. Higher levels of insulation are required, and not all pump manufacturers provide options on insulation.

In this case, the water temperature could climb as high as 90ºC. The huge vapour pressure head losses would rule out the options of using a centrifugal with a foot valve, or a standard self-primer. There are more specialised self-primers capable of pumping vapour, but the trade-off is a loss of efficiency. So a vertical sump pump was the best option in this case. For this type of pump, the wet-end sits directly in the fluid, while the motor is situated on a mounting plate above the pit. The motor and wet-end are joined by a long stainless steel shaft.

There are two variations on vertical sump pumps. The first is a cantilever type, built with robust bearings that sit directly under the motor and above the mounting plate. The shaft is large in diameter, as there are no support bearings along its length. This version is used primarily when there are solids or salts in the sump fluid.

The second variation on vertical sump pumps has column bearings that support the pump shaft along

its length. These bearings need lubrication and they sit less than a metre apart. This is a cost-saving on the cantilever configuration as the stainless steel shaft doesn't have to be quite as thick.

On the Goulds pump (pictured above), the stainless tube supported along the length of the shaft carries sump water to cool the shaft bearings. In addition, attached to that tube are cyclone separators to 'fling' out any small solids, returning them to the sump which keeps them away from the shaft support bearings thus increasing the bearing life.

Another consideration was selecting the correct paint. Paint that is suited to 90ºC in air is only rated to half that in water, so a paint suited to 180ºC in air was selected to provide adequate protection.

Kelair also worked in conjunction with the customer to develop a sliding support bracket for the discharge-riser piper at the mounting plate. This bracket was to protect the paint on the pipe from being scratched by the plate, as the pipe moved during expansion and contraction of the pipework with temperature changes.

• For further Goulds product information visit our website www.kelairpumps.com.au

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PUMP CLINIC 3

What is Recirculation and Separation?

There is a small flow from impeller discharge to suction through the wearing rings and any hydraulic balance device present. This takes place at all capacities but does not usually contribute to raising the liquid temperature very much unless operation is near shut-off.

When the capacity has been reduced by throttling (or as a result of an increase in system head), a secondary flow called recirculation begins. Recirculation is a flow reversal at the suction and/or at the discharge tips of the impeller vanes. All impellers have a critical capacity at which recirculation occurs. The capacities at which suction and discharge recirculation begin can be controlled to some extent by design, but recirculation cannot be eliminated.

Suction recirculation is the reversal of flow at the impeller eye. A portion of the flow is directed out of the eye at the eye diameter, as shown in *Figure 1 Page 1* and travels upstream with a rotational velocity approaching the peripheral velocity of the diameter. A rotating annulus of liquid is produced upstream from the impeller inlet and through the core of this annulus passes an axial flow corresponding to the output capacity of the pump. The high shear rate between the rotating annulus and the axial flow through the core produces vortices that form and collapse, producing noise and cavitation in the suction of the pump.

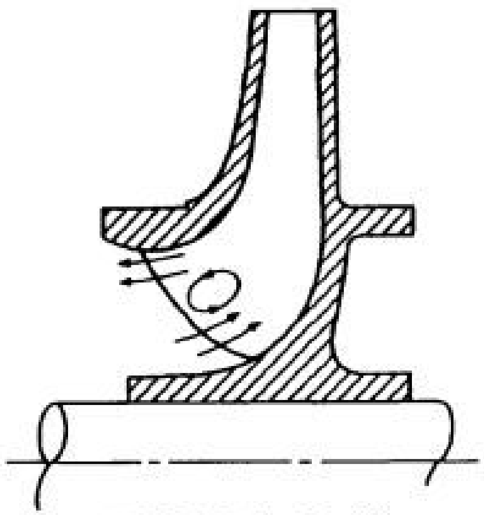

FIGURE 1 - Suction Recirculation

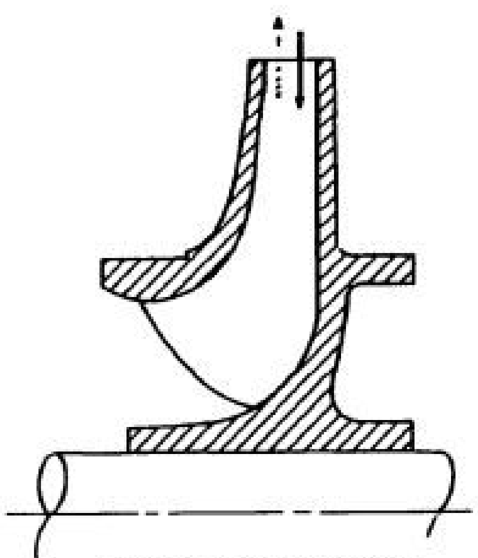

FIGURE 2 - Discharge Recirculation

Discharge recirculation is the reversal of flow at the discharge tips of the impeller vanes, as shown in *Figure 2 Page 1.* The shear rate between the inward and outward relative velocities produces vortices that cavitate and usually attack the pressure side of the vanes.

