Process Evaluation Section

Dezincing Scrap Steel

Problem/Opportunity

Half of the steel produced in the United States is derived from scrap. Over the past 15 years, automobiles and appliance manufacturers have increased their use of galvanized steel almost five-fold. This has resulted in a major increase in galvanized steel scrap returning to steel producers.

When galvanized scrap is melted in a steelmaking furnace, the zinc that it contains volatizes and ends up in the dust captured in the baghouse, or in plant waste waters. Either of these results in cost penalties to the steel producers, who could avoid these costs if the zinc coating could be economically removed from scrap prior to melting. In the absence of a commercial dezincing process, most iron and steel making operators are putting zinc-coated steel into their furnaces and absorbing the costs because of the high quality of the underlying steel.

Approach

In 1987, Argonne and its industrial partner, Metal Recovery Industries, U.S. Inc., undertook the development of a new technology for converting galvanized scrap into clean scrap for steel making.

Development of the dezincing process progressed in phases from bench-scale studies in the laboratory to a planned commercial operation. Three pilot plants were built for caustic dezincing process development. The first was located in Hamilton, Ontario, for dezincing batches of sheet, loose, and baled galvanized scrap. To further demonstrate the process, a second pilot plant was constructed at MRTI in East Chicago, Indiana, for dezincing prompt galvanized scrap from auto stamping plants. This plant processed loose chips and shredded scrap in a 200-cubic-foot reactor using a belt conveyor. The belt conveyor was replaced with a rotary-drum conveyor in the third pilot plant. The rotary-drum system is the basis for a commercial-scale plant.

Results

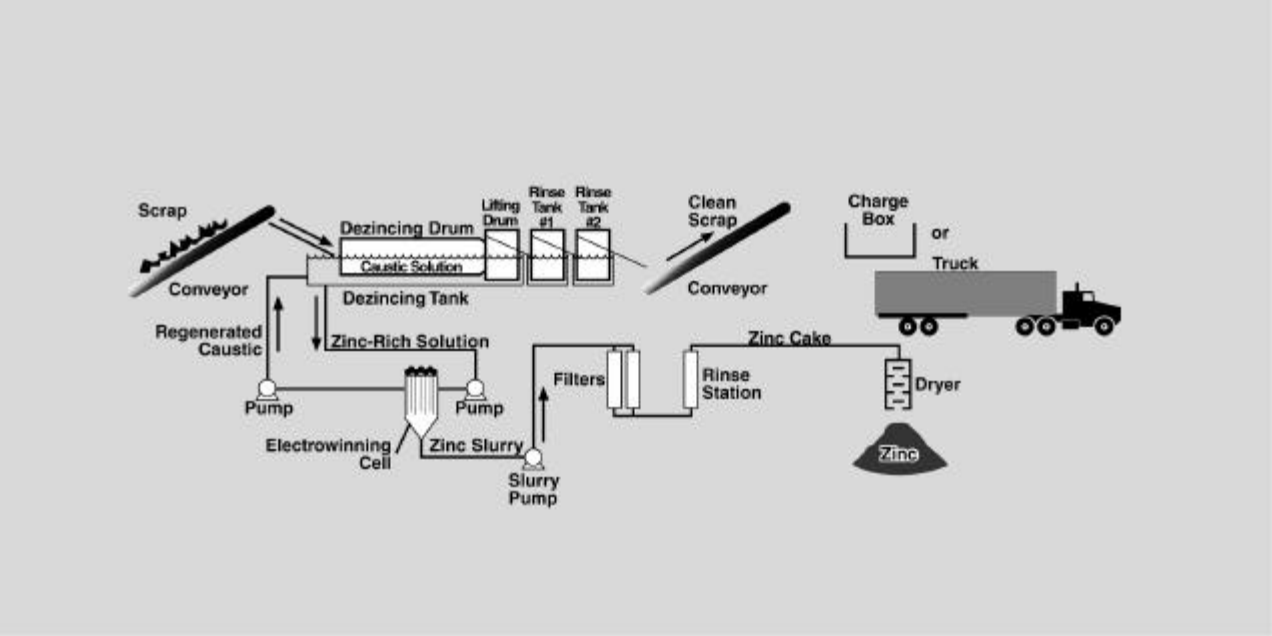
The research led to the selection of stripping in hot caustic and the subsequent electrowinning (removal) of zinc from the caustic solution as the most cost-effective approach. As shown in the schematic of the dezincing process on the following page, zinc-bearing, loose, shredded scrap is charged into the rotary electrolytic reactor containing a hot (70° to 90°C [158° to 194°F]) water solution of about 20-32% sodium hydroxide. The zinc dissolves into the host caustic. Clean (black) scrap is removed, rinsed, and recycled. The pregnant electrolyte is then pumped into a second cell, where the zinc is electrolytically removed from the solution. The liquids recovered from washing and filtration are sent to make up tanks (not shown in the schematic) for eventual return to the leaching tank. The process consumes no chemicals other than drag-out losses and produces only small quantities of wastes. Concentrations of zinc, lead, aluminum, and other coating constituents (except nickel) on the loose scrap are reduced by at least 98%; zinc is reduced to below 0.1%.

The cost of processing steel scrap (depending on the form and the zinc content of the scrap) is about $15 to $40 per ton for

plant capacities of 50,000 to 500,000 ton / year, respectively. These costs include capital recovery and reflect the credits for the co-product zinc.

Future Plans

The technology has been successfully transferred to industry. Commercial deployment of the technology is being pursued by Meretec Corp.



Schematic of the Dezincing Process