October 2006

Pump*Action*............Issue 34

Welcome to the 34th edition of Pump Action.

Sandpiper Air Operated Diaphragm pumps are highlighted in this issue. Two quite different applications are discussed, both in areas of waste removal / treatment that require a pump to operate effectively and reliably. Many plants have a filter press to process waste and getting effective pumping pressure to the press is an issue that Kelair's engineers are asked frequently to look at. Not all filter presses use an Air Operated Diaphragm pump as there are a number of reasons that they may not be the best pump for a particular duty but, in many instances they are. The case study is one example where using a Sandpiper Phoenix was the ideal solution.

If you work or have worked in the meat industry you will no doubt fully understand the feature article. To the rest of us it illustrates how many different pump applications there are out there and the sorts of issues that various industries need to deal with. After reading the articles, you can make up your own mind as to the consequences of an unscheduled failure of the pumps in either application.

This month Pump Clinic discusses the start up and operation of centrifugal pumps. We talk about what things you should keep in mind or check, and the safe, correct way to operate this equipment. Once again we hope you obtain some useful, or simply interesting information from this issue of Pump Action.

October 2006

PumpAction............Issue 34

CASE STUDY

Sandpiper's Phoenix rises to the challenge

Sales Engineer Hassan Saib

Trade waste from a filter press can become a messy headache. This was the problem Amcor Fibre Packaging, located at Box Hill, Victoria had for a long time, until matters came to a head at the waste disposal site concerning environmental issues.

The original air-operated diaphragm pump was not up to the challenge of satisfactorily processing the waste, which was taking over four hours to go through the filter press, with the disappointing result of liquid messy waste. Environmental issues arose in storing this waste and were further aggravated when transported to the prescribed waste disposal site at Lyndhurst.

So Amcor's maintenance team, mindful of OH&S, and public safety and cleanliness asked the engineering team to find a solution.

Amcor was faced with the challenge of either using a helical rotor pump or a high pressure pneumatic diaphragm pump. Kelair offered a Sandpiper Phoenix High-Pressure Filter Press pump which uses compressed air and produces 2.1 : 1 pressure to air supply ratio to run, and highlighted the advantages such as simplicity of installation and ease of operation in the existing set-up.

Amcor's Engineering Manager, Travis Anderson saw the advantages and took the opportunity to trial the Phoenix. No major modifications were required and the existing air supply to the original double diaphragm pump was sufficient to run the Phoenix, resulting in a much drier waste cake than the plant had been able to produce.

This result was very pleasing, from the maintenance team right through to the manager at the waste disposal site.

L to R: Amcor's Alex Sabo from the maintenance team, and Travis Anderson. Engineering Manager

Finished waste cake

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

PumpAction............Issue 34

FEATURE

Blood collection and pumping at abattoirs

By Sales Engineer Myro Bratkovic

Blood is a very difficult liquid to pump. Experience has shown that an air-powered diaphragm pump is the best option when pumping blood at abattoirs. Why?

Blood is collected on the floor drain of an abattoir process area. Depending on the particular animal being slaughtered, and the means used, the result will be a collection of other unwanted materials, together with blood. These unwanted materials may include things such as wool, hide, bone, hoof and horn pieces.

Sandpiper SA2A at Southern Meats abattoirs

Typically an abattoir blood pump is installed between the floor drain and a collection tank and is required to handle any of the unwanted materials that may be carried to it with the blood. Many of these solids are irregular in shape and size and this can pose problems for a conventional non-solids-handling pump.

The best choice for handling blood with some solids is the Sandpiper HDF (Heavy Duty Flap Valve) pump. Sandpiper HDF pumps are designed to handle irregular pipeline-sized solid particles without blocking. Basically, if a solid can pass down the pipe, the Sandpiper HDF pump can pass it.

Sometimes blood can be left which congeals and again this is not a problem for the Sandpiper pump to handle and pass.

Typically ball-valve-type diaphragm pumps are not suited to these applications due to the random nature of the size, type and consistency of solids that may be encountered at abattoirs and the ability of those pumps to cope with irregular solids.

Materials of construction are also quite important. Blood can be corrosive so typically Kelair's engineers would not recommend the use of aluminium-bodied pumps as these could be open to accelerated corrosion. Rather we recommend the use of cast iron pumps, or in some cases, the client may prefer to use stainless steel. Generally Buna-N or EPDM elastomers are more than suitable for blood and abrasives.

