

Warman pumps: 80-years of continuous development

In celebration of the 80th anniversary of Charles Harold Warman's first Warman® Pump, Pieter Jordaan, Weir Minerals Africa sales director for Africa and the Middle East, talks about the history and evolution of the Warman slurry pump.

Dr Charles Harold (CH) Warman started his career as a young engineer in the gold mines of Kalgoorlie in Western Australia in 1934. "While working on the mine, CH Warman came up with the concept of a slurry pump with replaceable liners," says Jordaan, "the idea being that, while material will always wear away, if a liner is used the worn material can easily be replaced," he adds.

Charles Warman also realised that by engineering a pump with individual components that are easily replaceable, he could extend the life span of the pump. "That way, a long life can be achieved from each set of wear components as well as the pump casing," Jordaan explains, adding that, in design terms, this is called maximising the wear to structural material ratio.

"If the wear to structural materials ratio is low, the material available for wear will have a relatively higher cost, as a larger portion of the component will not be utilised for wear but rather for structural purposes. Using a higher ratio of wear material, therefore, reduces the total cost of ownership of the pump," Jordaan tells *MechChem Africa*.

"This was CH Warman's revolutionary idea. He invented the concept and, in 1938, used it to build the first ever slurry pump with replaceable liners.

"From there, he started a business called Warman Equipment, which attracted interest from mines all over the world, including Africa. Then in 1969, Charles Warman sold a portion of Warman Equipment to the mining company Peko-Wallsend, while Charles Warman himself kept the CH Warman Pump Group portion of the company as an exclusive operation for Africa and the Middle East. "The reason he kept it was because of the aggressive ores found in Africa. Charles Warman was passionate about R&D and he believed that if he could develop pumps for African ores, then these would be better suited to mining operation everywhere else in the world," Jordaan explains.

In 1999, the UK-based Weir Group acquired what was then called Warman International. The CH Warman Pump Group in South Africa remained independent, until 2007, when it too was brought into the Weir fold. "And, along with Envirotech, which has been part of the Weir Group since 1996, this



now constitutes the current pump offering of Weir Minerals Africa," Jordaan informs *MechChem Africa*.

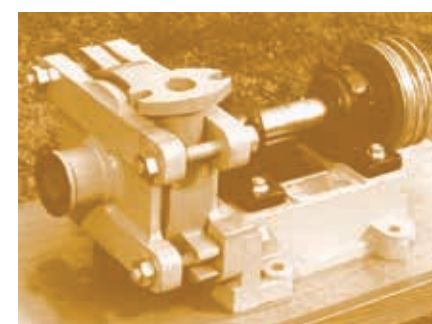
Continuous improvement

Early development by Charles Warman quickly led to the development of the Warman® AH centrifugal slurry pump range, which has been the leading Warman pump for over half a century. "Using feedback from our customers and data from engineers, we have continued to upgrade and improve this heavy duty pump over the years, by targeting important issues such as wear life, hydraulic design and the material composition of the liners.

"At the starting point of pump development is hydraulics, to keep the transfer of kinetic energy to fluid flow as efficient as possible. Impeller design, internal profiles and the positioning of the wear materials to reduce wear rates and ensure the maximum possible wear life are all critical design considerations.

"In principle, we are always striving to achieve the longest possible period between liner replacements. The longer this period can be stretched, the lower the operational costs of the pumping operations will be. Both the hydraulic efficiency and the materials used are critical in achieving this," he explains.

"Some applications work very well with rubber liners, but others need metal liners – and if these are swapped around, the results may be disastrous. Today we have numerous different material options, hard-chrome metal, corrosion-resistant steel, natural and synthetic rubbers, polyurethanes – and we even offer some ceramic liner components," Jordaan tells *MechChem Africa*.



Above: The CH Warman built in 1938 was the first ever Warman® slurry pump with replaceable liners.

Right: A Warman MCR 550 installed in a mill discharge operation. Since the wear rate increases exponentially with speed, the larger MC/MCR pumps are designed to meet the duty requirements at reduced speeds.

