Direct solution treatment for efficient annealing

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An innovative technology which is bringing benefits to stainless steel wire producers is Direct Solution Treatment and the company Linde has, in recent years, installed it at Fagersta Stainless, Sweden; POSCO Specialty Steel, Korea; and Dongbei Special Steel, China.

In the Direct Solution Treatment (DST) process, annealing and quenching take place fully in-line with the hot rolling operation. The wire products leave the hot rolling line annealed and they can be further processed without conventional heat treatment in batch furnaces. Thus the amount of products inmanufacture, the required labour force and internal transportation are reduced.

The REBOX® DST roller hearth furnace is placed directly after the laying head in the rolling line. This means that energy utilization is substantially improved. When the wire rod is entered it typically has a temperature of 900°C and this temperature has therefore only to be increased by some 200°C to reach annealing temperature. Energy savings are further enhanced by the use of energy-efficient flameless oxyfuel combustion, which provides uniform heating and leads to very low emissions of CO_2, and NO_X.

Higher yield, better quality

The formation of scales mainly depends on the time the material is kept at high temperatures. In REBOX DST, the annealing process only takes two-to-three minutes compared to a much longer time in batch furnaces: scaling losses can be reduced by ten tons or more per 1,000 tons of steel produced. As a result, great benefits are gained in the quality of the wire rod. A tensile strength deviation of less than +/-10 N/mm^2 within a coil of wire rod is achieved. This is a considerable improvement on off-line annealing. Furthermore, the surface is smoother and, with fewer process steps, the risk of damaging the surface is reduced.

The typical guaranteed parameters at a REBOX DST installation include grain size, tensile strength deviation, throughput capacity, fuel consumption, and NO_X emission. Low calorific fuels can be used; at Dongbei the fuel contains about 6 MJ/Nm^3.

Easy retrofit in existing lines

This type of roller hearth furnace is followed by a water spray cooling unit to cool the wire rod. Water is sprayed uniformly over the loops of wire rod and also between the layers. This method gives very uniform and rapid cooling, creating good properties of the wire products.

When installing DST air cooling (Stelmor Conveyor) is replaced while all other equipment is kept as they are. Steel grades not suitable for DST are processed outside the assembly on a parallel roller table or an air cooling unit (Stelmor Conveyor). Either the DST furnace is moved out of the line when not in use or the wire rod flow is by-passed next to the furnace.

The technique has demonstrated significant advantages over conventional wire rod annealing and is suitable for both greenfield plants and retrofits.

The Direct Solution Treatment furnace at Fagersta Stainless. Note that it can be shifted sideways to allow the roller table on the left to replace the furnace in the line.