Aqueous Systems for Cleaning Strip

by Carl Lawson, Lewis Corp., Oxford, CT, and William Noble, Intex Products, Greenville, SC

INTRODUCTION

The cleaning of metallic strip is frequently necessary in many manufacturing processes. Higher standards of cleanliness and increasing concerns about the use of solvents in the workplace are causing manufacturers to seek alternate cleaning methods to traditional vapor degreasing.

This article reports on the development and implementation of an aqueous based system that effectively cleans metallic strip on a continuous basis.

BACKGROUND

Current methods of continuously cleaning metal strip involve degreasing equipment that uses organic solvents as the cleaning fluid. While producing acceptable results at the required production rates, the use of solvents with their associated worker safety and waste disposal problems is becoming less tolerable. Recently, regulatory agencies have been taking an increasingly stronger stand on these issues. Clearly, a safer process that provides the same (or higher) levels of cleanliness at similar production rates is desirable.

THE SYSTEM

A straightforward system to continuously wash, rinse and dry metallic strip using a water based solution was designed, tested and evaluated. The system consists of three sections, each with its own particular function (Fig. 1). The strip is drawn directly through the system by means of an external power take-up reel.

The washing section, based on near field ultrasonic technology, consists of a chamber that is flooded with cleaning solution and a set of ultrasonically activated plates. The plates are somewhat wider than the strip. In this configuration, intense ultrasonic activity is generated between two narrowly spaced plates. The plates are activated by magnetostrictive transducers which operate at 20 kHz and 16 kHz, respectively, in order to prevent the formation of standing waves.

The alternate expansion and compression waves created in the cleaning solution by the transducers cause minute vapor-filled bubbles to form and then collapse. It’s the action of these microscopic bubbles on the surface of the strip that performs the actual cleaning. The action of the bubbles occurs in all directions so that even strip with complex profiles can be effectively cleaned (Fig. 2). The field is so intense that only a brief exposure time is required. The cleaning solution is continuously filtered and recirculated.

The strip then enters the rinse section where the detergent solution is thoroughly rinsed off with a direct spray of tap water. The strip is dried by means of air knives, nozzle-like devices that focus compressed air on the strip and physically remove all traces of water.

THE DETERGENT

The selection of the proper detergent is critical to any cleaning process. A wide variety of commercially available compounds can be used. The selection is determined by two factors: the type of metal being cleaned and the type of soil that has to be removed from the strip.

In most cases, the removal of stamping and forming lubricants and other nonorganic shop soils can be accomplished by using a 5 to 10% solution of mild alkaline detergent. The detergent contains a surfactant, enabling it to quickly wet-out all surfaces of the strip and physically remove all traces of water.

The strip emerges from the system without any water droplets that could cause spotting. No guides or rollers are employed and the product does not have to be depressed into a tank for ultrasonic cleaning. The entire cleaning process is essentially noncontact and since the process path is straight through, the system can also be used to clean rigid material such as pipe and bar stock.
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Fig. 2 Typical strip profiles.

be formulated so that it will rinse free in a short amount of time. The ability of a detergent to loosen soils quickly and rinse free makes it ideal for use in a continuous process.

There are several formulations that contain no hazardous ingredients and have a near neutral pH. Use of these products insures worker safety and holds waste disposal problems to a minimum.

RESULTS

Aqueous ultrasonic cleaning resulted in a cleaner product at higher production rates as compared to vapor degreasing methods. Independent laboratory analysis confirmed that cleanliness levels had been significantly improved in all cases and by an order of magnitude in some. The aqueous cleaning method removed many of the inorganic soils normally left behind by vapor degreasing and air knife drying, assured that all traces of minerals normally present in potable water were removed.

CONCLUSION

Aqueous based ultrasonic cleaning of metal strip and other continuous product is gaining acceptance as an alternate to vapor degreasing. The use of chlorinated/fluorinated hydrocarbons can be eliminated. In addition to addressing worker safety and environmental issues, the process produces a demonstrably cleaner strip at substantially higher production rates.

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Biographies

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