The capacity at which suction recirculation occurs is directly related to the design suction-specific speed ***S*** of the pump. The higher the suction-specific speed, the closer will be the beginning of recirculation to the capacity at best efficiency. *Figure 3 Page 2* shows the relation between the suction-specific speed and suction recirculation for pumps up to 2500 (1530) specific speed and *Figure 4 Page 2* shows the same relation for pumps up to 10,000 (6123) specific speed.

For water pumps, the minimum operating flows can be as low as 50% of the suction recirculation values shown for continuous operation and as low as 25% for intermittent operation. For hydrocarbons, the minimum operating flows can be as low as 60% of the suction recirculation values shown for continuous operation and as low as 25% for intermittent operation.

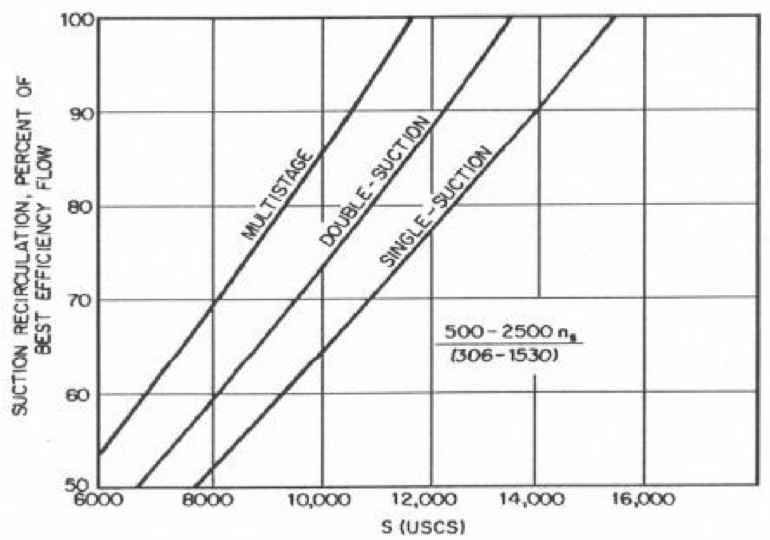

Figure 3: Suction-specific speed ***S*** at best efficiency flow, single suction or one side of double suction (to obtain ***S*** in ***SI*** units, multiply by 0.6123)

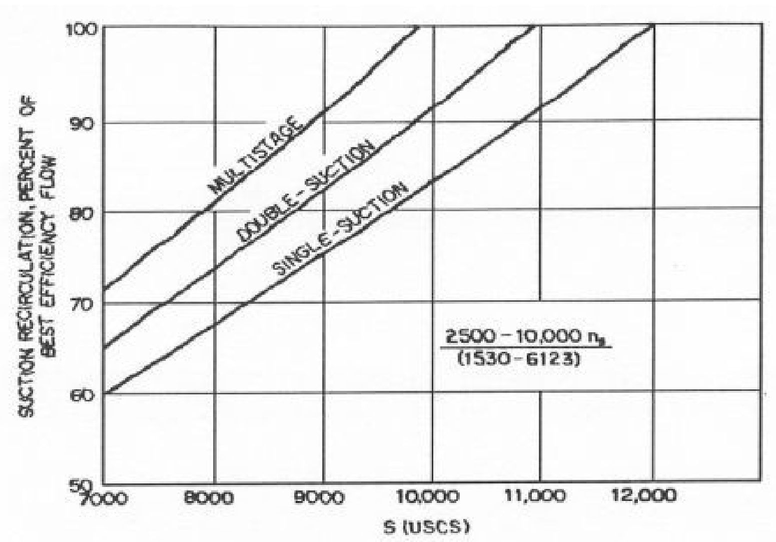

Figure 4: Suction-specific speed ***S*** at best efficiency flow, single suction or one side of double suction (to obtain ***S*** in ***SI*** units, multiply by 0.6123)

The high turbulence produced by recirculation and separation accounts for most of the high power consumed at shut-off. This may vary from about 30% of the normal power for pumps of very low-specific speed to nearly three times the normal power for propeller pumps. Separation and, possibly, cavitation may take place on the casing tongue or diffusion vanes at very low capacities. Operation near shut-off causes not only excessive heating, but also vibration and cavitation, which may cause serious mechanical damage.

