SUGAR MILL ROLLERS THAT LAST A SEASON

More than 2 million tonnes crushed ... NON-STOP!!!

Exclusive to:-

ABRASION RESISTANT MATERIALS PTY LTD
INCE around 1973, the sugar industry has used chromium carbide hardfacing products either applied with electrodes or wire. This technique has provided a reasonable level of grip, but needs to be constantly "touched up" or maintained.

An article published by the Welding Technology Institute of Australia states that this method (of welding chromium carbide hardfacing onto the mill roll shells) deposits less than 50% of the welding consumable, with the balance being lost as waste.

This wastage of material alone, could amount to approximately US$25,000 for each sugar mill.

**Intrigue and Curiosity Leads to Patent-Pending Applications**

Initially, it was intrigue and curiosity that led Tim Falkenhagen, the managing director of Abrasion Resistant Materials Pty Ltd (A.R.M.*) to consider whether certain hardfacing processes and welding techniques with which he had been experimenting in other industries, could be combined to manufacture a new type of roll shell, and perhaps be applied via a "plurality of layers" onto existing Gray cast-iron sugar mill rolls.

Tim Falkenhagen came up with some ideas that he felt could overcome the "wear mechanics" that plagued sugar mill rolls during the crushing season, and after filing patent pending applications of his ideas, set out to put them into practice.

Up until this time, there were no products or options commercially available which allowed a sugar mill roll to last a season without needing to be regularly arc-welded for grip.

This was all about to change with the A.R.M.* Hardfacing technique/s that Tim had...
invented and is in the process of refining.

In 1997, an opportunity arose to work with the Sugar Research Institute (SRI) in Mackay on a mill roll project to demonstrate the effectiveness of Tim’s invention.

**The 1997 Mill Roll Trial at South Johnstone Mill**

In the 1997 season, it was decided to trial the A.R.M.* Hardfacing invention by applying it to the centre 42 teeth on the top roll in No.4 mill (a 7ft roll with a 1” pitch) at South Johnstone Mill.

The trial was a SRI-syndicated project involving all sugar mills in Australia, with SRI nominated by A.R.M.* to report the outcome of the trial as it found them.

A.R.M.*’s preparation included transporting over 300klms, more than three tonnes of specialised welding equipment, and involved a specific procedure developed by A.R.M.* to apply the now-patented Hardfacing.

Part of the procedure involves machining the mill roll teeth to a particular profile, prior to the welding of the Hardface material to the teeth.

It was during this machining process that the special lathe tool became broken and was inoperable. It would take two weeks for the lathe tool to be replaced.

However, the A.R.M.* crew were able to use this “occurrence” to improvise, and the breakdown turned out to be a blessing in disguise, as it allowed extra scope for experimentation.

During this trial A.R.M.* evaluated seven (7) different combinations of tungsten carbide hard-facing applied to a Gray cast-iron roll shell.

All of the seven options lasted with good grip, up till about the 300,000 tonne mark. It was at about this point that some teeth started to polish smooth, and began losing grip.

However, one trial section of the A.R.M.* teeth lasted the entire season of 1,092,627 tonnes, with very little wear (see photo #14). There was no doubting that particular option could have gone on to last a lot longer.

Statistics showed in the 1997 trial the A.R.M.* Hardfaced centre-section of the mill roll only lost around 5mm in diameter, with the side of the teeth wearing only approximately 3mm.

The other sections of the mill roll (which used the standard chromium carbide hard-facing) were arc-welded at least fourteen (14) times, and lost around 25mm in diameter.

The results from this first test proved to be very encouraging, and led to a larger project being approved for the Tully Mill in 1998.

**The Tully Mill Project... 1998 – 1999 – 2000**

The Tully Mill project was another syndicated project funded by the Australian Sugar Mills and A.R.M.*. SRI was again nominated by A.R.M.* to report the results as it found them.

The 1998/99 projects were coordinated and reported by Dr Sander Kroes from SRI (now at Fiji Sugar). His paper was published in the 1999 ASSCT notes and is a true account of the trial.

**Summary of the Tully Mill Roll Trials in 1998, 1999, 2000**

The A.R.M.* Hardfacing applied in 1998 was of a greater depth on the mill roll compared to the 1997 trial.

All three rolls used in the 1998 trial lasted up to about the 1.2 million tonne point without any welding maintenance for grip.

The Feed and Delivery rolls were maintenance free for the entire season of 1.9 million tonnes. The diameter loss on all A.R.M.* Hardfaced rolls was around 5mm.

