Why AODD Pumps Are the Right Choice in the Production of Hemp-Based CBD Oil Products

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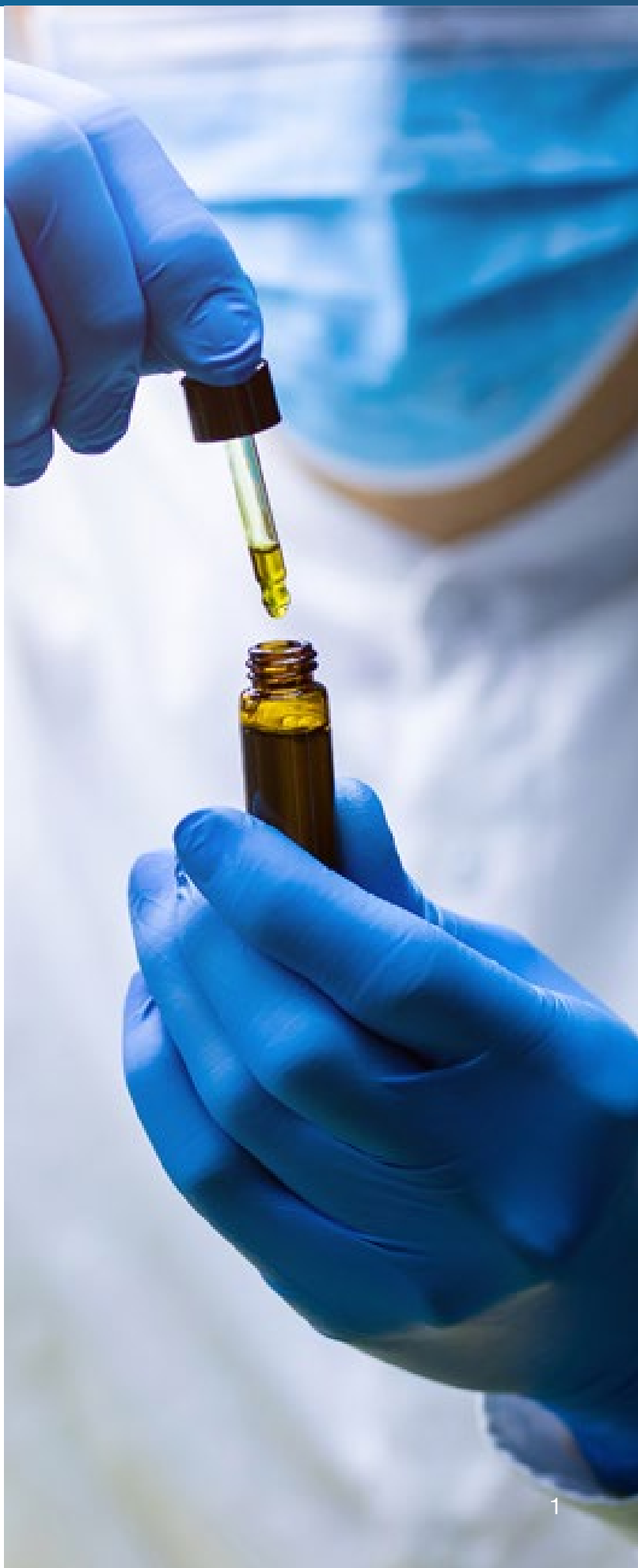
The production of hemp-based cannabidiol (CBD) oil has exploded globally over the past several years. Hemp-based CBD is taking on countless form factors, from topical treatments to edibles and beverages. There are also countless methods of extracting CBD oil from hemp plants, with the most common being ethanol, supercritical CO2 and hydrocarbon.

All extraction processes present unique pumping challenges, such as extreme low temperature and combustible, viscous and solids-laden fluids. Whether you're a large-scale producer, small-scale lab, equipment maker or consultant, you need a resource you can trust to provide the right pump for your application.

This whitepaper will dive into the advantages that air-operated double-diaphragm (AODD) pumps have over other technologies when used in the production of CBD oil. It will also provide guidance on where and how these pumps can provide safety and reliability for your process, including extraction, pre-winterization, solvent recovery, product filtration and more.



