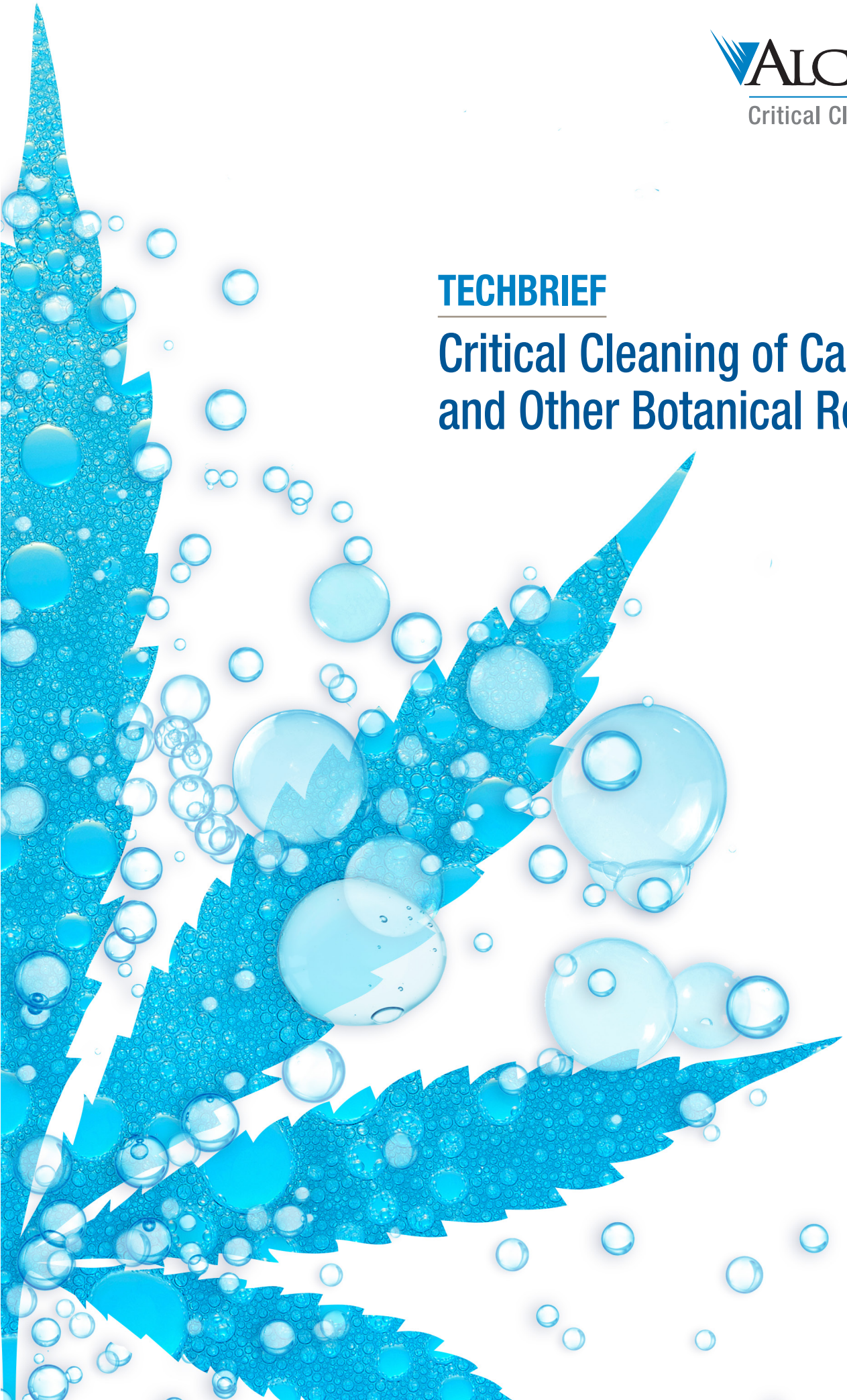
ALCONOX
Critical Cleaning Experts



TECHBRIEF

Critical Cleaning of Cannabis and Other Botanical Residues

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Abstract

The cannabis industry presents many very specialized and potentially difficult cleaning challenges, from the laboratory all the way through sophisticated large-scale commercial manufacturing processes. The sticky resins encountered every step along the process are legend. This paper focuses on the critical cleaning of a wide range of hard surfaces from delicate laboratory glassware, processing tools and irrigation lines, to the extraction vessels and clean-in-place (CIP) manufacturing tanks. We use the term critical cleaning to denote situations where the level of cleaning directly impacts the value of the product or results.