The top roll in the 1998 trial suffered a higher wear rate and lost material from the side of the teeth, just below where the A.R.M.* Hardfacing stopped. This resulted in an “undercut” wear on the roll teeth, which at a point of approx. 4mm thick, the A.R.M.* Hardfacing would break off.

To overcome this problem, in the 1999 trial a new top roll was installed in No.2 mill with additional A.R.M.* Hardfacing applied.

The delivery roll used in the 1998 trial was re-used for the 1999 season. A new A.R.M.* Hardfaced top roll was also installed in the No.4 mill (which has a 7ft roll with a 1.5” pitch).

The top roll in No.2 mill lasted the entire 1999 season with about only 10% of the A.R.M.* Hardfacing being detached.

The undercut wear (or more correctly – roll...
M.* Mill Roll Tooth Profile. Developed specificity of Layers* of Tungsten carbide hardfacing yet still retain a triangular shape after welding.

* Out-sourcing of all milling train maintenance
* Reduction in welding consumable costs
* Increased crushing rate improves factory production throughput.
* Feeding problems eliminated.
* Reduced crushing season duration due to less downtime.
* Reduction in welding consumable costs (estimated at 50%).
* Out-sourcing of all milling train maintenance (under a patent license).

**How can the A.R.M.* Hardfaced Mill Roll Increase Profits?**

As per the example overleaf the commercial impact to sugar mills as a result of converting to the A.R.M.* hardfaced mill rolls has been estimated to be US$445,000 for every million tonnes crushed.

No doubt this figure will vary, but clearly the net revenue increase will be significant.
Estimated revenue increase when using A.R.M.* mill rolls

There has been discussion recently on estimating the Net Benefit delivered to a sugar mill as a result of using the A.R.M.* Hardfaced mill rolls.

The input and output values when doing this exercise will vary according to each mill’s situation.

Some of these include:
- Increased revenue by a lift in the average juice extraction.
- The extension of the total roll shell life.
- Reduced labour costs.
- A reduction in the crushing season length.
- Welding equipment capital cost reduction.
- Welding consumable costs reduced.
- Labour savings.
- Freight costs reduced.
- Workplace Health and Safety risk reduction.

These are just some of the costs incurred in a sugar mill which could be affected by the A.R.M.* invention.

The actual amount of increase in terms of net revenue and cost reductions cannot be exactly determined until a complete milling train has been converted and in use for a some time. Until this occurs, A.R.M.* have estimated these to be as follows (based on a single train 20 x roll mill which crushes 1,000,000 tonnes in 100 days.):

**Estimated net revenue using standard hardfaced mill rolls compared to A.R.M.* Hardfaced mill rolls (per day)**

- **US$109,000 per day**

**US$111,000 per day**

**Using A.R.M.* Hardfaced mill rolls**

**Estimated benefit when using A.R.M.* Hardfaced mill rolls (per annum)**

- **US$445,000 per annum**

**US$245,000 per annum**

**Maintenance Cost Savings**

**NOTE:** The Combined total Net Benefit is the Net Revenue increase plus the Maintenance Cost Savings.

As per the figures above, there could be a net benefit delivered in the vicinity of US$445,000 per annum (or US$0.445 per tonne).

A.R.M.* is looking for a sugar mill (preferably a double train mill) to assist in conducting further research to confirm these estimates.

This could be conducted in any sugar mill (including those outside Australia) and where possible, convert the existing mill roll shells.
Features & Benefits of A.R.M.* Hardfaced “maintenance-free” Sugar Mill Rolls

- A.R.M.* Hardfaced mill rolls can last an entire season (now proven over 2.0 million tonnes)
- Delivers far superior grip than rolls using standard chromium carbide hardfacing.
- Increases mill crush-rates (the demonstrated increase available so far is +23%).
- Can double the life of the roll shells.
- Minimises roll shell diameter loss (as little as 5mm per season).
- Eliminate roll arcing labour costs during the crushing season.
- Benefit from consistent juice extraction rates (record of optimum extraction shown whenever used during mill trials).
- Reduces welding consumables and welding equipment costs.
- Estimated net benefit to be over US$200,000 p.a. for each million tonnes crushed.
- Access to this technology is available only from Abrasion Resistant Materials Pty Ltd via various patents, and patent licensing. A.R.M.* currently holds patents for the Hardfacing Invention in Australia; South Africa; Thailand; Pakistan; U.S.A., and the Philippines. Patents are also pending in Brazil; Mexico; and India.

Increase profits... reduce costs