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WHITE PAPER

Pump Wear and Wear Rings

by Steve Wilson

The loss of pump performance due to wear between the rotating impeller and stationary volute (or casing) can be expected. It is inevitable. In enclosed impellers, the wear occurs typically at the outside diameter ("wear ring fit") of the impeller eye or its respective point on the pump casing. In open or semi open impellers, the wear is more generalized, and may occur completely across the suction side of the vanes or throughout the suction side of the case.

This wear will impact both mechanical and hydraulic performance, and adversely impact operating and maintenance costs, as well as possibly result in performance so poor that system needs are not satisfied. This paper will discuss those impacts and a common solution to the problem.

THE IMPACT OF WEAR

The impact of hydraulic performance is shown in *Figure 1*.

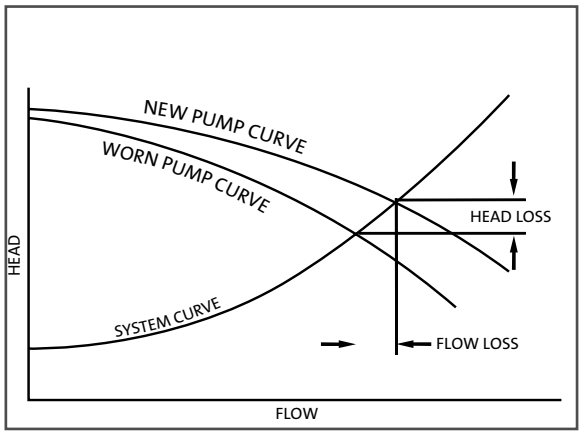

Figure 1. *Impact of wear on performance*

The actual operating points will of course vary with different pump and system curves, but the basic relationship remains the same

Several negative hydraulic and mechanical factors result. Among them are:

- The pump draws the same amount of power in its worn state as in its new state. It is actually "pumping at design point." Unfortunately, the system doesn't see this, since a portion (the exhibited "performance loss") is recirculated through the gap between the impeller and the volute. The user is paying for this recirculation in utility bills.
- The increase in recirculation directly contributes to loss of efficiency. Since efficiency is a ratio of output work against input power, and since output work (flow and head) is less with the same amount of input power, efficiency is lower. In addition, the increased suction turbulence and "pre-rotation" cause negative suction conditions which will drive efficiency down.
- As wear increases, the gap becomes larger if unaddressed, and larger "contaminants" can pass through the gap, speeding the deterioration process. In the instances where matter such as cloth, wet strength paper towels, or other stringy substances are included in the pumping (such as in non-clog pumps), the possibility of matter being lodged between the two components in increased. The lodging will result in pump binding, over amping and possible complete failure.
- The pump will have to pump longer to do its job, and system flow and head requirements

may not be met. This of course, compounds all negative factors.

POSSIBLE SOLUTIONS

There are several solutions to the problems, from utilization of extremely hard materials to the addition of wear rings or wear plates. If extremely hard materials are to be used for either volute or impeller construction, it should be remembered that even these components will eventually wear and the user should consider replacement costs and availability as well as what life extension can be expected.

These same considerations should be made when using hardened "premium" materials for wear ring/wear plate construction. Planning to replace a $1000 set of wear rings to save a $700 impeller is not the best use of capital, particularly in light of the fact that the downtime may be, and usually is, extended when replacing wear rings. The old rings/plates must be removed before the replacement components are added.

Many pumps, including many dry pit non-clog and industrial end suction pumps that are fitted with semi-open impellers are fitted with a means to adjust the shaft (and therefore the impeller) axially, thereby moving the impeller closer to the suction side of the casing. This mitigates the recirculation, but does move the impeller forward in the case, thereby opening the gap in the back (possibly allowing contaminants free access to the shaft and seal), and moving the impeller discharge position within the case (increasing the turbulence in the pump).

Utilization of low cost wear rings to protect other more expensive components is a much more acceptable solution to many users, and has become an industry standard. (Of course wear rings are not available on semi-open impellers.)

WEAR RINGS AND WEAR PLATES

Wear rings are, simply, rings of material that are affixed to either the case (volute) or impeller to protect that portion of the pump. Generally, the rings are press fitted. Material is removed from the case or impeller, depending on the type of ring, and this "removed material" replaced by the ring.

Since the idea is to allow inexpensive replacement when the wear occurs, many manufacturers have standardized on case wear rings. This greatly reduces downtime and its associated expense for the user, who would otherwise be required to remove the case from the piping and turn an inside dimension on a lathe to restore "like-new" dimensions. The approach is quite common, particularly in water pumps such as those found in commercial and industrial applications.

Impeller wear rings are typically avoided, unless extreme "wear prone" situations arise. Since the manufacturer would have to remove material from the eye of an impeller (which can be easily turned on a lathe) and replace it with like material in most cases, it is felt that the addition of impeller wear rings is best dealt with as an aftermarket retrofit. If wear is detected on an impeller, it can usually be turned down and a ring fitted to it. A common exception is in non-clog pumps. Wear plates are similar to wear rings in function, and used on pumps where the surface of the impeller eye "butts up" against a surface on the case. This is seen typically only in non-clog pumps. These plates are usually screwed into the surface of the case or impeller with flat head cap screws. If the ring is "flat," these cap screws are located directly on the wear surface, and may themselves be worn away, causing the ring to enter the impeller resulting in catastrophic failure. Because of this, many designers insist on wear plates to be "L" shaped, where the affixing of the plate is on the side, and not on the wear surface.

ADJUSTABLE WEAR RINGS

As previously discussed, adjusting the position of a wear ring or wear plate through axial movement of the shaft may pose the problem of disrupting the 'rear" of the impeller in the case.

One solution is to use adjustable wear rings. By allowing adjustment directly to the ring in the front of the pump, the frame adjustment can be used to assure correct dimensions in the rear. An adjustable wear ring is shown in *Figure 2*.

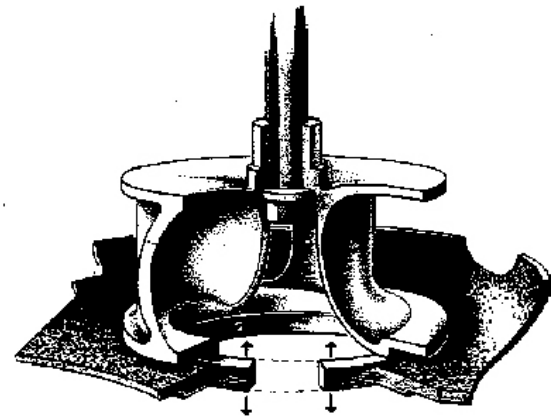

Figure 2. *Adjustable wear ring*

As wear is detected and the pumps removed from service, examination of the gap between the volute and impeller can be quickly made both visually and with feeler gauges. Setscrews on non wearing surfaces are used to hold the wear rings in place. These screws are loosened and the wear ring is moved (to locate a new set screw surface) immediately and without disassembly, restoring clearances to like new. Re-tightening the screws locks in “like new” performance. This procedure can be performed dozens of times (depending on the nature of the wear) before wear rings must be replaced.

CONCLUSION

The problem of wear between the impeller and volute can cause serious symptoms to appear. Wear rings and wear plates are effective solutions, when properly designed and applied.

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Thinking ahead makes it possible
Innovation is the essence

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