Hot news for EAFs

Consteel technology is gaining ground because of its sustainability advantages and feedstock flexibility, and a new mini-mill in Brazil will be the first to use a combination of scrap, pig iron and hot metal writes Francesco Memoli.

With abundant raw materials, low labour costs and modern technology, Brazil is looking to become a major player in the global steel industry. The country is racing to keep up with demand and investing billions of dollars to increase its capacity. In 2004, production growth totalling over 30% over the next four years was expected, but the investments were behind schedule and actual growth over the next three years was only 2.7%.

But the situation is quickly changing: Brazil increased its annual raw steel production by 9.3% in 2007. To stimulate investments and growth in basic industries, its federal government launched a new production development policy (PDP) with a budget of $125bn. In 2007 Brazil produced 33m tonnes of raw steel and by 2012 this is expected to increase by 15m tonnes. The PDP, announced by president Lula on May 12th, has the key aim of positioning and maintaining Brazilian companies among the top five players in their sectors, especially in mining and steel.

Among the new investments in steel is a greenfield project recently awarded to Tenova by Vallourec & Sumitomo Tubos do Brasil (VSB), a joint venture of France's Vallourec and Japan's Sumitomo. This will include a 140-tonne Consteel® EAF system installed in a 1m tpy seamless steel tube mill to be built in Jeceaba city, Minas Gerais.

This will be the first electric steel mill in the world to use an innovative metal feed mix of scrap, hot metal and cold pig iron. The furnace can be charged with up to 80% solid and liquid pig iron, including more than 50% of hot metal.

FLEXIBLE MIX

Tenova's Consteel is claimed to be the only proven technology capable of handling such a flexible metallic mix, and this fact will be very important for prospective installations in Brazil, which is one of the largest iron ore producers and where hot metal production will be standard for new mills.

Hot metal is extremely beneficial for increasing electric arc furnace productivity and achieving short tap-to-tap times. It provides benefits similar to pig iron with the added benefit that it is already at 1,300°C or more, thus providing a major portion of the energy requirement of the EAF. One tonne of hot metal at 1,430°C supplies approximately 250 kWh in the form of heat.

In the past there were limitations as to how much hot metal could be used in the furnace, but with advancements in EAF and process technology, high-speed carbon removal from hot metal can be achieved in the furnace without losing yield or over-loading the off-gas system. The economic feasibility of a hot metal charge in an EAF has increased from a maximum of 50% to as high as 80%.

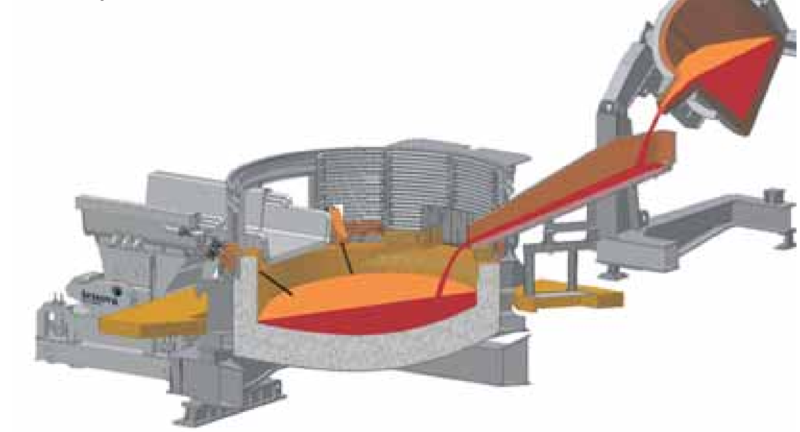
In fact, the use of hot metal in mini-mills has increased substantially in recent years, especially in China where power costs fluctuate considerably on a seasonal basis. The availability of pig iron and hot metal trebled in China between 2000 and 2006, and owing to the rise in scrap prices in the same period it has become more economical to charge substantial quantities of hot metal to EAFs rather than scrap.

This has been applied in the Consteel plants of Shiheng Special Steel (which uses 30% hot metal), Xining Special Steels Group (30%), Shaoguan Iron and Steel (up to 70%), Wuxi Xuefeng (up to 80%), E'cheng Iron & Steel (30%) and Tonghua Iron & Steel Group (30%). Another example is Wheeling Pittsburgh Steel in the USA where over the period June to December 2007 the EAF was charged with either 100% scrap, 65% scrap plus 35% hot metal, or 30% scrap plus 70% hot metal.

Tenova

Adding hot metal to a Consteel EAF via a tilting ladle at Wheeling Pittsburgh Steel

Hot metal pour into Consteel EAF



All these plants use Consteel to preheat and continuously feed scrap, and the majority of them use an automatic ladle tilting device to continuously supply hot metal to the EAF.

Although the geometry of a conventional EAF is not designed for large quantities of hot metal, the large hot heel typical of Consteel geometry is a good compromise for mixing large quantities of liquid charge together with a solid charge. With a large heel size and continuous flat bath operation, one can take advantage of larger heel sizes to melt scrap more quickly, using a melt regime where the liquid steel bath is properly stirred, and the temperature is kept uniform by continuously adding hot metal.