Left: The WRT impeller and throatbush upgrade for Warman AH pumps, due to the enhanced hydraulics involved, results in significant improvements in the wear life of the AH pump range.

"All of these are carefully chosen and tested for use in specific applications to get optimal wear from the liners for each client's slurry pumping application," he assures, adding: "While energy efficiency is always a driver, slurry pumping is not a one-solution technology. You have to match the whole pump to the medium being pumped and to the conditions that apply on each mine."

In recent times, Wear Reduction Technology (WRT) has been introduced to the AH slurry pump range. "WRT is a series of enhancements to our AH pumps – and the technology is backward-compatible with our AH pump casings. Due to the enhanced hydraulics involved, applied in the same liner materials, we have seen significant improvements in wear life on AH pumps that have had WRT incorporated into them," says Jordaan.

Inevitably, however, Weir Minerals also realised that the AH pump would need to be replaced by a new-generation pump, hence the release of the Warman® WBH range. "The Warman WBH slurry pump range, while still based on the original concept of replaceable liners, is a completely new design," Jordaan continues. "The hydraulics are upgraded, along with the mechanical end and the bearings and a number of enhanced features have been incorporated: an adjustable front end, for example, that enables single-point



adjustment of the gap between the impeller and the throat bush to minimise recirculation and associated wear," he explains.

"We have also applied the same principles to our vertical spindle pumps, and the WBV range was introduced a few years ago. One of the unique features of this pump is that it creates agitation flow underneath the impeller to disturb thick settled mud so that it can be easily pumped as slurry. We used to use mechanical agitators for this, but the new WBV relies on hydraulic agitation," he notes.

Also, recently released is the Warman® DWU range of dewatering pumps for pumping lightly contaminated water typical of the dewatering duties. "This is a bespoke pump for dewatering pits and shafts when some solids are present. Using materials of construction from our slurry pump experience, the DWU range offers high-head options of up to 130 m per stage. And a new one-piece bearing frame has been designed for optimum alignment of the bearings, seal and impeller with the front liner. This further reduces wear rates and lowers stockholding," he adds.

"Also, we have the Warman® MC and MCR pumps, which are purpose designed mill-circuit pumps, designed for the aggressive wear associated with milling. The particles involved in mill-circuit slurries typically have sharp, freshly broken and coarse edges that are highly abrasive and often have high density – and mill-circuit pumps are usually the biggest pumps on a plant.

"This is such a different application that it really pays for a customer to be using a bespoke pump tailored for mill duty. The larger MC/MCR pumps are designed to perform the duty at reduced speeds. The wear rate of impellers and liners increases exponentially with pump speed. So by selecting a larger pump that can run at a slower speed to meet the production requirements, the wear rate

can be significantly reduced," Jordaan tells *MechChem Africa*.

"Across the life of a mill pump, there is always a balance between the wear component costs and the initial capital or purchase costs. If one looks at the ratio of these costs, the initial capital cost will amount to around 10% of the total. So up to 90% of the total cost of ownership is taken up in replacement wear liners and spares.

"Shifting that balance a little by increasing the pump's capital cost can have a huge impact on the cost of the wear components across the lifetime of the mine," he notes, adding that this does not take into account any downtime, because a whole mill circuit may have to be taken offline while the pump is refurbished. "If a bigger pump results in one less shutdown over a period, the uptime and cost of spares savings that accrue will far outweigh the initial cost of the larger pump," he argues.

Jordaan says that Weir Minerals has achieved some significant successes with their lined mill-circuit pumps. "Through our Integrated Solutions offering, we investigate entire mill circuits and recommend process changes. By introducing the MC/MCR pump, adjusting the pump and pipe lining materials and rightsizing downstream equipment such as hydrocyclones, we are often able to prove very significant total cost of ownership savings, along with significant process improvements.

In cases where a mine's production has been increased from its design duty point, Integrated Solutions has achieved significant savings by optimising the wear life on the mill-circuit equipment," Jordaan says.

"At the heart of a host of mill-circuit and mine pumping applications all over the world are the descendants of an 80-year old Warman slurry pump with replaceable liners," he concludes. □



A Warman AH 14/12 pump installed at a dredging plant.