

Pall Creates Effective Two-Step Filtration Method for Clarification and Color Removal for Ethanol Extraction in Cannabis Oil Production

Overview

The legalization of cannabis and hemp in different parts of North America has led to a rapid increase in the demand for cannabis oil. Experts predict the market for cannabis oils to grow at a 31.90% rate over the next four years with the combined market value of cannabis oil reaching \$45 billion.

There are several ways to extract cannabis oils, however, ethanol extraction is one of the most common methods, with cannabis oil producers applying expert and proprietary techniques for their unique brands. Clarification and color removal are often an essential step to provide consumers with a high-quality product.

Cannabis oil producers face several issues during the downstream filtration process. These challenges include long periods of time to process, labor intensive change outs, lower yields due to drip losses, difficulty of use and open-air systems that lead to quality and safety concerns. To solve these production concerns, Pall has worked with customers in the cannabis industry to solve these problems.

The Challenge

To keep up with demand for cannabis oil, ethanol extraction has grown in popularity in the industry as one of the more efficient ways to produce cannabis extract.

After extraction, the oil commonly undergoes a “winterization” process where the oil is chilled to -40°C / -40°F to further purify and refine the extract to increase its quality and value. At cold temperature, the plant waxes precipitate and can be more easily removed with subsequent filtration. Byproducts of the extraction process are other compounds, such as chlorophyll and carotenoids, that give the extracted liquid its deep green color.

In addition, producers are under more pressure to find economical methods to improve extract quality and filtration techniques. Manufacturers need to meet consumer expectations for compound rich oil with a clear golden character free of chlorophyll. Additionally, they need filter assemblies that are easy-to-use, modular and scalable for producers projecting aggressive growth.

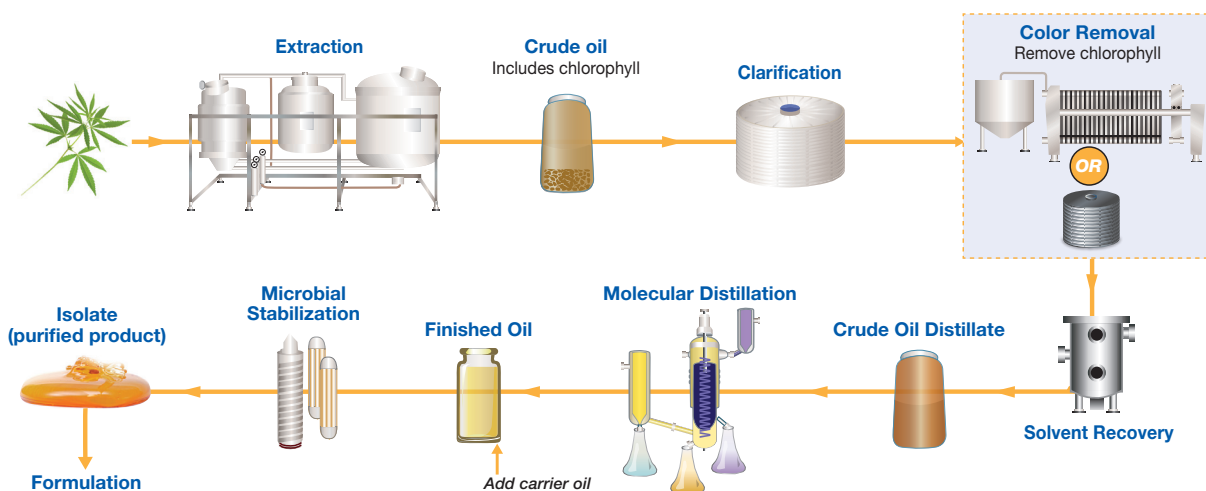


Figure 1: Typical Workflow for Ethanol Extraction

The Solution

Pall worked with cannabis extract producers using ethanol extraction equipment to develop a simple two-step filtration train to meet economic, quality and clarity requirements.

The recommended solution combines clarification and color removal. The first step for clarification utilizes Pall's patented **SUPRApak™** or **SUPRADisc™** technology for wax removal while the second step utilizes Pall's **SUPRADisc AKS** carbon impregnated filtration modules for chlorophyll reduction. The clarification step is performed at chilled temperatures, and the color removal step can be performed at room temperature. At low temperature, particle agglomeration and flocculation are encouraged and waxes harden. Consequently, there is less chance of the waxes being deformed and squeezed through the channels of filter media.