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Reasons to Choose AODD Pumps Over Other Pumping Technologies

With so many pumps on the market, including centrifugal, lobe, gear, screw, hose and piston/plunger, it can be tough to find the information you need to make the right choice.

One type of pump, however, has proven itself as a market leader when it comes to reliability, versatility and ease of maintenance: the AODD pump.

AODD pumps deliver unique benefits that are unrivaled by other pump technologies, which is why a wide range of industries rely on them to keep their operations running smoothly. These pumps require little maintenance and are cost-effective solutions for transferring almost any viscous fluid safely. Here are some additional benefits of AODD pumps:

- **Safety:** AODD pumps don't require electricity and can be grounded to prevent static buildup/explosive situations for pumping flammable solvents like ethanol.
- **Solids handling:** They can handle solids and slurries, such as biomass.
- **Deadhead:** When the pressure on the fluid discharge equalizes, the pump will stop pumping with no damage. This is common on filter press filtration applications.
- **Dry running:** They can run dry without damage. This is very beneficial when transferring products from tank to tank, such as in the CBD oil manufacturing process.
- **Low initial cost:** Their purchase price is usually less than other pumping technologies.
- **Low-temperature operation:** They can run at temperatures as low as -40 degrees Fahrenheit/Celsius, which is crucial in the production of CBD oil.
- **Simple installation:** They have a very simple design versus other pump technologies. There's no need for an elaborate setup or control systems.

Primary CBD Oil Extraction Methods

There are three primary methods of extracting CBD oil from hemp:

1. Supercritical C02 Extraction

This method has been commonly used for years to decaffeinate coffee and to create vanilla extract. It has been adopted more recently for CBD oil production. Supercritical CO2 extraction is when CO2 (at high pressure and very low temperatures) is forced through cannabis biomass. The process extracts the CBD oil out of the biomass while also removing unwanted substances, like chlorophyll.

2. Ethanol Extraction

Chilled ethanol (-40 degrees Fahrenheit to -80 degrees Fahrenheit) is mixed with cannabis biomass to create a reaction. The oils, waxes and lipids are released from the cannabis biomass and attach to the chilled ethanol molecules. The ethanol is then distilled to remove the ethanol and leave the remaining extracted product, known by many as crude oil. The remaining CBD crude oil is distilled and refined to separate the cannabinoids (clear valuable oil) and non-cannabinoids (dark waste residue).

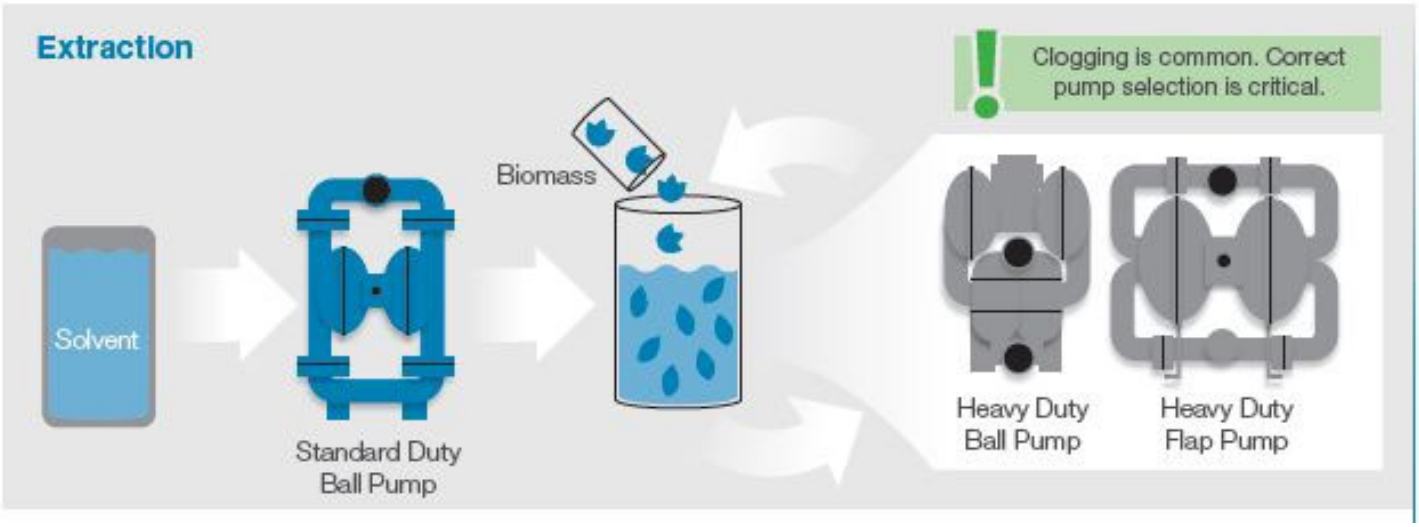
3. Hydrocarbon Solvent Extraction (Butane, Propane and Petroleum)

