Continuous improvement of a 25-year-old slab casting machine

Using a performance-based maintenance contract implemented on a fixed maintenance cost per tonne, it has been possible to extend the service life of 25-year-old caster equipment and components and improve productivity by designing out causes of early equipment failure.

Erhard Reichel and Karl Trnka
VOEST-ALPINE Industrieanlagenbau GmbH & Co (VAI) and VAIS do Brazil, Ltda

There are several ways to modernise or update a 25-year-old caster. The plant engineer may prepare a modernisation scheme and award a contract for the project. The advantage of such an approach is the rapid modernisation of the machine to improve quality in terms of slab manufacturing tolerances and to allow new steel grades to be cast. This, however, requires considerable financial investment and to make such an investment economically viable the capacity of the caster would also normally be increased. It becomes problematic, therefore, to adopt this approach if there is insufficient hot metal available to satisfy the new increased capacity of the machine, as increasing the hot metal production capacity requires even greater expenditure. There also has to be a market for the additional slabs and sufficient spare capacity in the hot rolling mill.

An alternative is for the steel company to modernise the existing caster on their own. Although this may be cheaper, such homemade modernisations are not easy. Modern engineering equipment will be needed and such a project incurs considerable administrative effort, for example: a design has to be produced, requests for proposals need to be prepared, and negotiations with multiple suppliers consume time, which then have to be coordinated and supervised.

Furthermore, investment funds might only be allocated in small portions over many years.

An attractive alternative is to outsource off-line caster maintenance to a competent partner who is interested in the modernisation of the old caster in order to make his own business more profitable – a performance-based payment model. An example of such a model is presented which is of considerable benefit to the steel producer. It does not, however, apply in situations when, for example, new steel grades have to be cast requiring significant use of new technologies or plant modifications.

Long-term maintenance out-sourcing contract
VAI (VOEST-ALPINE Industrieanlagenbau) has provided maintenance services for the refurbishing of moulds and segments of continuous casting machines since 1984 and the contractual set-up for the provision of off-line maintenance services has developed continuously since that time. Initially, they were rendered on the basis of fixed repair menu prices and, although this contractual model brought a cost reduction for the customer when compared to the previous off-line maintenance cost, it did not provide a real incentive for the service provider to improve the maintainability and availability of the casters, as extending a unit’s lifetime leads to a reduction of sales for the service partner. The

![Figure 1 Improved rotary joints with centric positioning and dense sealing](image-url)
The same lower maintenance costs and reduced operational stoppages

Example No.1 Mounting of rotary joints
The rotary joint of a caster roll was attached via a flange with four bolts. The problem was that the tolerances of the bolts and the holes of the rotary joints were such that cooling water could pass between the flange of the rotary joint and the face of the shaft of the caster roll. This design led to inadequate cooling and higher wear of the caster rolls. To solve this problem VAIS do Brasil engineered and manufactured bushings to ensure a centric position of the rotary joints and a dense sealing of the rotary joints (see Figure 1).

Example No.2 Stainless steel bolts
Corrosion is a major problem with continuous casting machines, especially if the water is soft – typical in regions where limestone is absent. Rusty bolts often broke, requiring a premature change of the bow segment. To avoid this, selected carbon steel bolts were replaced with ones made from a suitable stainless steel (see Figure 2).

Example No.3 Water-cooling piping
The caster mould water-cooling piping was located at a position where the piping vibrated and consequently often broke. This led to a need to change the mould more often than otherwise necessary. The piping was modified and relocated on the mould as shown in Figure 3.

Example No.4 Relocation of grease distributor
Cooling water was running over the grease distributor and caused considerable corrosion, failures during production, and the need to change this caster unit earlier than through normal wear. VAIS do Brasil designed and manufactured protection for the grease distributors and the entire system was installed in a different position (see Figure 4).

Example No.5 Hydraulic pipes
The hydraulic pipes were made from conventional carbon steel, which resulted in continuous corrosion
problems. The pipes leaked from time to time, stopping production and making the exchange of this caster unit necessary. The pipes were replaced with stainless steel, as is normal on modern casters (see Figure 5).

Example No.6 Corrosion protection of frames
The aggressive cooling water caused the frames of the segments to rust excessively, leading to high repair costs. To avoid this stainless steel plates were welded onto the frames to protect critical sections as shown in Figure 6.

Example No.7 Foot rolls with overlay welding
Initially the service life of the foot rolls was below or comparable to the service life of the mould copper. However, following the practice of nickel-plating the mould coppers to increase their lifetime, the foot rolls became a bottleneck for extended production. To increase the service life, the foot rolls were overlay-welded with stainless steel, which led to the desired improvements in lifetime and reduced repair work (see Figure 7). After 480 heats the foot rolls were still in good shape and are only polished before remounting.

Concluding remarks
Over a four-year period VAIS do Brasil – a company of the VAI Group – has considerably increased the service life of the moulds and segments of a customer’s 25-year-old slab caster by designing out causes of early equipment failure. This was achieved at no extra cost to the customer. Furthermore, unplanned interruptions in production caused by mechanical problems related to the moulds and segments have been virtually eliminated. Figure 8 shows the increased lifetime of the first segment after the mould over the last four years. Figure 9 shows the same improvement for a bow segment. Although impressive, it should still be
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