

Warman® WRT® impeller and throatbush combination set to deliver cost savings for AH® pump customers

Introduction

In line with our commitment to reduce total cost of ownership on the range of products supplied by Weir Minerals, an extensive research and development program, initiated by Weir engineers, aimed at better understanding the wear characteristics at the inlet and outlet of centrifugal slurry pump impellers was undertaken. The culmination of the project resulted in a totally new impeller and matching throatbush design which provides Warman® AH® pump users with significant advantages.

Approach

Years of infield wear data on the popular Warman® AH® 8/6 pump enabled our engineers to use a novel integrated design approach, comparing this data with our Computational Fluid Dynamics (CFD) simulation to obtain correlation between predicted and actual results for the traditional standard 5 vane slurry impellers.

The design team reviewed the various impellers on offer across the range of pumps and through careful consideration at design phase, a 4 vane option achieved the solution our engineers were looking for.

Design

In developing the 4 vane impeller, new impeller-throatbush inlet geometries were created with a focus on reducing turbulence and optimising the balance between wear and performance. From the CFD output, three dimensional CAD models were created. An iterative process produced a design which would become the new Warman® WRT® parts.

One particular 4 vane design proved outstanding in all areas. A prototype was manufactured, water tested, and then an extensive field trial conducted in an extreme application. Additional field trials assisted in confirming the data. All test results were fed back into the CFD program to validate the design and prediction methodology.

This outstanding design is aptly named Warman® WRT®, boasting an efficient streamlined entry for even and smooth transfer of the slurry particles from the inlet axial direction into the radial flow through the impeller. Smoother inlet flow and uniform velocities within the impeller vanes significantly lower the net positive suction head (NPSH) characteristics, extend inlet and associated throatbush wear life and improve overall performance.

Adding unique vanelets at the outlet of the impeller passageways maintain smooth flow from the inlet reducing turbulence, eddies and recirculation as flow exits from the impeller into the volute casing. The key aspect of maintaining uniform velocity profiles provides for extended wearlife of the surrounding pump chamber.

The end result an impeller that demonstrates improved efficiency, reduced NPSH and greatly improved wear performance assisting our customers in reducing their total cost of ownership.

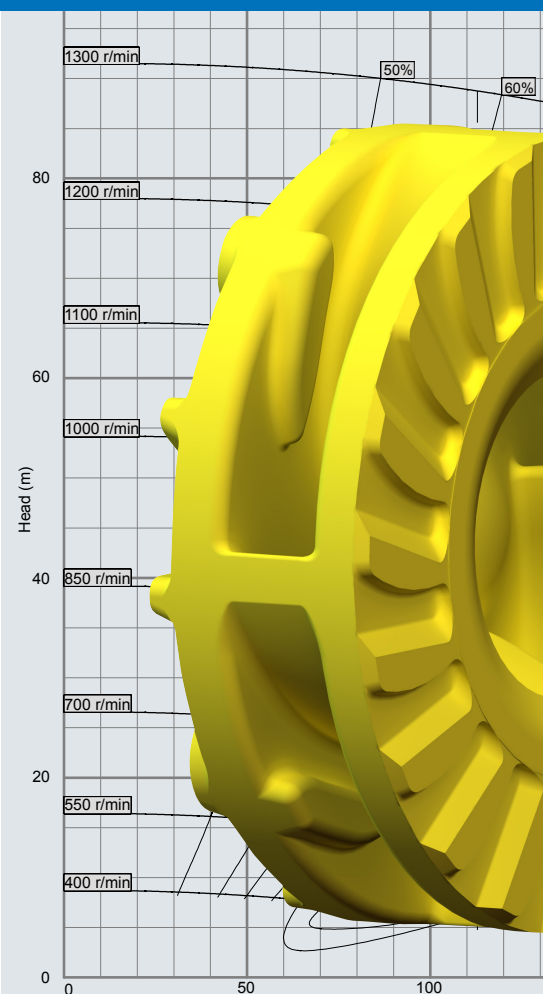


Figure 1. Simulations show reduction in wear "hot-spots", pointing the way to a better solution

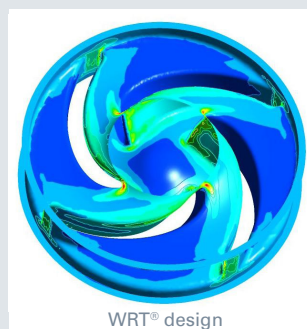
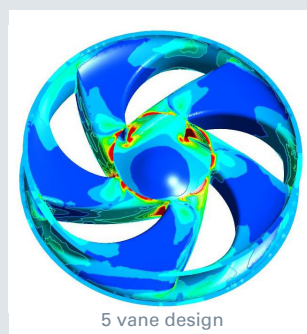


Figure 2. Performance comparison of the standard AH® F6147 versus the new WRT® impeller and throatbush combination at 1000rpm