Hydrocarbons are introduced to the cannabis biomass and the oils bond to the hydrocarbon molecules. The hydrocarbons are then removed, leaving the CBD crude oil to be processed as in the ethanol extraction process.

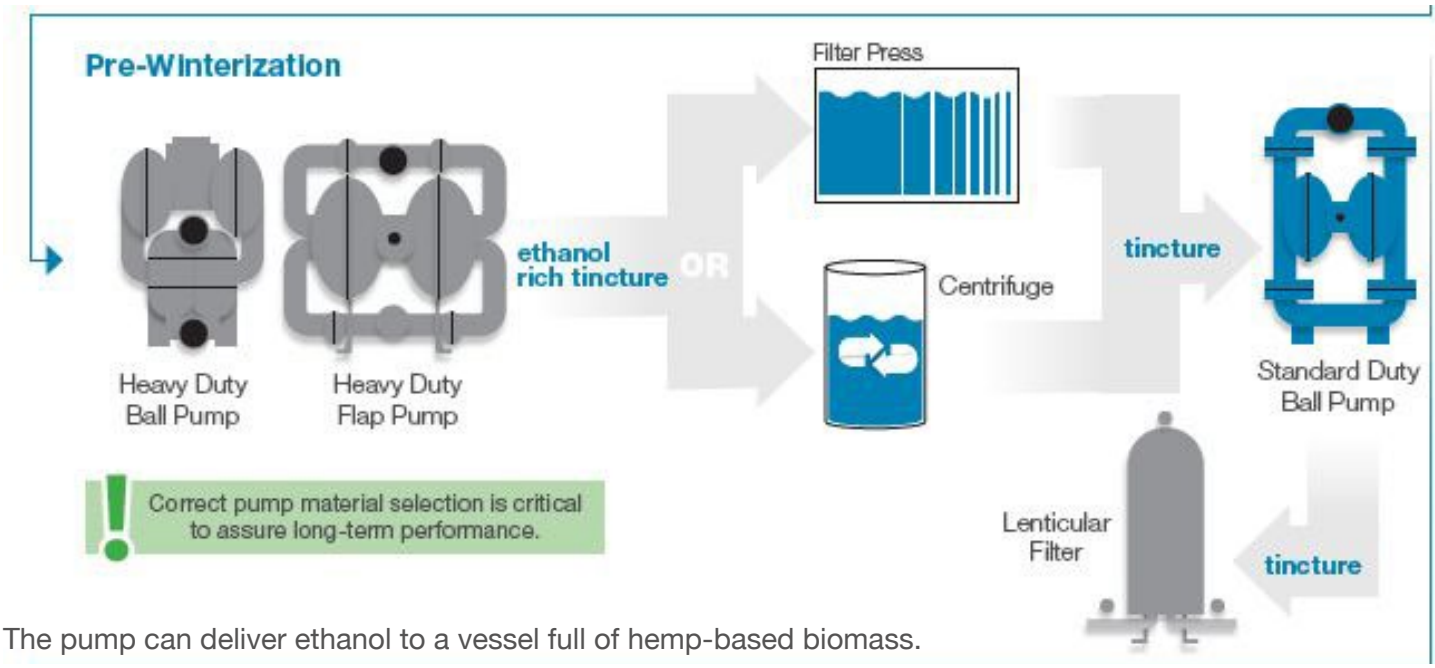
There are many methods to extract CBD oil from cannabis biomass. AODD pumps are mainly used as key process pumps in the ethanol extraction process by providing safe and efficient delivery of liquids.

Areas Where AODD Pumps Are the Best Solution

Extraction



Pre-Winterization



The pump can deliver ethanol to a vessel full of hemp-based biomass. They can also deliver a biomass slurry (biomass ethanol mixture) to the vessel using the AODD pump for winterization and extraction.

