State-of-the-art consumables for the sugar industry

Franz Rosenblattl, Business Development Manager for voestalpine Böhler Welding Wear Protection and Special Applications, outlines the successful development in Brazil of a new consumable metallurgy for enhanced performance and weldability during roller arcing in sugar mills.

The sugar industry is one of the oldest and most influential sectors in the global agricultural economy. From colonial roots to modern-day industrial production, sugar has shaped economies, diets and trade policies across the globe.

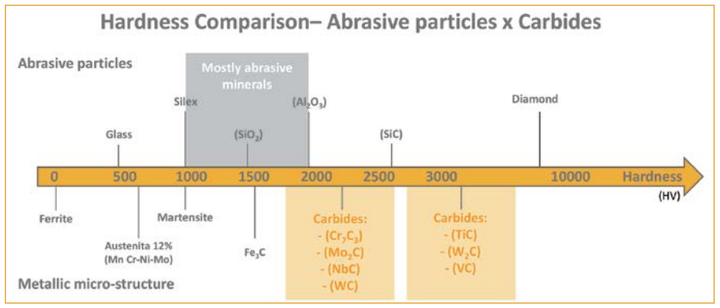
Today, the sugar industry faces a complex mix of opportunities and challenges, ranging from changing consumer preferences to the need for continually increasing production volumes to remain competitive in the global market. Many of these problems can be mitigated by optimising mill performance using better welding technologies.

Welding is a critical factor in several stages of the sugar milling, including:

- The efficiency of the sugarcane preparation system.
- Maintaining hydraulic load, oscillation and rotation.
- The surface conditions of the mill rollers.
- The opening setting of rollers during milling.
- The adjustment of trash plates.
- The feed of cane/bagasse into intermediate mills.

Enhancing the extraction index

In a sugar mill, the most important parameter for its efficiency is the extraction index.

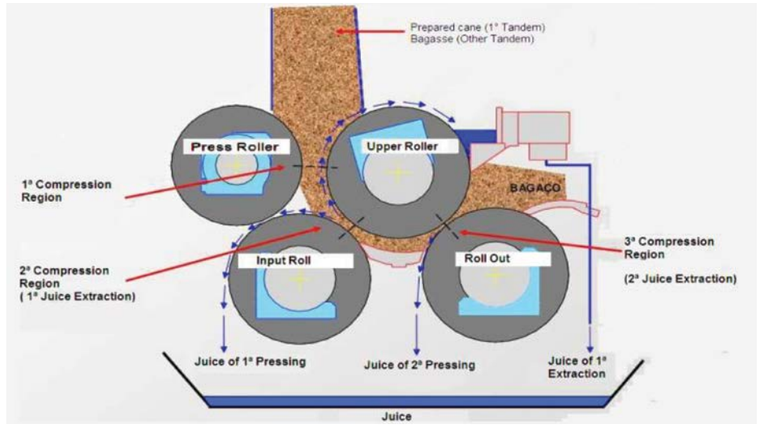


A comparison of the hardness profiles of various hard materials with the new UTP Vanadium consumable.

UTP, part of the voestalpine Böhler Group, has partnered with a leading sugar mill in Brazil to enhance this key production index.

Their joint initiative focuses on optimising the extraction process through the application of hardfacing technology – a wear-resistant coating technique that significantly extends the lifespan and performance of processing equipment. By reducing mechanical wear and improving operational efficiency, this innovation aims to boost overall sugar yield and reduce downtime, offering a strategic advantage in this highly competitive industry.

Applying roller arcing in mills is a basic operation at production plants during the on-season. The arcing application is carried out via a manual welding process using coated electrodes. The hardfacing material deposited during roller arcing protects the inside of the mill from wear and tear caused by sugar cane impurities such as grit and soil, improves sugar cane input levels, and aids juice extraction.



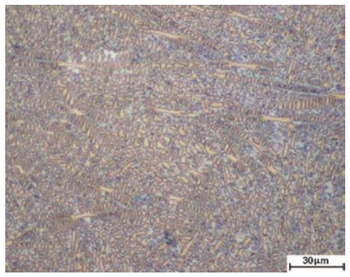
The cylinders or rollers of a sugar mill are arranged so that the intersections of their centres form isosceles triangles.

The sugar milling unit

Classically, a milling unit is composed of cylinders or rollers arranged so that the intersections of their centres form isosceles triangles. Cylinder spacings are set depending on their positions to optimise the extraction of juice, which is used downstream to produce sugar or ethanol.

