

WMRC Factsheet

Alternative to Solvents

Chlorinated and organic solvents are on the way out, so industries have begun to look for alternatives. Current estimates are that 80 to 90% of chlorinated solvents are replaceable and that 80 to 90% of metal cleaning and degreasing can be done with solvent alternatives. This factsheet gives an overview of current types of alternatives.

Alternatives

Aqueous Cleaners

Alkaline cleaners are good for removing salts, organic soils, oxides, metal chips, grease—just about anything a chlorinated solvent can remove. They are also recyclable, present a low health risk, and release no volatile organic compounds (VOCs). However, alkaline cleaners can have a high initial cost and cleaning time is sometimes extended.

Two other kinds of aqueous cleaners are acidic and emulsion cleaners. Acidic cleaners are effective on scale and rust; however, acid attacks most metals, except aluminum and zinc. Widespread use of acid cleaners is unlikely because most industrial painting is done on metal.

Emulsions are solvents mixed with water. Common solvents are alcohol, methylene chloride, and 2-butoxy ethanol. Emulsions are effective where extreme pH levels (over 12 or below 5) can't be tolerated; however, emulsions make waste disposal more expensive, and solvents release VOCs, which are coming under increasing regulation.

Semi-aqueous Cleaners

Semi-aqueous cleaners are emulsions of hydrocarbon solvents and water, such as terpenes. Terpenes

can effectively replace chlorofluorocarbons to clean circuit boards and circuit card assemblies, and their applications are broadening. Such cleaners have low toxicity and can be recycled. Terpene itself is biodegradable.

But using semi-aqueous cleaners has a high initial cost, and terpene can't be sprayed in an open tank because of its low flash point. The smell of terpene may also present a problem for workers, though in some cases this problem has been solved.

Liquid Carbon Dioxide (CO₂)

Liquid carbon dioxide is an expensive, limited alternative for removing contaminants, scale, corrosion, and carbon deposits from metal. Little waste is generated because the CO₂ evaporates. But its applications are narrow because it does not effectively remove greases, oils, or ionic contaminants.

Equipment

To switch to aqueous or semi-aqueous cleaners means more than buying a different cleaner. Solvent replacements require their own equipment to make cleaning more effective. Two possibilities are immersion and spraying equipment.

Immersion

Immersion cleaning has a relatively low price and need for energy. The energy is required to heat the washbath and rinse, but closed tanks retain the heat well. Batch basins are suitable when production speed is slow; automated equipment is used for continuous production. The disadvantage of immersion cleaning is that an oil slick may form on the top and recontaminate parts as they are

lifted out. This can be countered with special cleaning solution and/or oil skimmers or new technologies such as ultrafiltration.

Agitation during the wash can be done either by moving the parts themselves or the cleaning solution. Ultrasonic agitation vibrates the solution at 25 to 40 kHz (1 Hz=1,000 vibrations/sec). Bubbles form and collapse, creating a scrubbing action. Ultrasonic agitation is effective for a high degree of cleaning and removing difficult contaminants, but the equipment is expensive and requires a lot of electricity.

Spraying

With this method, objects are sprayed with cleaning solution at up to 60 pounds per square inch (psi), which makes cleaning faster and more thorough than simple immersion. Spraying is preferable for parts on an assembly line. It does take more energy to heat the solution because of heat loss in spraying and in spraying cold parts. A spray cleaning set-up also requires pumps, filters, and plumbing. Overall, it costs more than immersion.

Batch spray cleaning is suitable for maintenance applications, where there's a lower throughput and a lower requirement for cleanliness.

Conveyorized spray cleaning is for a higher throughput level and for objects of all sizes. This method is applicable to many industries.

Rotary spraying involves a steel drum with a perforated spiral partition in it. Small parts, ones that can be agitated without harm, circulate up and down the spiral as they're sprayed. Rotary spraying also offers a higher throughput level.

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