Diagnosis of Suction and Discharge Recirculation

Cause and Effect: Recirculation occurs at reduced flows and is the reversal of a portion of the flow-back through the impeller. Recirculation at the inlet of the impeller is known as suction recirculation. Recirculation at the outlet of the impeller is discharge recirculation. Suction and discharge recirculation can be very damaging to pump operation and should be avoided for continuous operation.

Diagnosis From Pump Operation: Suction recirculation will produce a loud crackling noise in and around the suction of the pump. Recirculation noise is of greater intensity than the noise from low NPSH cavitation and is a random knocking sound. Discharge recirculation will produce the same characteristic sound as suction recirculation except that the highest intensity is in the discharge volute or diffuser.

Diagnosis From Visual Examination: Suction and discharge recirculation produce cavitation damage to the pressure side of the impeller vanes. Viewed from the suction of the impeller, the pressure side would be the invisible, or underside, of the vane. *Figure 5 Page 3* shows how a mirror can be used to examine the pressure side of the inlet vane for cavitation damage from suction recirculation. Damage to the pressure side of the vane from discharge recirculation is shown in *Figure 6 Page 3.* Guide vanes in the suction may show cavitation damage from impingement of the back-flow from the impeller eye during suction recirculation. Similarly, the tongue or diffuser vanes may show cavitation damage on the impeller side from operation in discharge recirculation.

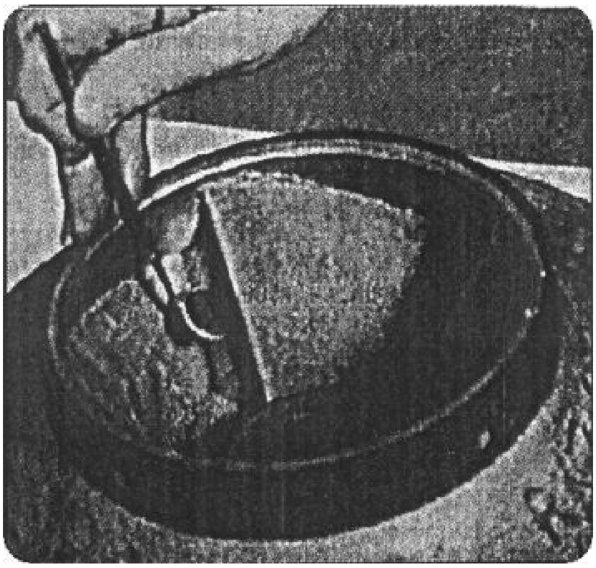

Figure 5: Examining the pressure side of the inlet vanes for suction recirculation.

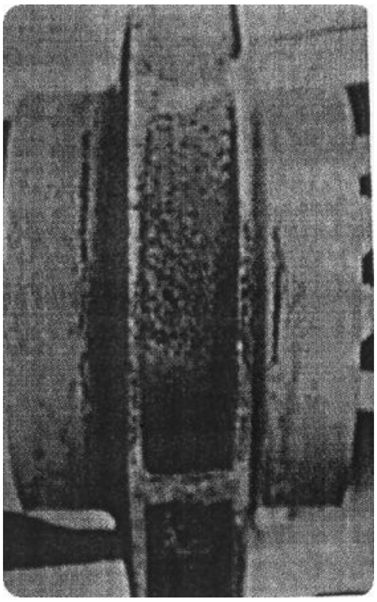

Figure 6: Damage to the pressure side of the vane from discharge recirculation.

Corrective Procedures: Every impeller design has specific recirculation characteristics. These characteristics are inherent in the design and cannot be changed without modifying the design. An analysis of the symptoms associated with recirculation should consider the following as possible corrective procedures.

1. Increase the output capacity of the pump.
2. Install a bypass between the discharge and the suction of the pump.
3. Bleed air into the suction of the pump to reduce the intensity of the noise, vibration and cavitation damage.
4. Substitute a harder material for the impeller to reduce the rate of cavitation damage.