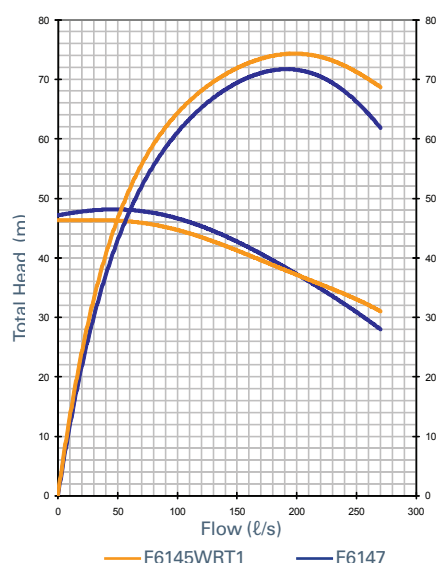


Figure 3. AH® 8/6 pump NPSH test comparison - standard Warman® impeller vs WRT® impeller

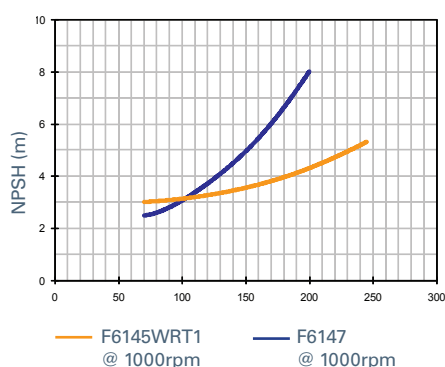
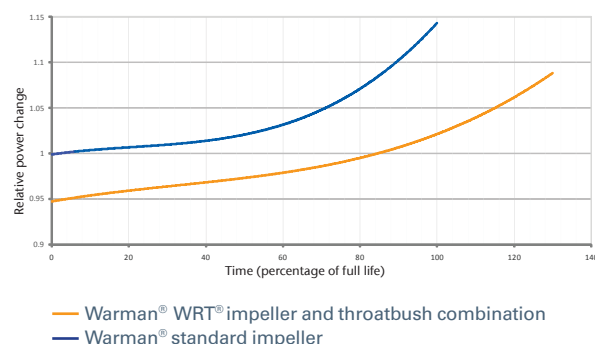


Figure 5. Lower power consumption of WRT® compared to standard Warman® impeller sustained over longer period



Five vane versus four vane design

The five vane impeller in the Warman® AH® pump range were for many years considered to be the 'standard' as their performance in terms of efficiency, cavitation, wear life and expeller sealing were the industry benchmark for general duties. To improve one or more of the performance parameters Weir Minerals used a range of four vane impellers developed for the Warman® pumps quite often with efficiency and cavitation performance improved at the expense of expeller sealing. Particle passing size was also an improvement compared to the older design five vane impellers.

The latest WRT® impeller designs maintain the four vane's advantages, but improved on all of the performance parameters - efficiency, wear and cavitation by improving the fluid guidance through the impeller with streamlined main pumping vanes, streamlined inlet, as well as vanelets at the outlet of the impeller. The vanelets help to boost the efficiency of the four vane design, and we have found that sealing is also improved when using the new side sealing vanes.

Due to these improvements in performance, the WRT® impellers represent a step change improvement compared to the older style five vane impeller design.

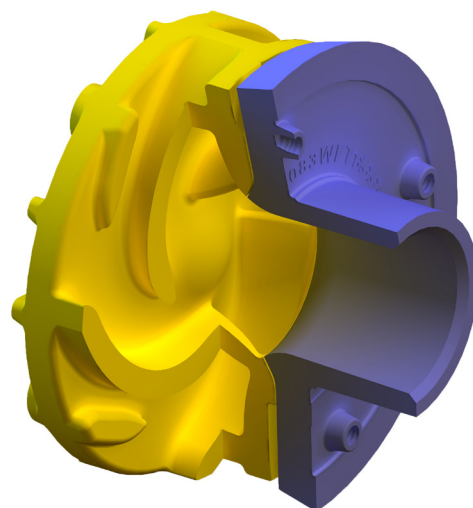
Consideration

An important and limiting consideration at design phase was to ensure that the new impeller would not alter the operating conditions of the pumps they are installed into, with performance relative to the operating speed remaining largely unchanged. This ensures that the range of WRT® parts are interchangeable and retrofittable into all current AH® pumps. The performance improvements are achieved by replacing the minimum number of parts.

Part designation

New impellers and throatbushes are characterised by a WRT1 suffix in the Warman® part number and are retrofittable in the Warman® AH® range of pumps. This is provided the mating parts are genuine Warman® manufactured parts. Impellers can be supplied with backvanes for use with gland and expeller seals or a smooth impeller backshroud (impeller types BF) for mechanical seal applications.