Cleaning in the Cannabis Industry

Critically clean processing equipment is vital, whether it be labware, glassware, instrumentation, trimmers or separation and extraction equipment. As indicated by several regulatory bodies including the FDA[1], the potency, purity and quality, essential characteristics of any product, rely on critically clean surfaces. Cleaning for cannabis industry processing is in fact more difficult than cleaning for traditional drug manufacturing. Waxy, resin, oily and sticky residues abound and are highly adherent, difficult to emulsify, in other words, just a plain challenge to remove. Strong solvents and harsh chemicals might be a quick answer. However, this approach can be hazardous to workers, require treatment prior to discharge and therefore have significant associated costs. In addition, solvents such as isopropyl alcohol and ethanol can be difficult to obtain with increased demand for microbial and viral disinfection.

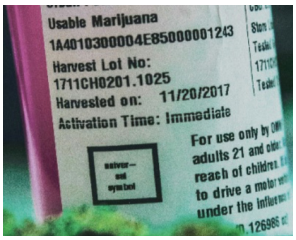
So, the more sensible and more efficient approach is to use detergents that are not only effective, but end-user safe, aqueous, free-rinsing, interfering residue-free, biodegradable and without any added dyes, fragrances, brighteners or softeners. In other words, residue-free cleaning eliminates impurities and thereby maintains the product in its most "natural" state.

Typically, aqueous cleaners are formulated to ensure maximum cleaning performance by using key biodegradable ingredients such as surface-active agents (surfactants) as wetting agents. Surfactants allow the cleaning solution to penetrate crevices while getting under soils to allow for removal. In concert with emulsification, chelation, dispersants, and other cleaning mechanisms, aqueous detergents provide multiple ways to get cannabis and other botanical residues reliably removed from equipment and instruments.

Often dilute solutions of an aqueous cleaner effectively remove even worst-case substances off a variety of hard surfaces, including stainless steel, glass and plastic (which we refer to as substrates). In addition, hard surfaces found in cannabis process equipment, irrigation lines, trimmers and flooring are compatible across a range of pH and temperatures. Thus, allowing for flexibility in detergent selection in terms of pH, cleaning conditions, and cleaning methods.

The ability to choose from a wide range of detergents should not be taken to mean any detergent will suffice. Indeed, achieving critically clean results with a water-based detergent requires a good bit of scientific expertise to match the correct detergent formulation to a specific cleaning challenge and substrate. Alconox Inc. provides the necessary technical support to select the most efficient and safest of our large family of products for any cleaning issue. We have a broad range of tried and true formulations covering a wide range of pH and phosphate content in both powdered or liquid detergents.

Quality in the Cannabis Industry



Fundamentally, when processing cannabis for making regulated products, we recommend using the same current Good Manufacturing Practices (cGMP) employed by pharmaceutical, biotech and related manufacturers. With FDA approval of some cannabis-derived drugs, manufacturers should understand that the FDA will seek assurance that changes or innovations in processing cannabis or cannabinoid (CBD do not outpace Quality and Regulatory (QARA) guidelines. By adhering to appropriate regulations, drug products will remain within proper controlled processing conditions and manufacturing claims will be backed by demonstrable, valid methods.

Cannabis and related processing are covered by drug related and, with edibles, food related QARA guidance. This includes GXP, FSMA – 21CFR117, ISO 17025:2017, ISO220021:2009 and ISO9001:2015. To avoid the risk of food contamination, critical cleaning is essential for cannabis drugs and edibles particularly as these products may be consumed by immunocompromised patients.