The Clarification Step

For the clarification step, Pall worked on a new solution utilizing SUPRApak or SUPRADisc technology to remove unwanted waxes while maintaining the quality-enhancing components that result in a clear, bright product. The sheet media has a unique matrix of components that provide an excellent combination of adsorption and mechanical removal making the SUPRA products the ideal solution. Compared to traditional methods used in cannabis, Pall's enclosed solutions reduce hold up volume and drip losses, maximizing the yield of highly valuable oils.

The high packing density of SUPRApak modules make them economical and a good fit for cannabis extract applications. SUPRApak L 16" modules have about 1.7 times the filter area of typical competitive 16" lenticular modules and would replace about twenty 40x40 flat sheet filters. For smaller batches, SUPRApak M or S size 7.5"

modules can be used. Also, the unique flow configuration maximizes the contact time the filtrate is interacting with the filter media, ultimately increasing removal efficiency of undesired solids.

For fluid streams with a higher particulate content, our SUPRADisc II line of lenticular filters offer an excellent option. Also comprised of our sheet media, these too combine surface, depth and adsorptive filtration while providing more dirt holding capacity to trap the increased solids load. Selected combinations of cellulose, filter aids, and other ingredients in the filter matrix result in a highly porous structure, which achieves effective filtration including coarse to fine particle removal, colloidal removal and final filtration.

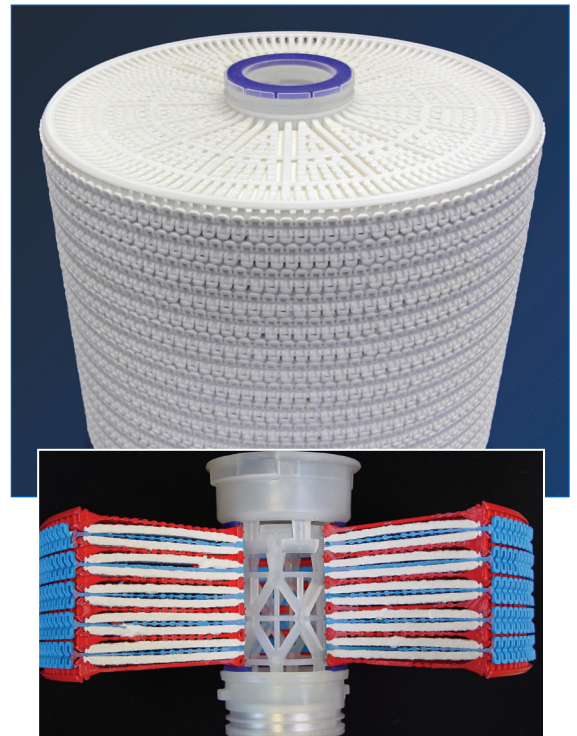


Figure 4 and 5: SUPRADisc II module with patented separator technology



Figure 2 and 3: SUPRApak Module and Enclosed Housing Assembly



SUPRADisc II Modules

Moderate to large batch size (26 to 132 gallons)
High solids load / high volume of waxes
Cold-pressed extracts
No upstream pre-filtration

SUPRApak Modules

Large volume of extracts
Low solids load / minimal wax
SUPRApak S for small batch size (13 gallons or less)
Higher filter area compared to lenticulars

Figure 6: Benefits of SUPRADisc II and SUPRApak Modules

SUPRADisc II modules offer increased capacity, reliability and handling advantages. The robust design satisfies customer need and the requirement for higher performing products. Modules come in 12" and 16" sizes, boasting surface areas of 1.5 m² and 5 m² respectively. Customers can easily scale their operation up to 4 modules that can be vertically stacked atop one another.

housings. In AKS modules, carbon is integrated into the filter matrix without the use of any binding agents. This maintains the adsorptive capacity and does not introduce any materials that might degrade or negatively impact the oil. Figure 8 below shows samples of raw oil (left), oil after filtration with SUPRApak modules for clarification (middle) and oil post treatment of SUPRADisc AKS modules for color removal (right).



Figure 7: Cannabis oil samples from an ethanol extraction process. Raw oil (left), after filtration with SUPRA technology for clarification (right).

