New Equipment Spotlight...

A Better Extrusion Die Cleaning System

Introduction

Hydro Aluminum's North American extrusion unit asked Kredit Automation & Controls, Inc. to design a better die cleaning system for its extrusion facility in Phoenix, Arizona (Figure 1). The primary goal was to increase operator safety. The extruder also wanted to reduce their chemical consumption costs as well as reduce labor costs.

Standard Die Cleaning Practice

The process for removing aluminum from extrusion dies prior to disassembly has not changed in decades. Dies are soaked in tanks containing a lye solution, i.e., sodium hydroxide (NaOH). The solution is heated (The *AEC Extrusion Dies & Tooling Manual* suggests a solution of 20% NaOH and 80% water heated to 140°F to 160°F).

There are four primary problems associated with the standard method:

Safety: Workers often load dies into hot open tanks of caustic. Hot caustic vapors present potential hazards to workers both in terms of fumes and splash. Tanks are sometimes open and not well ventilated. Additionally, because caustic corrodes metal, escaping fumes can negatively impact any metal structures nearby (Figure 2).

Time: A very slow process, it can take from 8 to 12 hours of soaking to get enough aluminum out of dies to permit disassembly (depending on the size of the die).

Costs: Temperature and pH are often not well controlled in cleaning tanks. Technicians may not understand the effects of temperature on the speed of the cleaning process, or the necessary items to control temperature may not be available. pH is very important in the cleaning process, and a lack of understanding of the non-linear nature of pH may result in the inefficient use of chemicals. The price for a 50% solution NaOH in bulk, liquid form is $4.20 per gallon in Phoenix.

Waste: Obviously regulations regarding waste vary geographically. In Phoenix, NaOH in water must have a pH of less than 10 to be considered non-hazardous. Reducing the pH requires the addition of acid in a controlled manner. The standard operating procedure has been to neutralize the waste and extract the solids through a filter press. Solids are disposed of in a landfill and liquids are generally of sufficient quality to enter the city sewer system.

Figure 1. "After" photo shows new improved die cleaning system.

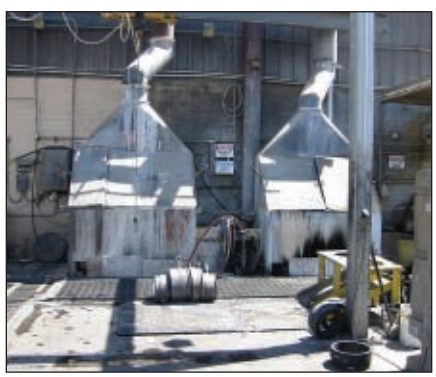

Figure 2. "Before" photo shows old die cleaning tanks. (Wall behind tanks was badly deteriorating.)

Improved Method for Cleaning Extrusion Dies

Kredit Automation & Controls, Inc., also in Phoenix, specializes in extrusion process control upgrades. They designed an automated process control system for die cleaning at the Hydro facility, which provided solutions for the main problems associated with the old system.

The main goal of improving worker safety was achieved by designing a system where workers are removed from direct exposure to the chemical. Measured amounts of NaOH and water are mixed in a central tank based upon the desired pH. Tanks are clean and dry when the dies are loaded and unloaded —the operator is not near an open tank of hot caustic. Dies are automatically rinsed before they are removed. Tank lids are locked closed automatically anytime caustic is in the cleaning tank.

The new system provides greater control of pH and temperature which has resulted in as much as a 50% reduction in cleaning time over previous soaking methods. Controlling pH by metered, automatic mixing results in efficient use of the NaOH. The system has proven the ability to use a single batch of caustic solution for 2 or 3 days. A substantial reduction in acid used for neutralization has also been experienced.

System Overview

The new system is controlled by an Allen-Bradley CompactLogix PLC and a PanelView Plus operator interface. The interface controls the mixing of the caustic, setup of the system for cleaning, individual tank cleaning times, and system alarms. Operational modes include caustic mixing, die cleaning, caustic neutralization, and a maintenance mode for system cleaning. The operational parameters can be customized to specific needs. The PLC controls the operation of the various modes by operating pumps, valves, heaters, and pH monitoring.

