TURI
TOXICS USE REDUCTION INSTITUTE
UMASS LOWELL

Making Massachusetts a safer place to live and work

Riverdale Mills Innovates to Reduce Chemical Use

RIVERDALE

"The best solution is to create a better process, not just fix a problem."

Shuai Duo,
Process Engineer,
Riverdale Mills

Summary

The manufacturing process employed by Riverdale Mills historically required the use of hydrochloric acid, ammonium hydroxide and sodium hydroxide. To reduce the amount of chemicals used, the company designed, fabricated, and installed a two-part dual brush roll system to remove excess water and acid at two points in the galvanizing process. Riverdale immediately realized a significant reduction in toxics use, an improved work environment, and increased cost savings.

About Riverdale Mills

Riverdale Mills, located in Northbridge, Massachusetts, is one of the largest manufacturers and distributors of galvanized and PVC-coated wire mesh products in the world. The company was established in 1980, employs over 100 people, and produces over 3,500 different wire mesh configurations. The main products manufactured are drawn wire coil, welded wire mesh, galvanized wire mesh/hex mesh, and PVC-coated wire mesh/hex mesh. These products are used in in the marine (lobster traps), aquaculture (oyster cages), security (commercial perimeter), construction (mattresses and gabions), agriculture (crops and livestock), and landscaping (soil management) industries.

The Chemicals

To create the wire products, the wire strands are first drawn off a spool, then go through welding, galvanizing, coating, and shearing processes depending on the final product requirements. Of these steps, the galvanizing process is the most chemical intensive and was the focus of this toxics use reduction (TUR) project. In addition to zinc compounds, galvanizing uses three key chemicals:

- Hydrochloric acid (HCl): used in acid cleaning to remove the oxidation layer and any rust from the wire.
- Ammonium hydroxide (NH4OH): used to increase the pH in the rinse tank for better quality outcome.
- Sodium hydroxide (NaOH): used to neutralize the pH in the wastewater treatment system to meet or exceed regulatory requirements prior to discharge.

All three of these chemicals are listed under the Massachusetts Toxics Use Reduction Act (TURA) and are reportable if used above the 10,000 pounds-per-year reportable threshold. In recent years, the facility has reported sodium hydroxide at acceptable threshold levels, while usage amounts of the other chemicals fell below the TURA reporting thresholds. Regardless of the

threshold levels, the facility wanted to reduce chemical use because of human health and environmental impacts.

All three chemicals are highly irritating and corrosive to skin, eyes, and the respiratory system, can trigger asthma, and are harmful to aquatic life.

The Motivation

As part of good engineering practices, and in line with TUR planning, Riverdale Mills sought to reduce employee exposure to toxic chemicals and the company's overall toxic chemical use, and therefore reduce TURA regulatory burdens, cut operational costs, and improve the rate of production on galvanized products.

Riverdale Mills applied for and received a $5,000 TURI industry grant to help with the capital cost of equipment modifications.

The Process

Figure 1 depicts the original galvanizing surface preparation process.