Tip: *For pumping liquids containing solids, consider using solids handling heavy-duty flap (HDF) valve or heavy-duty ball (HDB) valve pumps.*

Areas Where AODD Pumps Are the Best Solution *(Cont.)*

Winterization

AODD pumps can deliver and circulate the chilled ethanol (-40 degrees Fahrenheit) to extract the CBD oils from the biomass. If the biomass is free in the ethanol, you might need a flap valve-type pump. But if the biomass is in a “teabag” or is contained, then a standard AODD unit would work fine as solids will not be a factor.

Filtration/Decolorization

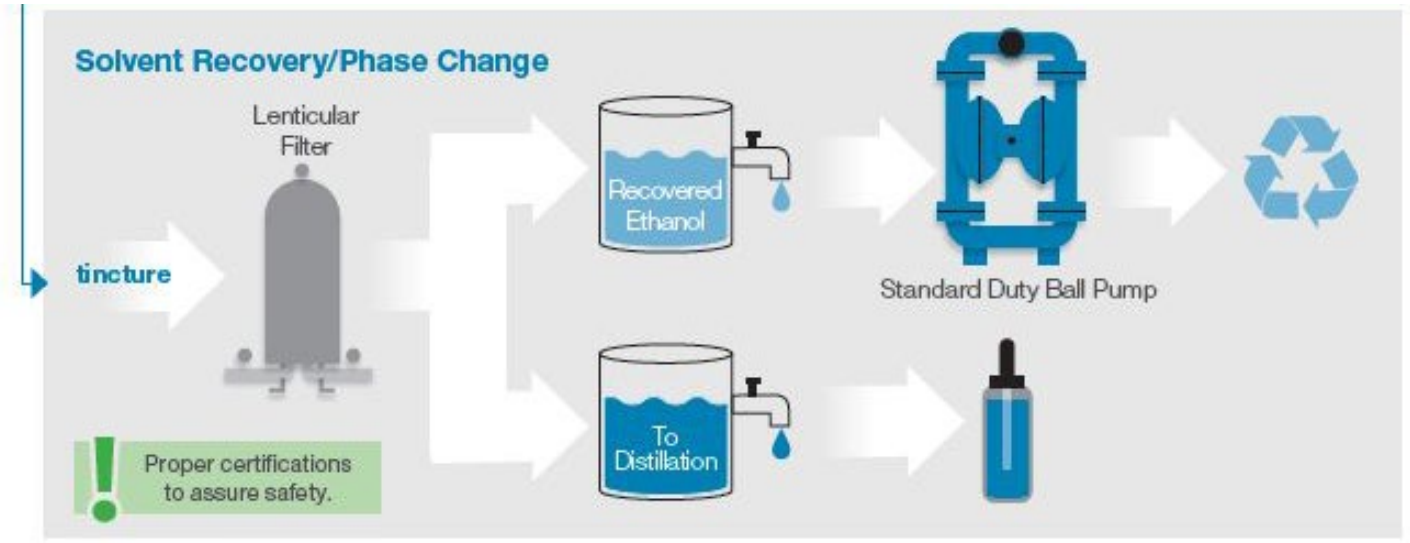
AODD pumps are widely utilized in the filtration process of the tincture. They are an optimal choice because AODD pumps can produce a wide range of pressures and can deadhead without damage when the filter plates in a plate and frame press become filled with cake/waste.

Also, they are used in conjunction with a decanter centrifuge for oil extraction from the hemp-based biomass. Once the filtration and distillation phase remove waxes, lipids and fine particles of biomass, the tincture is pumped by an AODD pump to a lenticular filter for additional refinement.

Areas Where AODD Pumps Are the Best Solution *(Cont.)*

Solvent Recovery/Phase Change

The final phases are the process of recovering the ethanol from the tincture and then distilling the remaining crude oil/distillate into the final product. The ethanol is heated and condensed off, leaving just the crude oil/distillate. An AODD pump is used to pump this ethanol back to be reused in the process.



The final distillation removes any remaining unwanted materials, such as lipids, waxes, cannabinoids, chlorophyll, terpenes and other impurities. The final distillation phase creates the golden final product that is clear, bright and enjoyable.