Figure 4. Warman® WRT® impeller and throatbush combination



Advantages of Warman®WRT® upgrade parts

- Increased productivity from modern four(4) vane impeller and streamlined throatbush
- Efficiency improvement over the part life cycle
- Additional wear performance
- Retrofittable to Warman® AH® slurry pumps
- Reduced inventory as several impeller types are replaced by one

Case Study 1 Location: New Zealand gold mine

Duty: Mill discharge

Standard Warman® Impeller F6147-A05



WRT® Impeller F6145WRT1-A05



Case Study 2 Location: Australian alumina refinery

Duty: Bauxite to slurry digestion

Standard Warman® Impeller F6058HE-A05



WRT® Impeller F6145WRT1-A05



Standard Warman® Throatbush F6083-A05



WRT® Throatbush F6083WRT1-A05



Sustained Efficiency

The Warman® brand has been synonymous with products which provide end users with a significant advantage in their process plants.

Warman® slurry pumps are designed to minimise the effects of efficiency drop-off during the useful life of their wearing parts.

The new WRT® impeller and throatbush combination with its higher sustained efficiency, provides lower power consumption over its full working life.

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Figure 6. Impeller performance test data

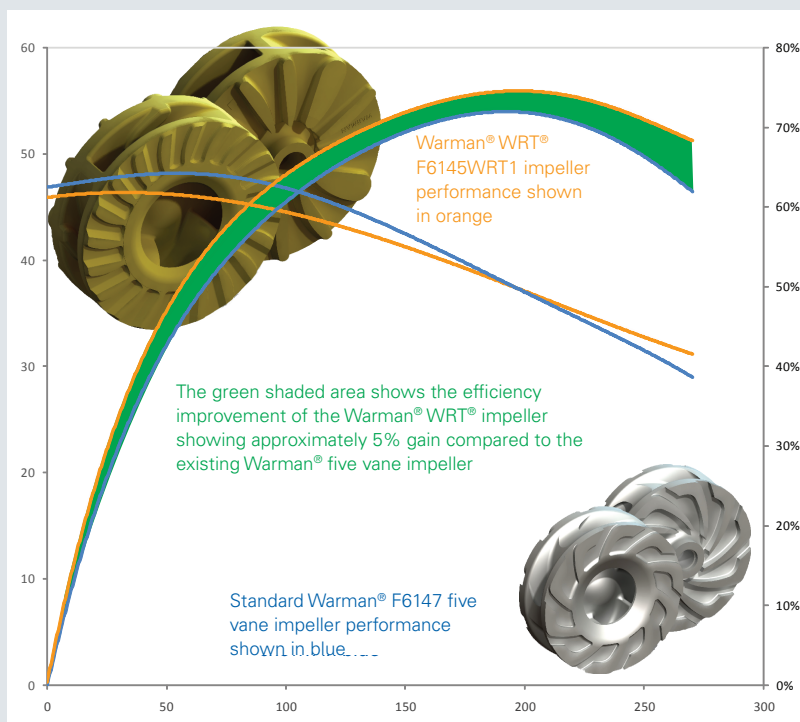
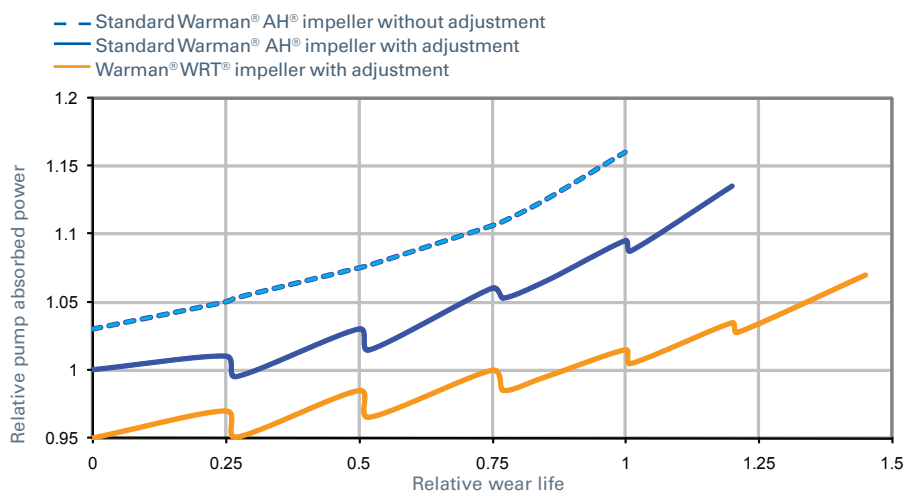


Figure 7. Pump absorbed power rises as pump efficiency drops during use, due to parts wear



The amount of power used by a pump normally rises over time as a result of wearing of internal parts. By adjusting the parts to try to spread the wear, and by using WRT® parts, the power used by the pump can be significantly reduced, and its efficiency maintained.

Please note this is a graphical representation and performance may differ depending on pump size, application and operations

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