

# Essential Oil Extraction from Hemp

Jacob Maupin, Shayne Stroh, Ryan Butcher Weltman

Dept. of Chemical Engineering, Oregon State University, Corvallis, OR

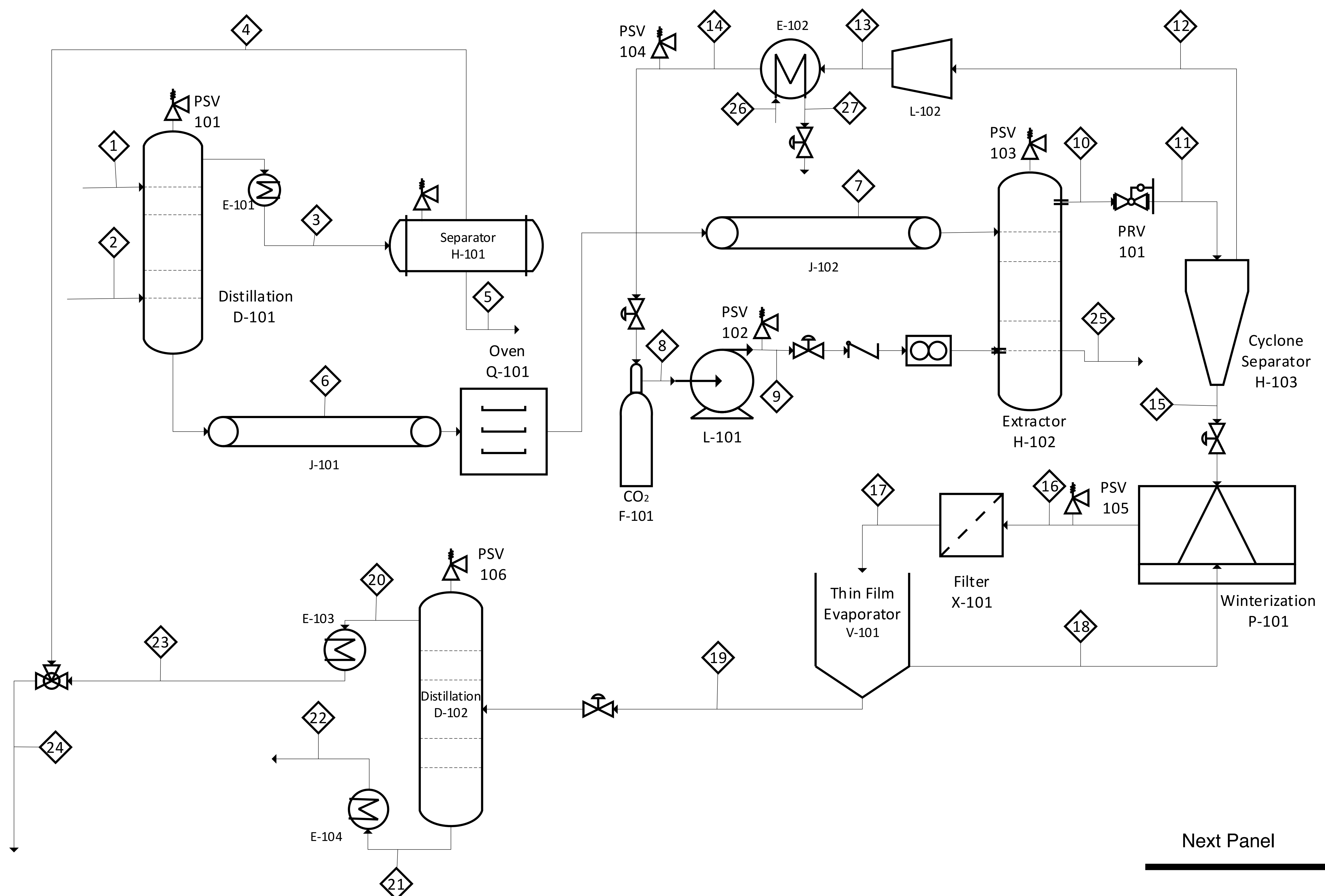
## Essential Oils from Hemp

- All parts of the hemp plant can be used. The stalks can be turned into paper, the buds can be sold separately, and the trimmings can be used for extractions.<sup>1</sup> This project focuses on the trimmings essential oil extraction.
- There is a demand for this extract in various sectors; pharmaceuticals, food/beverages, & personal care/cosmetics.<sup>2</sup> Hemp extract is sold as unprocessed buds, edibles, tinctures, concentrates, & more.<sup>2</sup> The desired botanicals are targeted and separated from the rest of the plant to make many of these products.
- Hemp is a new, rapidly growing industry with much profit potential. The hemp extract industry is forecasted to grow 22.2% in the next five years.<sup>1,2</sup>
- From initial economic surveys, full-spectrum tinctures in America sells for an average \$142 per gram. This process aims to preserve the terpene profile for a more marketable product. Experimentation is needed to determine the amount of CO<sub>2</sub> and energy to the refrigerator to determine the real cost of operation.
- This process is designed to fit inside a warehouse. The refrigerator (P-101) must cool the incoming oil for two days (~400 lb oil at any given time), making it likely the highest operational cost. The extractor column (H-102) will be ~3.0 m tall.

## Process Description

- The first step in the process is to remove the terpenes from the hemp in a steam distillation column. This is done to preserve these valuable compound because they are highly heat sensitive.
- Next, the plant matter is sent through an oven at 112 °C to decarbonize the desired compound, making it more bioavailable. This also dries the plant matter.
- Then the desired compound is extracted via supercritical CO<sub>2</sub>. This solvent was chosen because it is food-grade FDA approved. It is also easy to remove and recycle in a cyclone separator, for a greener process. *More details on the other panel.*
- The oil from the cyclone separator will be gravity-fed into a refrigerator for the winterization process in the presence of 10% ethanol to remove the fats, waxes, and oils from the desired compound.
- The thin film evaporator removes the ethanol from the concentrate. The ethanol is recyclable.
- In the final step, the oil is further concentrated in a distillation column to reach 99% purity of products.

