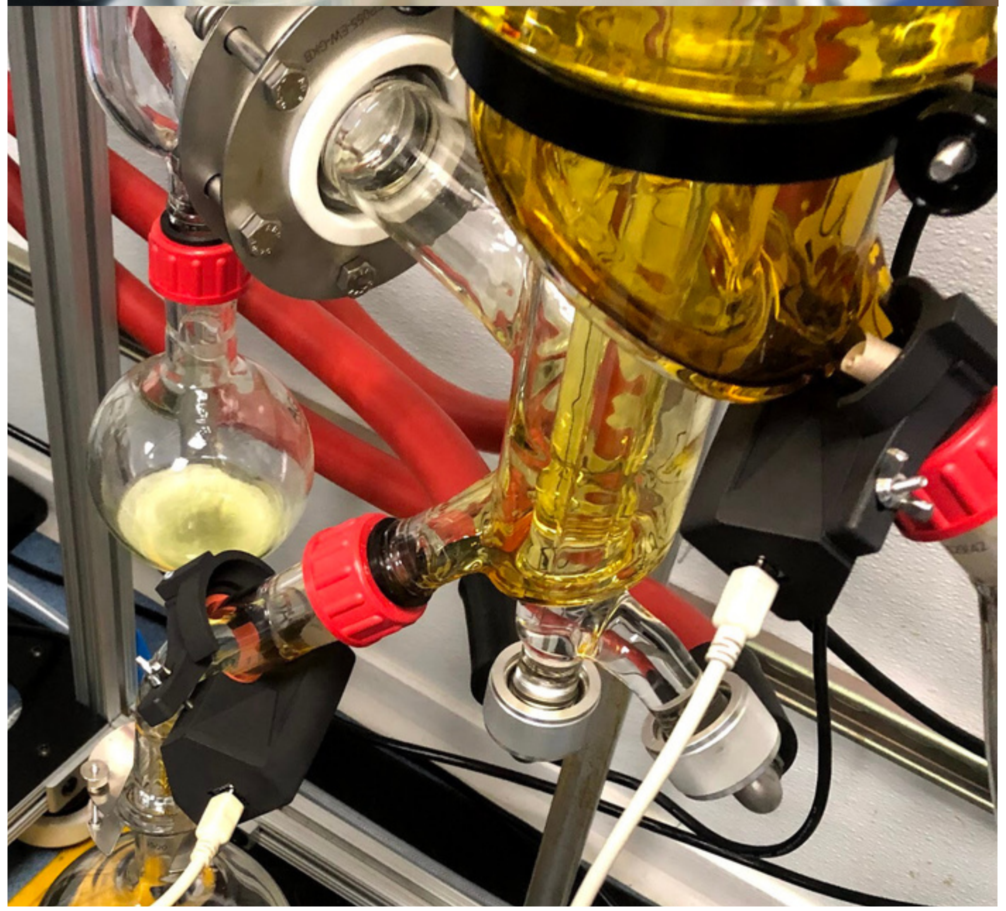
AROMETRIX

Arometrix Technology Overview

AROMETRIX

by AccuStrata & DigiVac



OUR VISION

TO BE THE STANDARD

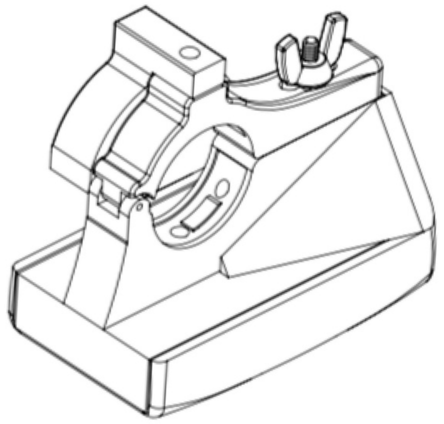
for **quality monitoring**, **compliance**, and **purity**

of life-transforming plant extracts

Our Technology: What You Need to Know

PATENTED, REAL-TIME MOLECULAR ANALYZERS FOR CANNABIS PROCESSING

- In-Line Spectroscopic Sensor
- Real-Time Molecular Data
- Applicable to Various Processes
- Objective Process Monitoring
- Precision & Repeatability
- Log Data for QA/QC Traceability



Before this Technology

Our customers relied on color changes to judge quality, which is highly subjective

Traditional cannabis analytical equipment is not capable of in-line, real-time analysis

What is the result of this lack of analytics? Human error, imprecision, “bad” batches, inconsistencies,

With this Technology

Arometrix technology's design utilizes the same science the traditional analyzers use

Our sensor is designed to support all sizes and brands of processing equipment

Our digital readout shows real-time molecular levels, giving you the tools to increase precision and repeatability

FUNDAMENTALS

High-Quality Digital Display

Miniature Optical Sensor

FLUORESCENCE SPECTROSCOPY

Our patent-pending technology utilizes a scientific method of measuring how molecules respond to light.