Sandpiper recently upgraded what was for 40 years the SA Series pump range to the HDF (Heavy Duty Flap Valve) series. The enhancements made by Sandpiper's engineers to these pumps were based around extending the diaphragm life by including a wear pad of sacrificial rubber that is sandwiched between the diaphragm and the piston plate.

Sandpiper's engineers also beefed up the pilot valve plunger pin and bushing area of the pump to reduce the unlikely risk of the pin bending. Both of these enhancements are now standard across the HDF2, 3 & 4 (50, 75 & 100mm) model pumps at no additional cost over the superseded SA range.

The Sandpiper HDF range of pumps is available in a variety of materials that does include aluminium, cast iron and stainless steel. A wide range of elastomers to suit many applications are also available for the entire HDF range.

Page 1 Cont.

PumpAction............Issue 34

FEATURE (Cont.)

Blood collection and pumping at abattoirs (Cont.)

Southern Meats located in Goulburn NSW is a large sheep/lamb abattoir for domestic and export markets. It has been using Sandpiper 50mm SA's, and now the HDF series flap valve pumps, for many years. According to Scott Newton, Engineering Manager at Southern Meats, the Sandpiper 'Blood' pumps (pictured pages 1 & 2) have been installed for approximately 7 years and only require a basic service once every 3 or so years. Scott also successfully operates a fleet of 50mm and 75mm Sandpiper flap valve pumps on other waste-type applications at Southern Meats.

Monbeef is an export beef abattoir situated at Cooma in the NSW mountain country. Monbeef has been using a Sandpiper SA2 flap valve pump now for approximately 4 years after having successfully trialled a pump to handle blood and waste. Bob Eley, Engineering Manager at Monbeef became interested after learning about another successful trial of a Sandpiper flap valve pump at a major Australian poultry abattoir/processor.

The problem Bob was encountering was that neither the existing 2" ball valve diaphragm pump, nor the open impeller centrifugal pump, was able to handle the mixture of blood, bone and hoof pieces, and horn buds, without blocking. These blockages were a major problem as they had caused the collection vessel to fill and overflow, as well as requiring a fitter to do the messy job of cleaning out a pump that was full of blood and animal pieces.

According to Bob, since the Sandpiper pump was installed in 2003, blockages have been eliminated and again as at Southern Meats, the pumps require minimal maintenance, only every few years or so.

Sandpiper SA2A at Southern Meats' abattoirs

Sandpiper SA2A at Monbeef abattoirs

Other successful installations of Sandpiper flap valve pumps on blood and waste applications at NSW abattoirs include, Gundagai Meat Processors, Gundagai, and Junee Abattoir, Junee.

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PUMP CLINIC 8

START-UP AND OPERATION OF CENTRIFUGAL PUMPS

OPERATION

Pumps are generally selected for a given capacity and total head when operating at rated speed. These characteristics are referred to as 'rated conditions of service' and, with few exceptions, represent those conditions at or near which the pump will operate the greatest part of the time.

Positive displacement pumps can not operate at any greater flows than rated, except by increasing the speed; nor can they operate at lower flows except by reducing their operating speed or bypassing some of the flow back to the source of supply.

On the other hand, centrifugal pumps can operate over a wide range of capacities, from near zero flow to well beyond the rated capacity. Because a centrifugal pump will always operate at the intersection of its head-capacity and system-head curves, the pump operating capacity may be altered either by throttling the pump discharge (hence altering the system-head curve, or by varying the pump speed (changing the pump head-capacity curve).

This makes the centrifugal pump very flexible in a wide range of services and applications which require the pump to operate at capacities and heads differing considerably from the rated conditions. There are, however, some limitations imposed upon such operation by hydraulic, mechanical, or thermodynamic considerations.

Operation of Centrifugal Pumps at Reduced Flows

There are certain minimum operating flows which must be imposed on centrifugal pumps for either hydraulic or mechanical reasons. Four limiting factors must be considered:

- Radial thrust
- Temperature rise
- Internal recirculation
- Shape of the power curve

For sustained operation, it is imperative to adhere to the minimum flow limits recommended by the pump manufacturer

The thermodynamic problem that arises when a centrifugal pump is operated at extremely reduced flows is caused by the heating up of the liquid handled.