Basic oxygen furnaces, on the other hand, are designed to use relatively small amounts of scrap and high rates of oxygen injection to remove the carbon present in the hot metal. These furnaces, taller than an EAF, cannot work properly when the cold charge (scrap or solid pig iron) is over 20-25% of the total metallic charge.

Invented in the late 1980s and developed during the last two decades, Consteel technology has established a reputation as one of the most advanced and efficient systems for steel production. Between 2008 and 2010 it will expand at the average rate of 5m tpy each year, to reach an installed capacity of 30m tpy of liquid steel.

NEW PLANTS

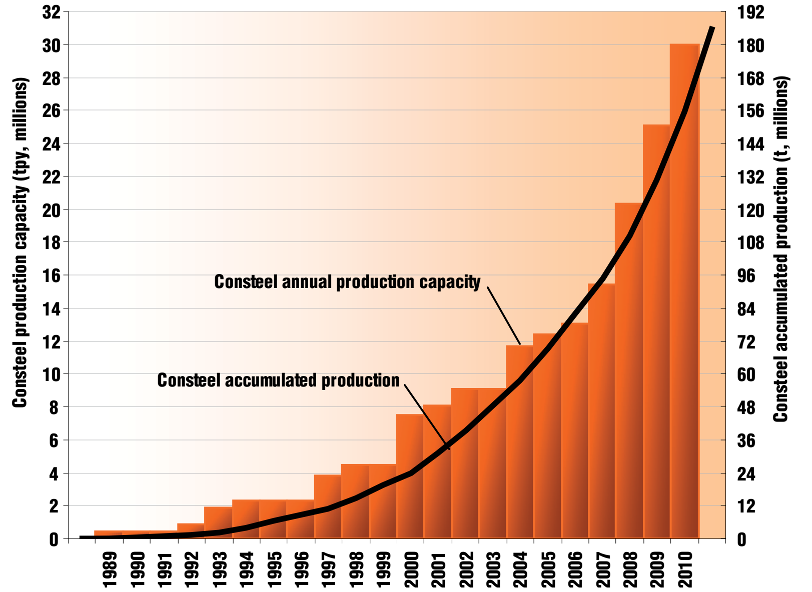
Three new greenfield plants and one retrofit Consteel will begin operations by the end of 2008, raising the total global capacity to 20m tpy, while the accumulated production of the existing 22 plants already in operation will reach more than 100m tonnes of steel.

For the next two years, 10 new projects are already under way – three retrofit and seven greenfield plants – bringing the total number of plants to 35, including VSB in Brazil.

Besides process flexibility, two other features in particular have been decisive in Consteel's success: energy saving and environmental sustainability.

Just a few years ago the international community was still debating the possible alternatives to conventional EAF design. Over 15 years, all the main suppliers to the steel industry have tested new designs of scrap pre-heating and melting equipment. The most significant example is the "shaft" concept, developed in Europe and Japan by different companies.

Consteel® production worldwide



Source: Tenova

Consteel and shaft furnaces both started with the first installation in 1988-89, but shaft systems expanded more quickly, aided by the attraction of its preheating data. However, in the last nine years, when energy and raw material prices have risen steeply and environmental regulations have become more and more strict, the Consteel system has highlighted its essential characteristics of saving energy and increasing production while minimising environmental impact. Today the number of Consteel installation projects is higher than those for shaft furnaces, and the world total in operation is expected to overtake the latter next year.

It has been clear since 1999 that Consteel has an energy consumption advantage. In a study on primary energy savings released by the Climate Protection Division of the US Environmental Protection Agency (EPA), savings of up to 0.66 GJ/t were calculated for Consteel compared with a conventional EAF, and 0.63 GJ/t for a shaft furnace. But sometimes the market needs time to absorb the scientific data.

At the recent ASITech2008 conference in Pittsburgh, on May 5-8, it was notable that ten out of thirty papers relevant to electric steelmaking were discussing Consteel, but only two of them were presented by Tenova, demonstrating how the technology is now part of a shared steelmaking knowledge.

Environmental sustainability is making Consteel increasingly attractive in today's market. It is no coincidence that the latest contracts signed include plants in Norway (Celsa Nordic), in Japan (Tokyo Steel) and in Italy (Acciaieria Arvedi), all countries with advanced environmental regulations. In addition, the projects at Tokyo Steel (developed in cooperation with Danieli) and at Arvedi will be the most productive plants of the world, with a nominal output of 300-330 tph of liquid steel.

Markets have acknowledged the importance of Consteel with several repeat orders. In China, where there are already nine installations, a tenth plant has being recently ordered, by Anshan Steel. Vietnam has three projects – with one already operating – and is investing in this type of furnace because the electrical grid is low power and Consteel can adapt itself to this situation.

The group with the largest number, Gerdau, has three Consteel meltshops and has decided to invest in a fourth for its 1m tpy Estructurales Corsa greenfield plant in Mexico.

Consteel is expected to continue to gain ground as a powerful alternative to conventional EAF design, and as a reliable technology for handling flexible feedstocks, including a high utilisation of both hot metal and pig iron in the charge.

■ *The author is area manager, North and South America, Tenova Group.*