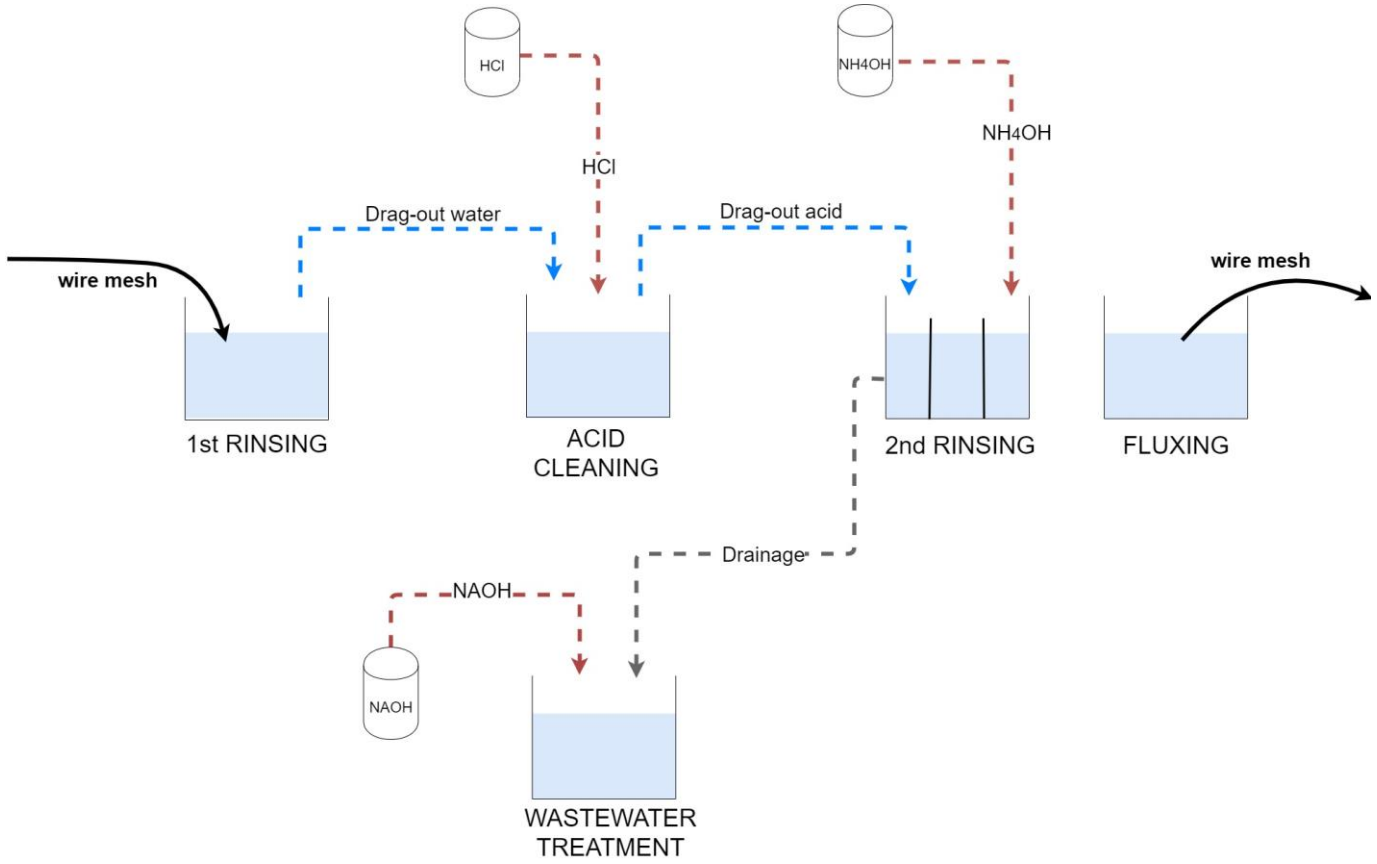

Figure 1: The original galvanizing surface preparation system.

Drag-out water from the first rinse tank was diluting the HCl in the acid cleaning tank, requiring additional acid to maintain optimal concentration. The drag-out acid from the acid cleaning tank to the second rinse tank was lowering pH levels, requiring addition of NH4OH to raise the pH. Drainage from the second rinse tank to the wastewater treatment system required additional correction to adjust the pH to within discharge limits, using NaOH.

The Solution

Over the years, Riverdale Mills had considered several ways to remedy the problems of excessive use of HCl, NH4OH and NaOH as part of its TUR planning efforts. These options included installation of an evaporator to vaporize the acidic water, using a heated air knife to blow off the acid before the wire mesh traveled to the next process step, or using other chemicals to neutralize the acidic water. However, none of these options were considered acceptable as they were too expensive, required significant maintenance and a long implementation period, did not reduce the acid usage to the desired level, and/or created other side effects such as toxic residue on the product.

The ultimate choice of designing, building, and installing a dual brush roll system was inspired by a drive-through car wash system that uses flexible brushes to swipe the sides of the car as the car travels past. For Riverdale Mills, the benefits of a dual brush roll system include:

- High efficiency of surface liquid removal
- Minimal facility management and system operator oversight
- No other chemicals needed
- Controllable costs with the system fabricated in house
- Minimal electricity consumption (especially as compared to other alternatives such as an air knife)
- Anticipated durability of the system
- Easy integration of the system into the existing process line

Figure 2 depicts the new galvanizing process.