The difference between the power consumed and the water power developed represents the power losses in the pump, except for a small amount lost in the pump bearings. These power losses are converted to heat and transferred to the liquid passing through the pump.

If the pump were to operate against a completely closed valve, the power losses would be equal to the shutoff power and since there would be no flow through the pump, all this power would go into heating the small quantity of liquid contained in the pump casing. The pump casing would heat up, and a certain amount of heat would be dissipated by radiation and convection to the atmosphere.

However, because the temperature rise in the liquid pumped could be quite rapid, it is generally safer to ignore the dissipation of heat through radiation and the absorption of heat by the casing. Calculations for determining the temperature rise in the liquid are available from Kelair.

The maximum permissible temperature rise in a centrifugal pump varies over a wide range, depending on the type of service and installation. The minimum capacity based on thermodynamic considerations is then established as that capacity at which the temperature rise is the maximum permitted.

There are also hydraulic considerations which may affect the minimum flow at which a centrifugal pump can operate. In recent years, correlation has been developed between operation at low flows and the appearance of hydraulic pulsations both in the suction and in the discharge of centrifugal impellers.

It has been proven that these pulsations are caused by the development of an internal recirculation at the inlet and discharge of an impeller at certain flows below the best efficiency capacity. The pump manufacturer's recommendations on minimum flows dictated by these considerations should always be followed.

The NPSHR curve becomes increasingly unstable at low flows. As a rule of thumb, do not operate pumps at flowrates lower than that equivalent to the left-hand end of the NPSHR curve. This rule has to be considered in conjunction with other issues detailed in this section.

Priming

With the exception of self-priming pumps, no centrifugal pump should ever be started until it is fully primed. That is, until it has been filled with the liquid pumped and all the air contained in the pump has been expelled.

Reciprocating pumps of the piston or plunger type are, in principle, self-priming. However, if quick starting is required, priming connections should be piped to a supply above the pump.

Positive displacement pumps of the rotating type, such as rotary or screw pumps, have clearances that allow the liquid in the pump to drain back to the suction. When pumping low viscosity liquids, the pump may completely dry out when it is idle. In such cases, a foot valve should be used to help keep the pump primed. Alternately, a vacuum device may be used to prime the pump.

When handling liquids of higher viscosity, foot valves are usually not required because liquid is retained in the clearances and acts as a seal when the pump is restarted. However, before the initial start of a rotating positive displacement pump, some of the liquid to be pumped should be introduced through the discharge side of the pump to wet the rotating element.

The various methods and arrangements used for priming pumps are available from Kelair.

FINAL CHECKS BEFORE START-UP

A few last-minute checks are recommended before a pump is placed into service for its initial start.

- **Lubricate** the bearings with fresh grease if the pump has been standing for a long time since delivery. With oil-lubricated bearings, fill the bearing housing with the correct quantity and quality of oil (as per manufacturer's recommendations).
- **Open** any sealing and cooling liquid valves where applicable. A mechanical seal should not normally show a leak, but a soft-packed gland should drip during the start-up period and be adjusted as required.

- **Check** that the cooling/sealing liquid outlet pipes are not blocked, where applicable.
- **Fill** the pump casing by opening the suction valve, or through a filling pipe. Vent casings by opening the discharge valve, or ventcocks when fitted.
- **Ensure** the pump shaft turns freely by hand. If it does not, check for foreign matter in the pump, an over-tightened gland or pipe stresses causing the impeller to seize in the casing.
- **Check** the direction of rotation by running the motor for a few seconds.

It is recommended when checking the direction of rotation, that coupling halves are disconnected to eliminate the risk of loosening the impeller, which could cause damage to the pump.

Starting and Stopping Procedures

The steps necessary to start a centrifugal pump depend upon its type and upon the service on which it is installed. For example, standby pumps are generally held ready for immediate starting. The suction and discharge gate valves are held open and reverse flow through the pump is prevented by the check valve in the discharge line.

The methods followed in starting are greatly influenced by the shape of the power-capacity curve of the pump. High and medium head pumps (low and medium specific speeds) have power curves that rise from zero flow to the normal capacity condition. Such pumps should be started against a closed discharge valve to reduce the starting load on the driver.

A check valve is equivalent to a closed valve for this purpose, as long as another pump is already on the line. The check valve will not lift until the pump being started comes up to a speed sufficient to generate a head high enough the lift the check valve from its seat. If a pump is started with a closed discharge valve, the recirculation bypass line must be open to prevent overheating. If a bypass line is not installed, start the pump with the discharge valve cracked open.