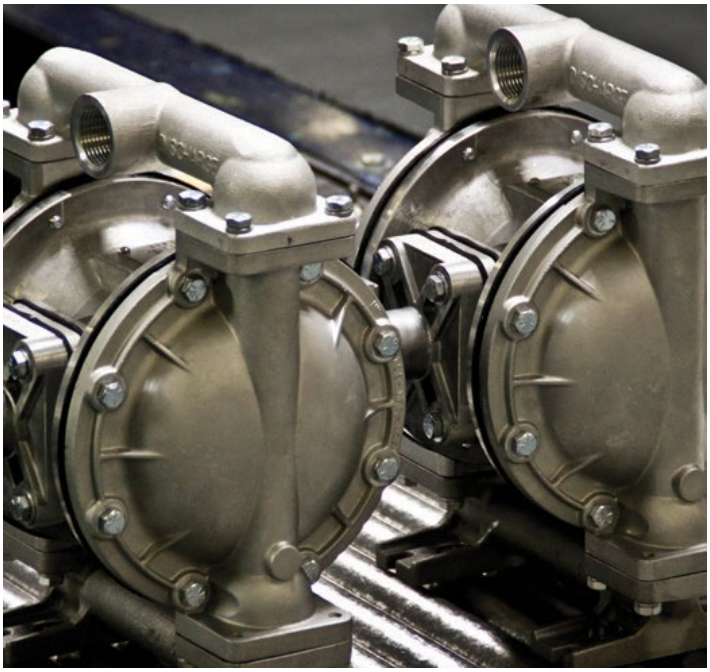
The SANDPIPER Difference

SANDPIPER offers problem-solving AODD pump designs like HDB valve and HDF valve pumps. These designs are perfect for handling solids and slurries that standard-duty ball (SDB) valve AODD pumps can't.

SANDPIPER also offers the best SDB valve pumps on the market today, with features like an externally serviceable air distribution system (ESADS) for ease of maintenance. The air valve is also available in an all-metallic design to effectively handle extremely cold temperatures.

When it comes to safety, SANDPIPER offers each of its designs in groundable ATEX-certified models for the safe transfer of flammable liquids, such as ethanol.

FDA-compliant food processing pumps are also available for the safe, clean transfer of CBD oil products and solutions. In clamped style or bolted construction, they are simple to disassemble for cleaning and repair. Electropolished casting and FDA-compliant materials ensure cleanliness can be maintained. These styles of AODD pumps can be used when adding flavors and mixing CBD with other edible products.



Commonly Used Applications for SANDPIPER AODD Pumps in Hemp-Based CBD Production

- Chilled Ethanol transfer
- Biomass slurry transfer
- Ethanol-Rich Tincture transfer
- Filter Press systems
- Centrifuge systems
- Lenticular filter systems
- Ethanol recovery
- Wax and lipid transfer

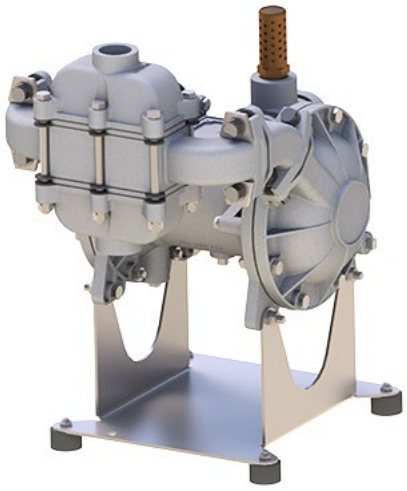
Commonly Used SANDPIPER AODD Pumps in the Hemp-Based CBD Industry

Solvent Filling, Transfer and Recovery

- 1" (S1F) Standard-Duty Ball Metallic & Non-Metallic
- 1 ½" (S15) Standard-Duty Ball Metallic & Non-Metallic
- 2" (S20) Standard-Duty Ball Metallic & Non-Metallic