1. https://www.ecfr.gov/cgi-bin/text-idx?SID=fd6ec4304870a0004624548e9cf65a19&mc=true&node=se21.4.211_167&rgn=div8

Selecting the Proper Aqueous Cleaner In Cannabis Cleaning

Cleaning Chemistry

Since most cannabis industry related soils are acidic or alkaline hydrolysable, alkaline cleaners are very effective. Alkaline cleaners remove organics including oils, tars, resins, extracts, proteins and an array of other soils. Most cleaning applications will involve an alkaline cleaner or a combination of an alkaline cleaner and an acidic cleaner. In concert with micelle forming surfactants for emulsifying, aqueous detergents are the safe, efficient, effective alternative.

Alconox Inc. is armed with 75 years of experience recommending cleaners for use in cosmetics, dietary supplements, food, and pharmaceuticals, where we have gained experience cleaning all sorts of herbal and botanical residues and resins. This same experience allows us to bring great insight into removing cannabis residues found in the manufacturing process.

When large amounts of residue are attached to manufacturing surfaces, increased detergent concentration is generally required. Typically, a 1–2% (10-20 mL/L or 1.3–2.5 oz/gal) concentration suffices for routine cleaning, however, 2–5% (20–50 mL/L or 2.5–6 oz/gal) is often required for cannabis related residues. The higher the concentration of detergent, the greater the capacity available to remove a larger volume of soil. Accordingly, increased detergent concentration allows for most resin, extract, oil and the like to be removed, reducing or eliminating the need for repeated cleanings.

Heat is an important variable in the cleaning of cannabis and other botanical residues. Within reason, higher temperatures ensure the softening of hardened resins and accelerates residue removal. Using elevated temperatures of 60–70°C (140–160°F) and higher provides softening and efficient emulsification of an array of cannabis, CBD, organic, and oily residues.

Critical Cleaning by Application

Laboratory: Keeping your laboratory glassware and equipment clean is vital. This ensures your cannabis, CBD or other botanical product testing and assays are of the highest purity and accuracy. Clean round bottom flasks and vessels helps ensure higher potency and no batch to batch contamination in smaller scale processing. For the laboratory setting, we would recommend mild alkaline detergents for soaking, scrubbing or sonication (ultrasonic) of your parts.

For manual cleaning in the laboratory, we would recommend warm to high temperatures (140F/60C+) and a 2–3% concentration (20-30 mL/L or 2.5–4 oz/gal) of a moderate pH, safe for manual use detergent to start. Initial rinse should also be of similar temperature to avoid thermal shock of micelles that form. Subsequent rinses can be at ambient temperatures.

A low foaming detergent is highly recommended, if not required, for use in connection with lab washers and other high-pressure spray applications. A typical for-manual use detergent creates truly excessive foaming when used in these applications.

Irrigation Lines: Irrigation lines have residues that differ from other fluid transport creating very specialized cleaning applications. Fertilizers are often made up of plant nutrient-based compounds such as nitrogen and phosphorus. This inorganic residue can easily build up in small diameter irrigation lines.

Residual water in irrigation lines can also lead to the buildup of biofilms and bacteria to the likely detriment of your plants. If hard water is being used, scale build up is also a typical issue. Some recommended irrigation line cleaning protocols, other than aqueous based detergents, entail numerous steps and, in many cases, require the use of harsh chemicals.

Simplifying your cleaning process and eliminating hazardous cleaners is an important goal regardless of industry. Enzymatic detergents equipped with powerful emulsifiers of organic residues, enhanced with chelators to remove inorganic fertilizer residue, and bolstered with protein enzymes for the removal of biofilms and biologic residue are highly recommended.

A warm flush with biodegradable, drain-safe, aqueous enzymatic detergent solutions will ensure irrigation lines are able to provide vital nutrients to plants, and stay clean of biologic, organic and inorganic contaminants alike.

We recommend warm 1–2% (10–20 mL/L or 1.3–2.5 oz/gal) solutions up to 130°F/55°C, followed by a thorough, warm rinsing flush of the line.

Manufacturing: As cannabis manufacturing throughput increases from analytic and prototype to a commercial scale operation, critical cleaning remains an important element of success. Many cannabis by-products are edibles and the cleaning requirements are the same as for other food processes.

Cannabis manufacturing has some very specialized niche cleaning issues. For example, there are oily residues found in vape cartridge manufacturing (e-cigarettes, vaporizers, etc.). Cleaning vape manufacturing equipment, tanks and their laboratory glassware presents a real challenge that can be dealt with using certain of our products.