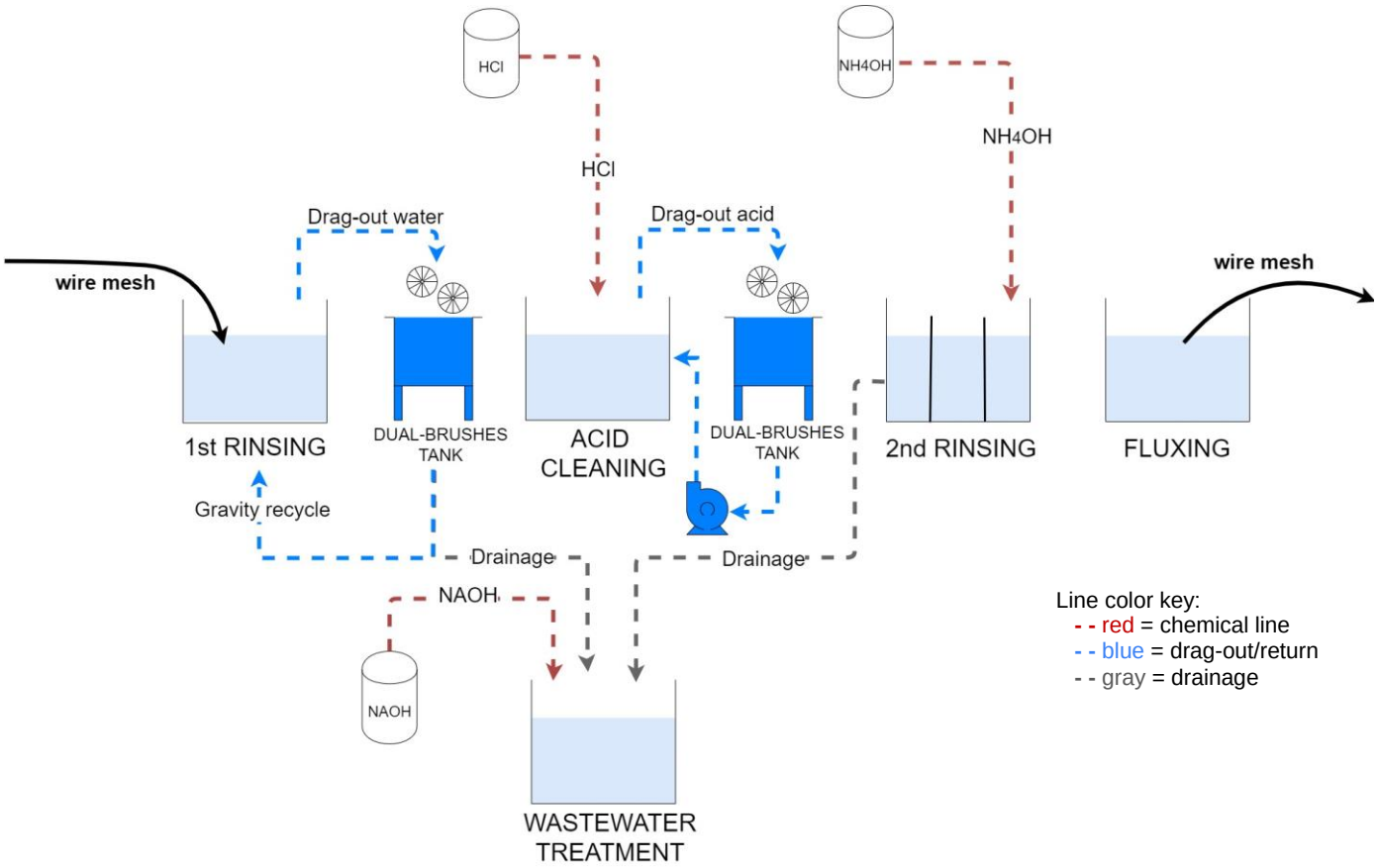

Figure 2: The new galvanizing surface preparation system.