## Process Flow Diagram

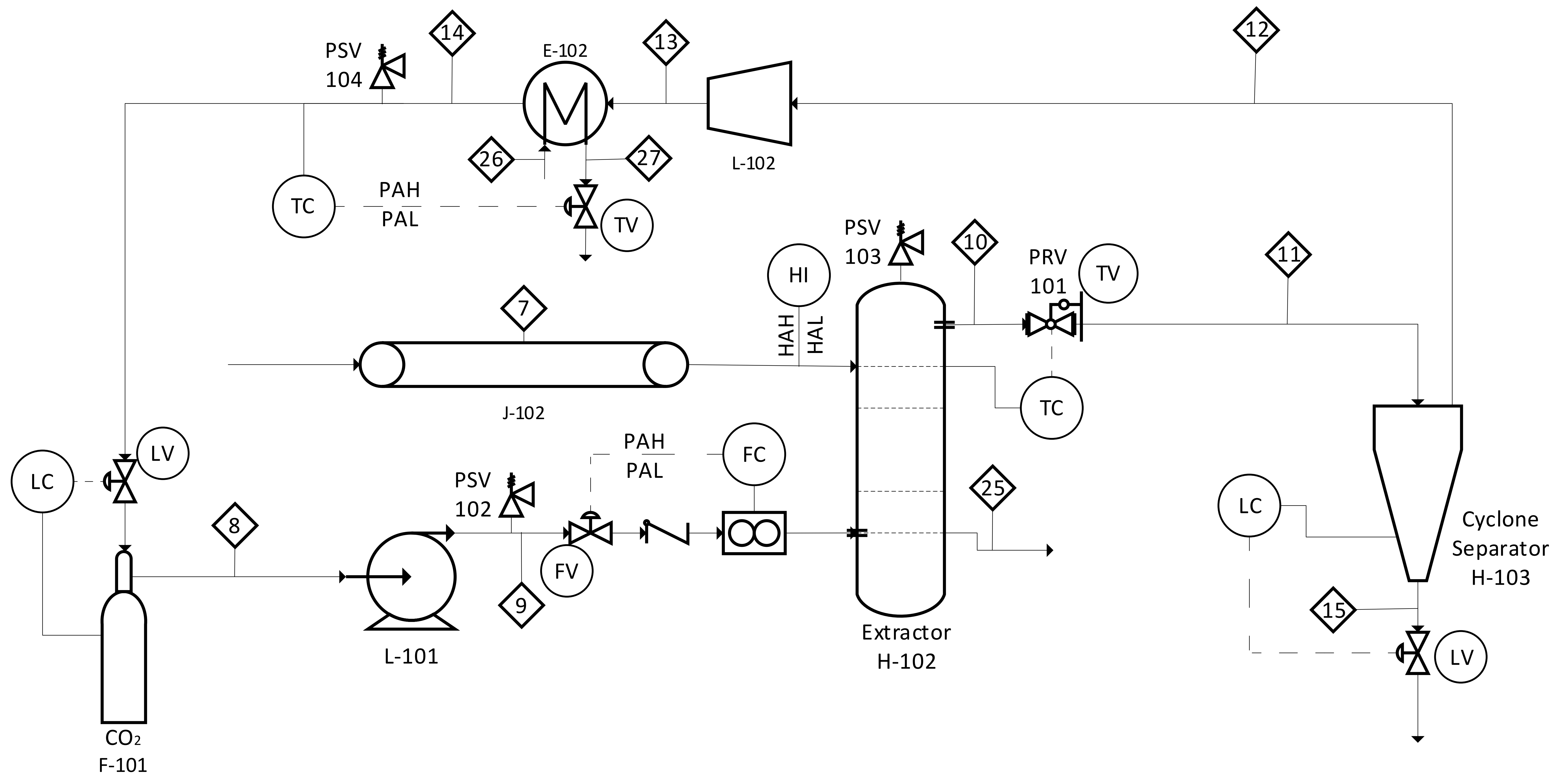


Next Panel

# Essential Oil Extraction from Hemp

Jacob Maupin, Shayne Stroh, Ryan Butcher Weltman  
Dept. of Chemical Engineering, Oregon State University, Corvallis, OR

## Extractor P&ID



## Extractor Detailed Description

- Liquid CO<sub>2</sub> in F-101 is pumped into extractor H-102 from stream 8 to 9
- CO<sub>2</sub> becomes supercritical (sCO<sub>2</sub>) in the extractor by heating and increased pressure within the extractor
- Decarboxylated hemp is fed to top of extractor with conveyor belt
- Pressure regulating valve at top will decrease the pressure to atmospheric pressure
- Stream 11 will lead to a cyclone separator H-103 that will separate the CO<sub>2</sub> and the oil extract from the plant matter
- CO<sub>2</sub> that is removed in the separator will rise into stream 12 which will then be compressed and brought down in temperature to be placed back into the CO<sub>2</sub> canister
- This recycling of CO<sub>2</sub> is to save on solvent, and to limit the release of CO<sub>2</sub> to the environment since CO<sub>2</sub> is a green house gas
- There are controllers in place that help control the flow, temperature, pressure, and level at different parts of the extraction process. Also, there are high and low alarms added to ensure that the process is safe. More details can be seen in the safety portion.

## Safety

- Flow controller added to sCO<sub>2</sub> inlet. This ensures the correct amount of sCO<sub>2</sub> is flowing into the system. There is also a check valve on this line to ensure that CO<sub>2</sub> does not flow back into the pump.
- A level valve and level controller were added to the CO<sub>2</sub> tank to ensure the level of CO<sub>2</sub> does not get too low or overfill.
- A temperature controller with pressure alarm high, pressure alarm low, and temperature valve were added to the sCO<sub>2</sub> condenser to adequately control the temperature of the recycle stream. The pressure alarms ensure the operators will be alerted to any significant deviation from intended pressure.
- A combination of a humidity indicator, humidity alarm high, and humidity alarm low were added to the incoming hemp. This ensures there is not an excessive amount of moisture in the extract.

## Reference Links:

- [1] <https://www.grandviewresearch.com/industry-analysis/cannabidiol-cbd-market>  
[2] <https://www.databridgemarketresearch.com>

doi:10.1089/can.2016.0020  
doi:10.1016/j.supflu.2017.03.014

doi:10.1016/j.indcrop.2011.09.015  
doi:10.1016/j.jcou.2018.12.014

doi:10.1016/j.cofs.2019.04.007  
doi:10.1186/1475-2875-10-s1-s4