Likewise, boiling flasks can frequently end up being coated with a thick layer of tar that is quite difficult to remove safely. Again, certain of our products can address even this tough issue.

In all above applications, like the laboratory environment, manual cleaning can be done with high temperatures (140°F/60°C+) and a 2–3% concentration (20–30 mL/L or 2.5–4 oz/gal) of a moderate alkaline pH, safe for manual use detergent. However, concentrations up to 5% (50 mL/L or 6 oz/gal) can be required for the higher yields and residue levels seen at manufacturing scale.

For tanks, extractors and other equipment where a Clean-In-Place (CIP) system is installed, low foaming detergents would be required. These tend to be higher in alkalinity to compensate for the lower foaming surfactants (foam is good for emulsifying).

A concentration of 3–5% (30–50 mL/L or 4–6 oz/gal) is a good place to start for these low-foaming, CIP detergent applications. Recall that higher concentrations increase cleaning capacity, or amount that can be removed by a detergent. Therefore, qualitatively speaking, if there is a large amount of resin, or the resin is difficult to emulsify, higher concentrations may be needed. Naturally, it is uneconomic to use a higher concentration than is required to achieve the desired result. Beyond economic considerations, more detergent does not always lead to a better result.

Using the hottest practical temperature; 160–180°F (70–80°C) would be ideal. It is best practice to have that initial rinse be of equal or similar elevated temperature as well. This is to avoid thermal shock to any surfactant-derived micelles that have formed and the risk of redepositing the removed residue.

A good rule of thumb is you need about 10% of the overall tank/vessel volume as cleaning solution to properly CIP. For a 100L process tank, 10L of detergent solution would typically be used to clean for the spray/recirculation CIP process. Therefore approximately 0.5 L of detergent (3–5% of 10L) would be used.

To find the best concentration, we suggest starting at reasonably high detergent concentration levels to know what can get the job done. Thereafter, beginning to reduce concentrations to learn what level provides a critically clean result and the best economic result, is a good practice.

Floor Cleaning: Cannabis, CBD, and other botanical processing must be produced in a clean environment. Floor cleaning can be done daily, weekly, or as necessary.

A proven floor cleaning method utilizes two buckets and one or two mops:

1. Sweep or vacuum the floor to remove loose particulate residues;
2. Dip clean mop in 1% wash solution and ring out into the wash solution;
3. Mop an area of floor to wash it;
4. Dip the mop back in the wash solution and ring it out into the wash solution bucket;
5. Repeat step 2, increasing the amount of floor that has been washed, but don't increase the area so much that the beginning area starts to dry out;
6. Either switch to a fresh mop, or use your rung out wash mop and dip it in a fresh rinse water bucket, ring out the mop into the fresh rinse water bucket;
7. Mop rinse the beginning approximately 1.5 sq. meter (16 sq ft) area;
8. Dip the rinse mop in the fresh water and ring it out;
9. Continue mop rinse as in steps 7 and 8 until all the washed area has been rinsed;
10. Go back to step 2 to continue washing more of the floor; and
11. Replace the mop head, wash bucket or rinse water as they become excessively contaminated.

Methods to Clean and Cleaning Agents

Cleaning methods can be generally divided up into manual cleaning and automated cleaning as outlined in Critical Cleaning by Application above.

Manual cleaning includes those which included direct applied mechanical action. This is also where higher foaming detergents are not only permissible but useful. As mentioned, foaming detergents are best for emulsifying. Emulsifying is the preferred approach to remove organic soils, like oils, extracts and resins. Manual cleaning methods are soaking, scrubbing, and sonication (ultrasonic tanks).

Automated methods include uses of washers, high pressure sprayers and CIP systems. Low foaming detergents use surfactants which foam less and thereby eliminate situations where over-foam can occur. The less efficient surfactants are compensated for by higher alkalinity, chelation, wettings agents and other methods to ensure cannabis resin is quickly, safely and reliably removed.