The new process includes two dual brush roll systems to reduce the drag-out water going into the acid cleaning tank and the drag-out acid going into the second rinse tank. The rinse water removed from the mesh after the first rinse can be recirculated to the rinse tank using a manual gravity feed process; operators manually open the valve to drain the water and choose whether to send it back to the rinse tank or to the wastewater treatment system. Acid removed from the mesh after the acid cleaning is pumped back into the acid cleaning tank via an automatically controlled, closed-loop system; an ultrasonic sensor continuously measures the level of the acid that is collected in the second dual brush roll tank, and when the acid level reaches a specific high set point, the pump starts running and pumps the liquids from that second dual-brush tank back to the acid cleaning tank until the level reaches a specific low set point. The set points are programmed in the controller mounted on the side of the second dual brush roll tank.

The locations of the brush rolls are fixed rather than adjustable, to maximize overall efficiency and simplicity rather than optimizing performance for each different type of product. The brush roll systems were designed and fabricated onsite by Riverdale Mills' engineering staff.

One of the dual brush roll systems

The interior of the dual brush roll system, with wire mesh moving between the brushes

After installation, the system was monitored for 50 days to assess the performance. Several factors influenced the accumulation of the liquids brushed from the wire, including the wire gauge, running speed, mesh width, mesh size, brush height, and quantity of wire rolls going through the process. The following chemical savings were realized.

50 Day Chemical Reductions		
Chemical	Reduction in Gallons over 50 Days	Reduction %
Hydrochloric acid (HCl)	47	13%
Ammonium hydroxide (NH_4OH)	20	16%
Sodium hydroxide (NaOH)	107	30%

Financial Analysis

After running the system for 50 days, the engineers at Riverdale Mills estimated the costs and savings associated with the new system. As shown in the following table, the facility sees a monthly savings of $455.

Monthly Costs and Savings				
Category	Item	Monthly Cost		Savings
		Before	After	
Chemical costs	HCl, NH_4OH, and NaOH	$2,341	$1,658	$683
Expenses	Maintenance labor	$0	$48	-$48
	Waste disposal	$20	$15	$5
	Electricity	$0	$180	-$180
PPE costs	Safety glasses, gloves, cleaning rags, etc.	$46	$51	-$5
			Total monthly savings	$455

The reduction of chemicals being used in the processes and the reuse rather than disposal of acid reduced the company's overall costs. Labor costs for the facility increased because the new system requires additional maintenance: The ultrasonic sensor surface on the second dual brush tank periodically needs to be cleaned and calibrated, and the dual brush collection tank surfaces and filters also need to be periodically cleaned. In addition, the monthly cost of electricity increased with the use of the new brush roll and monitoring systems.

The capital costs are listed below. These figures do not include the $5,000 TURI grant.

Dual Brush System Capital Costs	
Item	Cost
Stainless steel shaft	$4,452
Water jetting service (used to fabricate the brush-holding plate)	$1,356
Brushes	$2,184
Pump	$651
Frame system	$2,807
Miscellaneous	$500
TOTAL	$11,950

Weighing the monthly savings against the capital investment in the system, the expected payback period for Riverdale Mills is slightly over 26 months. Based on the initial data above, Riverdale Mills expects to see over $25,000 in chemical cost savings over the next five years. The company plans to reinvest the money in other toxics use reduction projects and to improve and expand this new process.

Results

By employing toxics use reduction problem-solving techniques, Riverdale Mills has significantly reduced its use of three toxic chemicals. The implementation of a two-part dual brush roll system is improving the work environment, saving money, and reducing the company's regulatory burden.

The Toxics Use Reduction Institute (TURI) at UMass Lowell *provides the resources and tools to help Massachusetts companies and communities make the Commonwealth a safer place to live and work. TURI awards grants to businesses, community organizations, and researchers to discover new opportunities to reduce the use of toxic chemicals and to demonstrate technologies to peers. For more information, visit http://www.turi.org or contact Joy Onasch (joy@turi.org, 978-934-4343).*