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Stripping Organic Coatings

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With advances in coating technologies, more and more product finishers are concerned with how to remove coatings. Electrocoating and electrostatic spray coating applications require absolute electrical contact between products and their hooks, hangers, racks, carriers and other conveyor line fixtures. To ensure electrical contact, residual coating materials must be stripped from these fixtures. With the increasing costs of raw materials, rejected manufactured parts can no longer be scrapped because of poor finish quality. They must be stripped. Stripping also must precede maintenance refinishing for some products. For example, old coating is removed from aircraft before repainting because it would add weight that reduces payloads.

Basically all coating stripping methods fall into one of three categories: chemical, pyrolytic and mechanical.

Chemical stripping methods use corrosives, solvents and combinations of corrosives and solvents.

Pyrolytic methods use high-temperature ovens, open flames, hot fluidized beds, molten salt baths and lasers. Mechanical stripping uses high-pressure water, abrasive media, brushes, abraders, scrapers, chippers and cryogenics.

Materials of construction for conveyors have not changed, but coating materials and substrates have. To strip these new coatings, more aggressive materials and methods have been developed. Since many chemical, pyrolytic and mechanical stripping methods are too harsh for aluminum, plastic and composite substrates, stripping methods have been modified.

There is a stripping method for every combination of coating and substrate. These methods vary in cost, processing speed and worker safety. This paper will acquaint the reader with most current stripping methods. Space does not permit a detailed description of each stripping method. Instead, a brief sketch of each method along with its advantages and disadvantages will be presented to aid the reader in his selection of the method which meets his needs.

Chemical Stripping

Chemical strippers work by softening or dissolving the film and breaking the bond between the coating and substrate. The loosened coating is then removed mechanically. Chemical strippers can be classified by their operating temperature, as hot or cold. They can also be classified by their compositions as corrosives, either acidic or alkaline, as solvents or as combinations of corrosives and solvents.

However, corrosive strippers are used hot, at elevated temperatures of 80 to 100C. On the other hand, solvent strippers are used cold, at or near room temperature. It makes more sense to use the chemical classifications because of worker and community "Right to Know" regulations.

In the past, it was claimed that chemical strippers could remove an alkyd enamel in seconds. Today, in addition to the alkyds, products are finished using acrylics, epoxies, polyesters, polyurethanes, vinyls and other highly durable coatings. Due to their chemical resistance, they are difficult to remove. Furthermore, governmental regulations, which now control worker safety, air and water quality, are affecting the composition and use of chemical strippers. Consequently, there are now scores of chemical strippers commercially available. The advantage of chemical strippers is formulating versatility to remove even the most durable coating with little effect on metallic substrates. The disadvantages are the potential health hazards and environmental problems associated with using corrosive materials, chlorinated solvents and flammable solvents.

Corrosive strippers are generally aqueous solutions of potassium or sodium hydroxide that operate at a pH of 13 or higher. Acidic strippers, on the other hand, are aqueous solutions of organic or mineral acids that operate at a pH of two or lower. They are applied by immersion, flowing or steam gun for periods of 15 to 30 minutes.

Solvent strippers can contain methylene chloride, cresols and flammable hydrocarbons. Used at room temperature, they are applied by immersion, brushing or flowing. Since solvent strippers are used cold, at or near room temperature, they are slower acting than the hot corrosive chemicals and stripping may take up to seven hours.

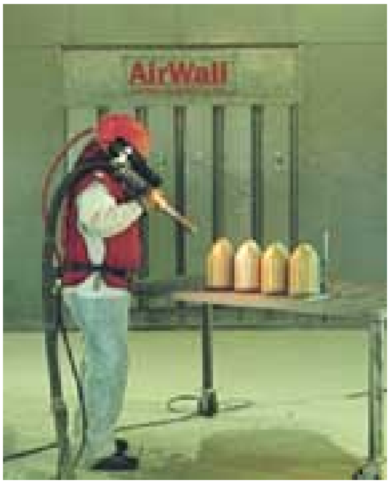
Combination strippers are formulated using corrosive materials and solvents and enjoy the benefits of both. They can remove the most durable, chemical-resistant coatings. Used at or near room temperature and below the boiling point of the solvents, they are nearly as slow acting as the solvent strippers.

Pyrolytic Stripping

Pyrolytic stripping equipment includes open flames, high-temperature ovens, fluidized beds and molten salt baths. At the 700 to 800F operating temperatures, most organic coatings are pyrolyzed in a relatively short time. The advantage is fast and complete stripping. The disadvantages are high energy use and damage to some substrates.

Open-flame strippers are used on a limited basis because of environmental and safety considerations.

High-temperature-oven strippers pyrolyze organic portions of the coatings in an oven heated to 700 to 800F, in a low-oxygen atmosphere. The resultant volatiles



are driven off, in this first phase, leaving carbon and inorganic compounds. In the second phase, the carbon remaining on the substrate is burned in excess oxygen, to form carbon dioxide. Afterwards, the inert pigments and fillers remaining on the substrate are removed mechanically. To comply with air-quality standards, an afterburner in the oven exhaust burns the remaining organic volatiles to form carbon dioxide and water. Heat exchangers, in more efficient systems, recycle the energy.