Manual Cleaning Detergents:

For the laboratory setting, we would recommend the following detergents for soaking, scrubbing or sonication of your parts from cannabis, CBD, botanical, waxy type residues:

DETONOX® Ultimate Precision Cleaner is our flagship cannabis detergent, our most potent manual detergent and ideal for hand and ultrasonic use on difficult botanical residues. It is a non-caustic detergent for exceptional removal of cannabis, botanical, residues and sticky extracts, resins, creams and lotions.

ALCONOX® Powdered Precision Cleaner is a powerful emulsifier of organic and oily residues, used for many decades in cannabis and similar soils. It is biodegradable, drain-safe and completely free rinsing. A powdered alternative to Detonox detergent.

LIQUINOX® Critical Cleaning Liquid Detergent is a phosphate free alternative for manual cleaning.

For each of the previous, we would recommend warm to high heat temperatures (140°F/60°C+) and a 2–3% concentration for starters. Initial rinse should also be warm to avoid thermal shock of micelles that form. Concentrations up to 5% can be required for higher yield or residue applications.

However, care should be taken to keeping washing and soaking times limited for glassware, especially art and sensitive glass in applications outside the laboratory. For extended soaking, ensure the glass is completely submerged and all air bubbles have been released to avoid forming meniscus edges. Some types of art glass can be etched in such circumstances. Typical laboratory glassware would not be.

TERGAZYME® Enzyme-Active Powdered Detergent is a powerful emulsifier of organic and oily residues, enhanced with chelators to remove inorganic fertilizer residue, and bolstered with protein enzymes for the removal of biofilms and biologic residue. A warm flush with biodegradable, drain-safe, Tergazyme solution will ensure irrigation lines are able to provide vital nutrients to plants, and stay clean of biologic, organic and inorganic contaminants alike. We would recommend a warm 1–2% (10–20 mL/L or 1.3–2.5 oz/gal) solution up to 130°F/55°C, followed by a thorough warm rinsing flush of the line.

Machine Washers:

For washer or other low foaming detergent requiring cleaning of your glassware, equipment, vessels, shears and trimmers, we would recommend:

Keylajet® Low-foaming Chelating High Alkaline Liquid is ideal for CIP and washer cleaning where the washer has a liquid dosing system to remove tough, sticky, waxy botanical residues, resins, and other highly adherent organic and oily soils. And of course, much more. It is also ideal for vape cartridge manufacturing (e-cigarettes, vaporizers, etc.) residues that can be tough to remove and make cleaning vape manufacturing equipment, tanks and laboratory glassware a challenge.

A concentration of 3–5% detergent (30–50 mL/L or 4–6 oz/gal) is a good place to start, and the highest temperature that can be reasonably achieved. Recall that heat expedites cleaning and higher concentrations increase capacity, or amount that can be removed by a detergent. Therefore, qualitatively speaking, if there is a large amount of resin, higher concentrations may be needed.

Alcojet® Low Foaming Powdered Detergent is ideal for washers with a cup-in-door designed to hold powdered detergent, often with a door that stays closed during the prewash cycle and then pops open during the wash cycle. These cups are sized to give a dose of roughly 1% detergent relative to the volume of wash water in the wash cycle.

In both manual and washer applications, the detergent amount, time and temperature can be optimized in collaboration with Alconox Inc. critical cleaning experts.

References

- The Aqueous Cleaning Handbook by Malcolm C. McLaughlin, M.A and Alan S. Zisman, M.D and the Technical Services Staff of Alconox Inc. Fourth Edition. Al Technical Communications, LLC White Plains, NY 2005.
- https://alconox.com
- https://technotes.alconox.com

Alconox Inc. Product Innovation

Alconox Inc. is honored to have reached our 75th anniversary milestone. Lets take a look back at some important dates in the company's history.

Pre 1941 While working at a hosiery company, chemist Louis Zisman learned about the emerging chemistry of synthetic surfactants. He discovered that a wetting agent he developed excelled at cleaning glassware without leaving a residue.

1940s Louis Zisman combined his talents with that of William Lebowitz, owner of Standard Scientific Supply Corporation. Standard Scientific was a distributor of products focused on the laboratory market. Together, they began selling and distributing detergent to hospitals and laboratories.

The detergent was first used in commerce on September 1st, 1943 and was coined, ALCONOX® Powdered Precision Cleaner.

Alconox Inc. was formed May 28th, 1946, to hold exclusive rights to ALCONOX detergent and its distribution.