The Color Removal Step

After clarification, a carbon treatment step helps to achieve the desired golden hue by removing the green color resulting from chlorophyll in the cannabis plant. There are different methods available for activated carbon treatment including manual addition of carbon powder or granules and carbon packed columns. While manual carbon addition is low cost and effective, it is labor intensive, messy and requires enhanced attention to operators' health and safety. Packed carbon columns often bleed carbon downstream. Carbon bleed can be resolved with two options: recirculation through the filter train and cartridge trap filters placed directly after the carbon column.

As an alternative, carbon impregnated SUPRADisc AKS Series filter modules make for easier handling and more hygienic carbon treatment of small batches with modules that fit directly into enclosed

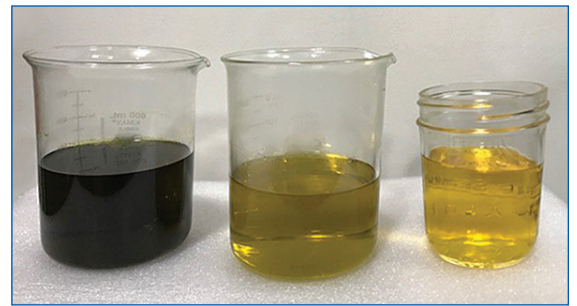


Figure 8: Cannabis oil samples from an ethanol extraction process. The beaker on the left shows feed before clarification, the middle beaker shows filtrate post SUPRApak module and the beaker on the right shows filtrate after color reduction (chlorophyll) with SUPRADisc AKS modules.

For the AKS modules, two layers of the filter media are joined to form a cell. The cell is sealed around the edges and then assembled into a stack to form the module. See Figure 9. The typical recommended flow rate per 12" module is from 5.7 to 9.5 lpm (1.5 to 2.5 gpm). Over time, the activated carbon in the modules will become exhausted and the modules should be changed.



Figure 9: SUPRADisc AKS Module

Main SUPRAdisc AKS Benefits for Cannabis Oil Producers

- ✓ Reduction of green color from chlorophyll
- ✓ Easy and hygienic alternative compared to manual carbon addition or packed columns
- ✓ Reduced carbon bleed or carryover

SUPRA Module Housings

Pall offers a range of stainless-steel module housings for the SUPRApak, SUPRAdisc II, and SUPRAdisc AKS Series Modules. The closed assemblies eliminate drip losses resulting in higher yields than traditional sheet filter assemblies. Furthermore, when a batch is complete, inert gas can be used to push out the remaining liquid in the housing resulting in more recovered product and faster filter changes.



The Benefits

Through working with Pall and implementing modular technology, manufacturers can realize the following benefits:

- Minimal spare parts and maintenance
- Simple inline solution, which reduces oxidation
- GMP and FCC compliance for applications in cannabis oil
- Reduced operating costs with a short return on investment
- Module change-outs are quicker and easier than traditional sheet filter changes
- Improved filtrate quality utilizing high quality products that are reliable and durable
- Enclosed assembly increases yield by eliminating drip losses and enabling a gas blow down at the end of a batch
- Enclosed assembly increases process security by preventing contamination that can result from open filter sheet or Buchner funnel assemblies

Pall Food and Beverage Cannabis Filtration Expertise

Extracting the various cannabinoids is a complex process that is continually evolving. With over 70 years of application experience and product development in Food and Beverage, Pall offers itself not only as an informed filtration solutions provider, but also as an informed technical partner, who understands how to adapt and create products that meet the needs of emerging markets. As production needs evolve within the cannabis market, Pall is the partner that can adapt and grow with you in this rapidly changing market.

References

- ¹ Data Bridge Market Research —
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Pall Corporation works to protect what matters every day by providing filtration, separation, and purification solutions to businesses across the globe. Pall serves the food and beverage industries with advanced membrane filtration technology and systems, enabling companies to produce shelf-stable, consumer-safe products at the lowest operating cost.

There are only a few companies in the world that can effectively do what we do, and none of them match our combination of product breadth and performance across traditional filters and system solutions with our depth of application knowledge.

To learn more about Pall Food & Beverage visit www.pall.com/foodandbev.

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Pall Corporation

Pall Food and Beverage

25 Harbor Park Drive
Port Washington NY 11050
+1 516 484 3600 telephone
+1 866 905 7255 toll free US

foodandbeverage@pall.com




Visit us on the Web at www.pall.com/foodandbev

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