Biomass Transfer and Pre-Winterization With Large or Suspended Solids

- 1" (HDF1) Metallic Heavy-Duty Flap
- 2" (HDF2) Metallic Heavy-Duty Flap

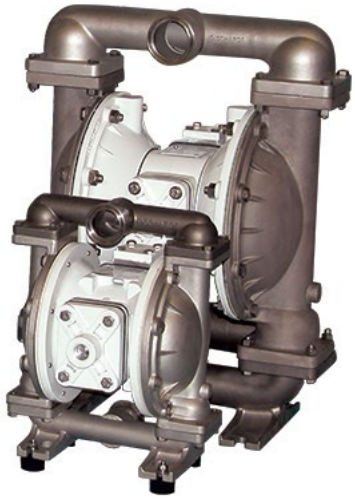


Biomass Transfer and Pre-Winterization With Viscous or Settling Solids

- 1" (SB1) Metallic Heavy-Duty Ball Valve
- 2" (HDB2) Metallic Heavy-Duty Ball Valve

FDA-Compliant for CBD Oil Filtration

- 1" (T1F) FDA Bolted Stainless
- 2" (F20) FDA Clamped Stainless



SANDPIPER provides the most engineered product solutions of any AODD pump manufacturer. Our AODD pump portfolio is the broadest and most versatile, and we have engineered solutions for hemp-based CBD oil extraction as well as post-recovery and filtration systems.To learn more, please feel free to reach out to one of our seasoned application engineers for guidance.

Glossary of Terms Commonly Used in the Production of Hemp-Based CBD Oil

Biomass: Hemp-based CBD biomass refers to excess hemp plant material that is rich in CBD. This kind of biomass is best used to extract CBD oils, distillate or isolate. It can be ground or in pellet form.

Cannabidiol: The scientific name for CBD. It is a phytocannabinoid (one of 113 found in the hemp plant).

Cannabis: A plant that is part of the hemp family. Cannabis is a genus of plants from which CBD is derived.

CBD Oil: An abbreviation for cannabidiol oil. CBD can only contain no more than .03 percent THC by law and does not have any psychoactive properties.

Crystalline-Isolate: This is CBD oil that has been processed to eliminate all cannabinoids, which includes THC. This product is preferred by those who take drug tests as standard CBD oil contains trace amounts of THC.

Flavonoids: Flavonoids are plant compounds that are abundant, biologically active and water-soluble. For humans, flavonoids are important antioxidants and are reported to have a variety of benefits, such as reduction of free radicals, anti-inflammatory and anti-allergic effects.

Full-Spectrum Oil: A full-spectrum CBD oil is an extract that has not been purified, isolated or refined in any way, which would remove the other naturally occurring elements of the hemp plant, such as terpenes, lipids, waxes or other cannabinoids.

Hemp: Hemp is a variety of the cannabis plant, which is grown for industrial purposes and contains extremely low concentrations of THC (less than 0.3 percent), as defined by the Agricultural Act of 2018. Hemp does, however, contain high quantities of CBD, making it a common source for CBD products.

Hemp Oil: The term hemp oil most commonly refers to oil made from the seeds of the hemp plant. It can also be called hemp seed oil. While hemp oil does contain trace amounts of CBD, it is only present in extremely low concentrations, making it an unreliable source of CBD.

Lipids: Any of a class of organic compounds that are fatty acids or derivatives. They include many natural oils and waxes.

Marijuana: Marijuana is any plant in the cannabis family defined by its THC content being higher than 0.3 percent by dry weight, as opposed to hemp, which contains a lower percentage of THC. Marijuana includes two types of plants: cannabis Sativa and cannabis Indica.

Terpenes: Terpenes are natural, organic compounds present in a wide variety of plants and are responsible for taste and scent.

THC: THC, or tetrahydrocannabinol, is the main psychoactive compound in marijuana. THC is responsible for producing the “high” sensation or mind-altering effect of marijuana consumption.

Tincture: Tinctures are most commonly a mixture of alcohol and water, which is used to naturally extract CBD oil, although other methods can be used, such as glycerin, vinegar or oils. Other ingredients may then be added to a tincture to create a more distinctive product, such as essential oils for flavoring.

Supercritical CO2 Extraction: This process uses highly pressurized carbon dioxide and forces it through hemp-based biomass to extract CBD in a clean and efficient way.

Winterization: Winterization is a refinement process of taking “raw” hemp oil once extracted, adding an alcohol to it, then freezing it. This process separates any phytonutrients, chlorophyll, waxes and fats as well as most terpenes from the oil, leaving a more purified CBD product.