

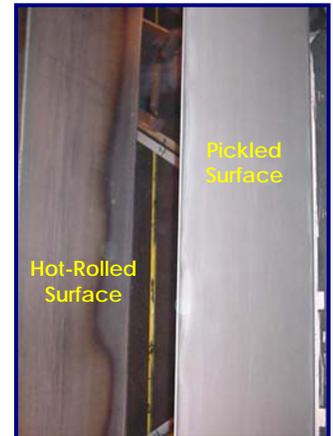
The Pickling Process



CSI's pickling line started up in late 1994, and typically processes two out of every three coils produced at the Hot Mill. Its primary function is to remove the thin layer of oxidized iron, or scale, that forms on the surface of the steel at the temperatures employed during hot rolling.

The unit is capable of pickling 1.2 million tons per year of steel up to ¼" thick and 62" wide. This includes all Cold Roll and Galvanize products, as well as Pickled and Oiled hot roll (P&O) purchased by customers who desire a surface quality more conducive to painting or plating.

Scale itself is chemically very similar to rust, being made up of iron and oxygen bonded together in various molecular arrangements. Like rust, scale develops at the steel's surface where the iron is exposed to air, except that it forms at higher temperatures such as those used during hot rolling. The scale layer grows deeper into the steel over time at a rate that increases rapidly as the temperature rises; for instance, slabs exit the reheat furnace at the Hot Mill with a layer of scale up to 1/8" thick. The typical layer of scale, or 'scale jacket', being pickled is less than one thousandth of an inch thick and has a dull gray appearance.



The heart of the Pickling Line, its acid baths, consists of four tanks in a row containing hydrochloric acid in concentrations ranging from 2% to 10% at temperatures held between 180 and 200 degrees Fahrenheit. Chemical inhibitors are added to discourage the acid from attacking the steel beneath the scale (the 'base metal').



The strip is pulled through the bath section at speeds up to 540 feet per minute, then rinsed with water sprays and air-dried, leaving bare steel with a dull silver luster. Massive strip accumulators, also called loopers, on both the entry and exit ends of the acid tanks are employed to keep steel moving through the pickle baths and rinse tanks at a constant speed as coils are loaded ('charged') onto and taken off of the line. This is important, both to maintain productivity and to avoid the stains that may occur when the strip stops between the acid baths and the air dryer.

Continuous Operation

The continuous nature of the Pickle Line requires that the coils be joined together, head to tail. To accomplish this, hydraulic shears at the entry end cut a section of the strip from each end of the coil, squaring up the ends of the coil and removing damaged outer wraps. To expedite the preparation of each coil, the head end is sheared shortly after the band is cut, before it is even charged onto the line.

The head of the next coil to be charged is butted up against the tail of the last coil, and high voltage (and current) is applied across the seam, melting the two ends. The two strips are then forced together (upset) hydraulically, joining them together with what is called a 'butt-weld'. The amount of current employed, the upset distance, and the time each process is allowed are all preprogrammed in a computer as various 'recipes'. Over a hundred such combinations are possible, and the dimensions and grade of the steel being welded determine which will be employed. Cutting tools immediately after the welder trim the flash that is forced out of the seam during the upset.



The integrity of the weld is, naturally, very important since strip breaks on the line tend to be time-consuming to repair. For this reason, specific limitations are placed with respect to scheduling orders so as to maintain strong welds between coils of different dimensions and chemistries.

For Pickled and Oiled products, the welds are typically removed with a shear at the exit end of the line prior to shipment. Conversely, many coils destined for cold rolling will be left 'built up', improving the productivity of downstream units; the high tension applied to the strip during cold reduction must be withstood by these welds.

Flatness Correction

At the extreme entry end of the line, even before the shear and welder, two sets of rolls, three below and two above the strip, mesh together to tightly work the steel up and down. The 'Uncoiler Leveler' serves to move the head of the coil to the welder, remove the memory in the steel of being coiled up (coil set), and break up the scale jacket prior to pickling.

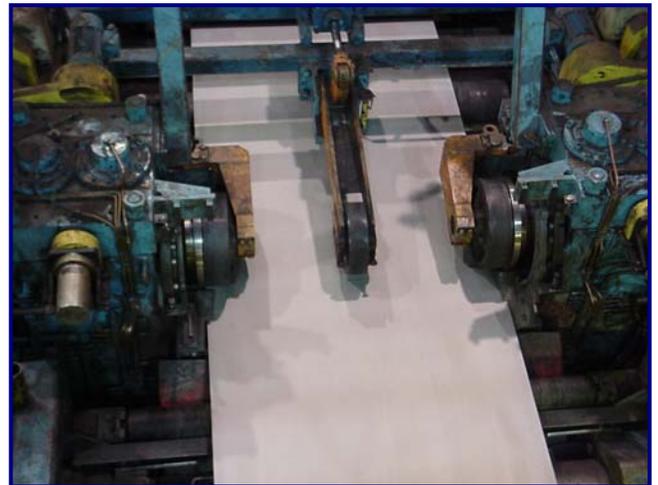
Ahead of the bath section, a more powerful version of the uncoiler leveler, with seven rolls total, operates under high strip tension to improve the flatness of the steel. This 'Tension Leveler' reduces the gauge by around one-half of one percent and further breaks up the scale jacket. Pressure on the rolls is relieved as welds between coils of different dimension pass through to avoid damaging the rolls' surfaces.

Final Processing

At the exit end of the line the edges of P&O product are trimmed by rotary shear 'knives' when required, resulting in a more uniform width and edge condition. Typically, shearing the edges at the Pickle Line removes around 1¼" of 'side-trim' from the width, though as little as ¾" and as much as 2" or more can be sheared as necessary.

Oil is applied with one of two electrostatic oilers, which use electrical charges to attract oil mist to the surface of the steel just before it is recoiled. The P&O oiler applies a protective film of high-quality oil to the steel to prevent it from rusting until the customer can process it, and may protect the steel for upwards of six months. The second oiler applies oil with sulfur additives to cold rolled sheet products to improve the cleanliness of the final product. Galvanized products typically are not oiled after pickling.

The pickled steel is then recoiled with a 24" eye, weighed, and banded with a pair of high-strength steel straps cinched around the coil's circumference ('belly bands'). If specified in the order, one or more 'eye bands' can also be used, which are threaded through the middle of the coil and then around, cinching the inside wrap to the outside wrap.



Inspection

Between the rotary knives and the oilers is a brightly-lit inspection area with a scanning x-ray thickness gauge. The quality of the top and bottom surfaces, as well as the flatness, are confirmed and a tape measure is used to check the width at the head and tail of each coil. The x-ray measures the gauge at the center of the strip throughout each coil, and at the strip edge at each end of P&O coils.