Low head pumps (high specific speed) of the mixed flow and propeller type, have power curves that rise sharply with a reduction in capacity; they should be started with the discharge valve wide open against a check valve, if required to prevent backflow.

Assuming that the pump in question is motor-driven, that its shutoff power does not exceed the safe motor power, and that it is to be started against a closed or cracked open gate valve, the starting procedure is as follows:

1. Prime the pump, opening the suction valve, closing the drains, etc to prepare the pump for operation.
2. Open the valve in the cooling water supply to the bearings, where applicable.
3. Open the valve in the cooling water supply if the stuffing boxes are water-cooled.
4. Open the valve in the sealing liquid supply if the pump is so fitted.
5. Open the warn-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature. When the pump is warmed up, close the valve.
6. Open the valve in the recirculating line if the pump should not be operated against dead shutoff (if fitted) or slightly crack open the discharge valve.
7. Start the motor.

8. Open the discharge valve slowly.
9. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. If the packing is new, do not tighten up on the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
10. Check the general mechanical operation of pump and motor eg; bearing temperature, noise vibration.
11. Close the valve in the recirculating line once there is sufficient flow through the pump to prevent overheating.

If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same, except the discharge gate valve is opened prior to the motor being started.

In certain cases, the cooling water to the bearings and the sealing water to the seal cages are provided by the pump. This, of course, eliminates the need for the steps listed for the cooling and sealing supply.

Just as in starting a pump, the stopping procedure depends upon the type and service of the pump. Generally the steps followed to stop a pump which can operate against a closed gate valve are:

1) Open the valve in the recirculating line.
2) Stop the motor.
3) Close the gate valve.
4) Open the warm-up valve if the pump is to be kept at operating temperature.
5) Close the valve in the cooling water supply to the bearings and to the water-cooled stuffing boxes.
6) If the sealing liquid supply is not required while the pump is idle, close the valve in this supply line.
7) Close the suction valve, open the drain valves, etc as required by the particular installation or if the pump is to be opened up for inspection.

In general, the starting and stopping of steam-turbine-driven pumps require the same steps and sequence prescribed for a motor-driven pump. As a rule, steam turbines have various drains and seals which must be opened or closed before and after operation. Similarly, many turbines require warming up before starting.

Finally, some turbines require turning gear operation if they are kept on the line ready to start up. The operator should therefore follow the steps outlined by the turbine manufacturer in starting and stopping the turbine.

Most of the steps listed for starting and stopping centrifugal pumps are equally applicable to positive displacement pumps. There is, however, a notable exception and that is:

Never operate a positive displacement pump against a closed discharge. If the gate valve on the discharge must be closed, always start the pump with the recirculation bypass valve open.

Auxiliary Services on Standby Pumps

Standby pumps are frequently started up from a remote location, and several methods of operation are available for the auxiliary services, such as the cooling water supply to the bearings or to water-cooled stuffing boxes:

a) A constant flow may be kept through the bearing jackets, seal plates, oil coolers and through the stuffing box lantern rings, whether the pump is running or on standby service.

b) The service connections may be opened automatically whenever the pump is started up eg via solenoid valves.

c) The service connections may be kept closed while the pump is idle, and the operator may be instructed to open them shortly after the pump has been put on line automatically.

The choice among these methods must be dictated by the specific circumstances surrounding each case. There are, however, certain cases where sealing liquid supply to the pump stuffing boxes must be maintained, whether the pump is running or not. This is the case when the pump handles a liquid which is corrosive to the packing or which may crystallise and deposit on the shaft sleeves. It is also the case when the sealing supply is used to prevent air infiltration into a pump when it is operating under a vacuum.

Restarting Motor-Driven Pumps after Power Failure

Assuming that power failure will not cause the pump to go into reverse rotation, that is, that a check valve will protect the pump against reverse flow, there is generally no reason why the pump would be permitted to restart once current has been re-established. Whether the pump will start again automatically when power is restored will depend on the type of motor control logic used.

Because pumps operating on a suction lift may lose their prime during the time that power is off, it is preferable to use starters with low load protection for such installations to prevent an automatic restart. This does not apply, of course, if the pumps are automatically primed, or if some protection device is incorporated so that the pump can not run unless it is primed.