1950s Alconox Inc. opens an office on 853 Broadway, New York, NY. Over time, more and more dealers signed up to distribute Alconox detergent and the product became widely distributed by just about every lab or hospital dealer.

Alconox Inc. launches a decade of innovation with some hits and some misses. They created the powdered detergent, ORANOX® Rust Inhibitor, that targeted dentists and oral surgeons. It was ultimately not successful and was discontinued in 1954. Recently, one box was recovered from an antique store in Albuquerque, New Mexico.

ALCOTABS® Tablet Pipet Detergent, a tablet solution to better clean siphon pipet washers, was developed and hit the market July 12th, 1957. The new, innovative, flotation cleaning, slow dissolving tablet allowed for cleaning over multiple cycles in the pipet washer resulting in better pipet cleaning.

Closing out the decade came another Alconox Inc. powerhouse, in fact our flagship detergent for lab washers. ALCOJET® Low Foaming Powdered Detergent was created and put in distribution August 12th, 1959. It was invented to provide a low-foaming detergent effective in automatic dishwasher glassware washing applications.

1960s On Oct. 28th, 1964 LIQUINOX® Critical Cleaning Liquid Detergent, was developed in response to customer requests for a phosphate-free detergent that would not interfere with biological oxygen demand (BOD) bottle washing where unrinsed bottles could result in contamination with phosphate essential nutrients causing false high readings in BOD testing.

1970s In order to improve removal of protein residues of blood, body fluids, and tissue for cleaning medical instruments, TERGAZYME® Enzyme-Active Powdered Detergent was introduced on November 21st, 1971.

In order to improve removal of protein residues of blood, body fluids, and tissue for cleaning medical instruments, TERGAZYME® Enzyme-Active Powdered Detergent was introduced on November 21st, 1971.

1980s In response to requests for a nonionic and ion-free detergent that does not leave conductive residues on electronic components, DETERGENT 8® Low-Foaming Ion-Free Detergent was introduced on July 14th, 1983.

For improved inorganic salts, oxides and acid labile residue cleaning, CITRANOX® Liquid Acid Cleaner and Detergent was introduced on December 8th, 1987.

1990s To help replace hazardous ozone depleting solvents that were being restricted by the Montreal Protocol, LUMINOX® Low-Foaming Neutral pH Liquid Detergent was first sold on April 21st, 1997.

2000s Per the need for a low foaming acid detergent and neutralizing rinse for automatic lab washers, CITRAJET® Low-Foam Liquid Acid Cleaner/Rinse was released on March 13th, 2001.

To address requests for an automatic lab washer phosphate free detergent for use in cleaning biological oxygen bottles (BOD), SOLUJET® Low-Foaming Phosphate-Free Liquid, went on sale July 2004.

Concurrently, TERGAJET® Low-Foaming Phosphate-Free Detergent was also released at the same time in order to have a powdered product for use in automated washer BOD bottle cleaning.

TERGAZYME makes a cameo on *Bones* Season 10 Episode 4.

Working with customers with difficult cosmetic polymer and sticky botanical extract residues we developed DETONOX® Ultimate Precision Cleaner, introduced in April 2015.

To match the manual cleaning power of DETONOX for cosmetic polymers and sticky botanical residues in an automated washer cleaning, KEYLAJET® Low-foaming Chelating High Alkaline Liquid was released on August 18th, 2016.

Alconox Inc. celebrates 75 years of solving critical cleaning challenges.

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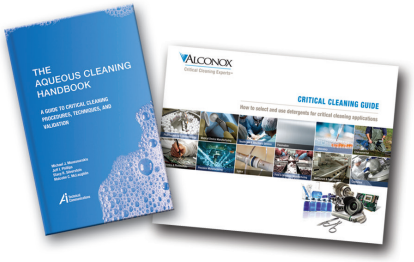
Get Validation Support or Help With Your Critical Cleaning Challenge

Alconox Inc. has more than 75 years' experience developing aqueous cleaning solutions for pharmaceutical manufacturing. Let us help solve your next critical cleaning challenge.

Please contact Alconox Inc. for expert validation support or verification laboratory services:

cleaning@alconox.com



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