A tandem mill in sugar cane processing consists of a series of roller mills. Each mill typically includes three rollers, two at the bottom and one at the top, through which the cane passes. The crushed cane (bagasse) moves from one mill to the next, with each stage extracting more juice. A tandem roller mill configuration increases extraction efficiency and throughput.

Sugar roller arcing using hardfacing welding consumables is used to improve mill efficiency for several reasons. First, it assists in feeding the cane by increasing the compaction load applied to the bagasse layer. This also helps to minimise reabsorption. In addition, roller arcing helps protect the sides of the grooves against wear, it increases the tonnage of cane that can be processed per season and raises the milling speed (t/hour).



The microstructure of the weld deposited by the new UTP Vanadium SG consumable includes eutectic carbides in martensitic matrix, with chromium and vanadium carbides.

UTP solutions for roller arcing in the sugar industry include alloys based on abrasive mineral impurities and other novel alloy concepts. Hard facing electrodes and cored wire consumables are available, with the UTP VANADIUM product line offering tailored solutions for the sugar sector.

The existing roller arcing consumable

Several years ago, UTP developed a specialised electrode specifically designed for arcing applications in the sugar industry. This electrode still stands out from standard products available on the market due to its unique composition and performance characteristics. It has been successfully implemented in various regions, including South Africa, where it has demonstrated excellent wear resistance, improved arc stability, and enhanced deposition efficiency. This electrode is currently known as UTP Vanadium 500.

Designed for resisting low to moderate wear, UTP Vanadium 500 promotes the formation of a hypereutectic alloy containing chromium carbides along with small amounts of vanadium carbides.

The new state-of-the-art consumable

In a recent breakthrough, UTP has been able to develop hypereutectic carbide alloys containing higher amounts of vanadium carbides than UTP Vanadium 500, which can resist much more severe wear conditions. This electrode is currently being called UTP Vanadium SG.

Table 1 highlights the compositional and performance differences between the existing and the new consumable designs.

Advantages of the new design

The new design promotes a martensitic matrix rich in chromium and vanadium carbides, offering one of the highest available levels of wear resistance. The consumable metallurgy replaces the formation of hypoeutectic carbides with hypereutectic carbides, along with the formation of several other carbides with hardness and abrasion resistance superior to previous-generation hypoeutectic carbide consumables formulations.

On the left, the new UTP Vanadium SG consumable for roller arcing produces a sharper grip with more arcing material than the original UTP Vanadium 500 consumable on the right. This not only enhances the wear resistance of the crusher rollers but also improves the sharp grip, which leads to increased production efficiency.

The interactions between the elements vanadium, silicon, chromium and carbon in the new severe duty metallurgical design not only improve weldability and wear resistance but also leave the surface of the teeth of the mill rugged. This improves the 'sharp grip', resulting in a considerable increase in the tonnage of sugar cane that can be milled and raises the potential milling speed.

For the UTP Vanadium SG electrode, specifically tuned parameters have been optimised, most notably the weldability when applying the consumable in a liquid sugar syrup environment, and the ability to achieve the 'sharp' surface finish. This has been achieved by increasing the silicon (Si) content to modify the viscosity of the molten weld metal. Higher Si content contributes to arc stability by producing a more stable and controllable arc and improving wetting behaviour under these harsh conditions.

Silicon also promotes the formation of ferrite, which enhances the hardness and strength of the weld metal.

Conclusions

By optimising the composition of carbide-forming elements, the service life of wear parts in sugar mills can be significantly extended. With decades of experience in this field, voestalpine Böhler Welding UTP is the market leader in Brazil and, through collaboration with renowned sugar plants, a pioneer in developing innovative solutions for wear protection.

UTP is currently working on a project to realign its wear protection segment, which will include renaming existing products. UTP Vanadium 500 will continue to be offered in parallel to the new alternative solution, but both consumables will be renamed.

welding.middle-east@voestalpine.com

UTP roller arcing electrode	Typical chemical composition (%)	Typical Hardness	Wear resistance	Weldability
Original: UTP Vanadium 500	5C, 23Cr, 0.4V	60 HRC	Moderate	3
Severe duty: UTP Vanadium SG	4C, 28Cr, 0.6V	62 HRC	High	5

Table 1: A comparison of the composition and performance of the original UTP Vanadium 500 hardfacing electrode for roller arcing and the new severe duty UTP Vanadium SG consumable. Key weldability criteria: ignition and arc stability. Scale: 1: poor, … 5: excellent.