Hot fluidized-bed strippers use the pyrolytic process in fluidized beds, heated to 700 to 800F. The suspended media is hot sand. The fluidizing gas can be oxygen-poor or oxygen-rich, depending on the process stage. The closed system has dust collectors, afterburners and heat exchangers. Organic volatiles are converted to carbon dioxide and water by the after-burners to meet air quality standards. Heat exchangers increase energy efficiency.

Molten-salt-bath strippers use baths of proprietary molten, oxidizing, inorganic salts heated to temperatures of 600 to 1000F. Coated objects are immersed in the bath for five to 25 min., depending on the salt formulation and the coating composition. In a closed system, the exhaust is treated to meet air quality standards. Some proprietary molten salt baths have been developed that operate at lower temperatures, allowing some aluminum products to be stripped.

Laser stripping is a high-tech method that uses the energy of a laser beam to pyrolyze organic coating. The beam is moved automatically along the substrate, decomposing the coating as it goes. This procedure is slow and works best on flat substrates.

Mechanical Stripping

Mechanical stripping includes some old and widely practiced methods, such as abrading, scraping and chipping by hand and power tools and blast cleaning by impingement of a medium to abrade coatings from the substrate. It also includes high-pressure water and cryogenic stripping. Mechanical stripping often supplements other methods to completely remove loosened coating residues.

Hand abrading, scraping and chipping are still practiced. Tools for this method are abrasive pads, sandpaper, wire brushes, scrapers and chipping hammers. Electrically- or air-operated power stripping tools include disc, orbital and belt sanders, chipping hammers, rotary wire brushes and abrasive flap wheels. The advantage is fast stripping. The disadvantage is labor intensiveness.

Abrasive blast stripping uses various types of media, which are propelled centrifugally, by compressed air or by low-pressure water. Centrifugal blast stripping uses motor driven wheels to hurl the media on the coated surface. In abrasive air blast stripping, the media is propelled by a stream of compressed air. Both processes are done in enclosures. Dust collectors and cyclones are used to recover and separate the media from coating residue for further use. In abrasive

water blast stripping, media is carried in a stream of low-pressure water. One advantage of abrasive blast stripping is rapid removal of coatings from most substrates. Another advantage is meeting environmental and safety regulations. The disadvantages are distortion and abrasion of substrates by the impingement of the media. Today, blast stripping media includes sand, shot, plastics, ice crystals and carbon dioxide pellets.

Sand and shot abrasive media have traditionally been used for blast stripping. Since they are the hardest, they are also the most aggressive. The advantage of a high stripping rate may be overshadowed by high substrate distortion and attrition rates.

Plastic media stripping was developed for the special requirements of aircraft repainting because of the size of the product, as well as the effects of chemical strippers on non-metallic substrates and on the environment. The plastic media, which is harder than the coating to be removed, is propelled by a stream of compressed air at pressures from 15 to 45 psi. The choices of media hardness, particle size, composition, nozzle shape, angle of attack and air pressure are dictated by the coating type. It is even possible to remove coatings one layer at a time. The advantage of plastic media stripping is less damage to the substrate. The disadvantage is slower stripping.

Ice crystal blast stripping uses refrigeration equipment and air compressors. The ice crystals are carried in an air stream that is directed at the coating by a special nozzle. The impingement of the ice crystals fractures the coating film which is then lifted off the substrate. The advantage of no media residue (only water) is balanced by the requirement for elaborate equipment.

Carbon dioxide (dry ice) blast stripping uses a compressor to produce dry ice pellets that are propelled by a stream of compressed air. The advantage is no media residue because dry ice sublimates. The disadvantages are the need for elaborate equipment and a slower stripping rate than with other media.

Other blast media that can be used for stripping coatings include wheat starch, sodium bicarbonate, glass beads, nut shells, corn husks, fruit seeds and a host of others. The choice of medium is dictated by the type of coating to be stripped and by the durability of the substrate.

High-pressure water stripping removes coatings by impinging a stream of water on a surface, at pressures of 15,000 to 50,000 psi, using specially designed nozzles. By changing the parameters of water pressure, angle of attack, nozzle design and dwell time, even the most durable coatings can be removed.

Cryogenic stripping uses a bath of liquid nitrogen operating at temperatures ranging from-200 to -300F. Objects to be stripped are immersed in the bath for 30 sec to three minutes. Owing to the differences between the coefficients of linear expansion of organic coatings and metallic substrates, the coating cracks and delaminates as it cools. The loosened coating film is removed mechanically. The system is housed in a relatively small enclosure. The advantages of a pollution-free, worker-safe process are balanced by the disadvantage of part size limitation.

There is no “best” method for stripping organic coatings. All the aforementioned methods will work. The choice can only be made after careful consideration of the objects to be stripped, their size, the substrate, the nature of the coating, operating costs, environmental impact, worker safety and cost.

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