The system is designed to premix, under a controlled environment, the sodium hydroxide and water to obtain a predetermined pH. The caustic is heated via an electric immersion heater to a value specified by the operator in the same mixing tank.

New tanks were designed to receive baskets loaded with dies. This allows for a better arrangement of dies and controls the use of the tank volume. The tanks are empty when the baskets are loaded. An operator selects the soak time on an interface panel. When the operator selects "start" the programmable logic controller locks the lids closed and starts pumping the caustic solution from the mixing tank to the cleaning tank.

When the soak time has been reached, the PLC opens valves to drain the tank

and automatically rinses the dies. When the rinse is complete, the tank lids are unlocked and the operator is notified that the cycle is complete. The operator then removes the basket of dies from an empty tank (Figure 3).

Various localities have different requirements for the waste. Hydro Aluminum neutralizes the caustic to a pH of 10 or less. The neutralized caustic and associated salts are pumped into a holding tank for removal as non-hazardous waste. The neutralization process is pH controlled. Other locations may skip the neutralization process by hiring a company that will remove the caustic waste for a reasonable fee. Hydro has its 3,000 gallons of non-hazardous waste removed for less than $1,000.00. The tank is emptied every couple of weeks.

Summary Results

The primary driver for the system was to increase the safety within the area for the employees. Secondary was cost reduction through reduced labor and chemical usage. The safety objective has been easily met. A significant reduction has also been experienced in the removal of caustic waste, sodium hydroxide consumption, and acid consumption.

The cost reductions have been partially offset by an increase in labor and maintenance costs. Net savings are on the order of $60,000 per year

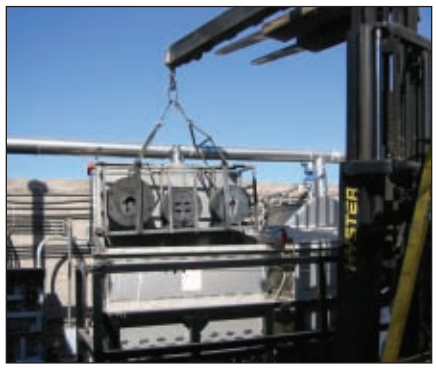

Figure 3. First set of dies removed from the cleaning tank. (At this point in time forklift was being used because overhead crane had not yet been installed.)

in addition to increased capacity over the old system. As the system is considerably more complex than just caustic filled stainless steel tanks, one would expect the maintenance cost to increase. Experience with the hot and very high pH environment has shown the need for periodic rebuilding of one of the pneumatic pumps.

A reduction in labor has not been met. However, while no quantitative numbers exist, there has been an increase in the number of short extrusion runs, requiring more dies per shift to be cleaned. The new system has allowed the die shop to keep up with production requirements. The system has cleaned up to 48 dies in two 8-hour shifts. The capacity of the system is dependent on the die size. Hydro's dies range from 9 to 17″.

Besides achieving the primary goals, the new system provides other benefits. Hydro had a pit for containing spent caustic prior to neutralization. This caused problems as the pit had to be cleaned annually, and if it was filled with water, then the water had to be contained and also neutralized. The pit has been removed and filled in, eliminating another annual expense.

Neutralization time for the used caustic has been reduced from 3 hours plus to ½ to 1 hour for 250 gallons of caustic. This is another decrease in chemical and labor cost. The new system also eliminated a filter press that was used to process the caustic waste, resulting in a further reduction in labor.

Finally, cake from the filter press previously was placed in a 20-yard "roll-off" container that had to be hauled off and disposed every few weeks. There is now no longer a need for the roll-off container, which has resulted in an increased working space.

Conclusion

In the pursuit of designing a new extrusion die cleaning system, standard industry practices have been challenged and a new improved system has been shown to provide safety and cost benefits valuable to any aluminum extrusion operation.