- **Spectroscopy:** The broad study of how light interacts with other light, surfaces, molecules, etc.
- **Fluorescence:** The light produced after a wavelength is exposed to it.

In Situ Fluorescence Spectroscopy for In-Line Distillation Process Monitoring

Currently, cannabis distillation requires specialized personnel, which raises costs and lowers yields. Furthermore, process monitoring is dependent on indirect controls, such as temperature, flow, and color. Here, fluorescence spectroscopy was investigated as an in-line process monitoring tool for cannabis distillation to alleviate these challenges. First, excitation emission matrix spectroscopy (EEMS) was utilized to determine optimal excitation wavelengths for various stages of fractional distillation. Based on these results, a benchtop fluorometer that could use various excitation wavelengths was developed. Samples of extract, distillate, and pure laboratory grade cannabidiol (CBD), cannabidiolic acid (CBDA), delta-8 tetrahydrocannabinol (Δ^8-THC), and delta-9-tetrahydrocannabinol (Δ^9-THC) standards were measured with the benchtop system. The measurements from the extract and distillate samples exhibited several fluorescence peaks. These measurements depended on the processing conditions and product quality of the tested samples. Measurements of the chemical standards exhibited similar fluorescence to the extract and distillate samples. Finally, an in-line sensor was developed and installed on a short path distillation system (SPD). Measurement from the in-line sensor showed distinct differences between distillation fractions validating its capability as a cannabis distillation process monitoring tool.

Jonathan Kenneth Bunn, Christopher Jason Metting, and Hasso von Bredow

The rising commercial interest in cannabis extract and distillate is increasing the need for more rapid and precise extraction and distillation methods. This need is especially critical for more precise dosing of compounds derived from cannabis for medical applications. While many common distillation methods exist (short path distillation, wiped film distillation, column separation, and so on) the techniques are highly technical and often can only be carried out by specialized personnel. This leads to lower production volumes and higher costs. To help reduce costs and increase purity of cannabis distillation, more precise and intuitive process control tools are needed.

Historically, fluorescence spectroscopy has been used for inline process control and quality control in several industries, including pharmaceuticals and food safety (1–8). Furthermore, studies on cannabinoids and their metabolites indicate that many of the compounds derived from cannabis will have unique spectroscopic properties, including fluorescing under ultraviolet (UV) light and Raman signal (9–15). While some literature exists, very little work has been published on using these unique optical properties to provide a process control system that can help improve product safety and purity.

Distillations of cannabis extract are carried out at temperatures reaching over 165 °C and under vacuum pressure. Vacuum distillation is utilized because desired cannabinoids chemically degrade into undesired compounds at temperatures below their boiling point under atmospheric pressure. This degradation is either decelerated greatly or completely halted under vacuum pressure.

The required vacuum pressure and temperature make the process of selecting and adding an in-line sensor challenging. The sensor must be robust enough to function under harsh conditions without creating undue risk of vacuum leaks during operation. This challenge is only exacerbated when considering a sensor that can be retrofitted onto existing distillation systems. Optical metrology methods are a promising approach for process control because they can probe processed material through a sight-glass or glass tube positioned away from the heat source. Specifically, fluorescence spectroscopy is a promising method to investigate the presence or absence of auto-fluorescing compounds within the distillate throughout the process.

In this work, fluorescence spectroscopy is investigated as a process monitoring technique for short path distillation (SPD).

Experimental

Excitation Emission Matrix Spectroscopy

A portable benchtop excitation emission matrix spectrometer (EEMS) was developed to determine the optimal excitation wavelength that could be used for monitoring fluorescence during the distillation of cannabinoids. Figure 1 shows the EEMS system used to investigate the approach.

For the excitation components of the instrument, the EEMS system used a Lambda LS Xenon Arc Lamp (Sutter Instrument)

R&D ARTICLE

PEER-REVIEWED AND PUBLISHED ARTICLE

Cannabis Science and Technology

(Volume 2, Issue 5) in 2019.

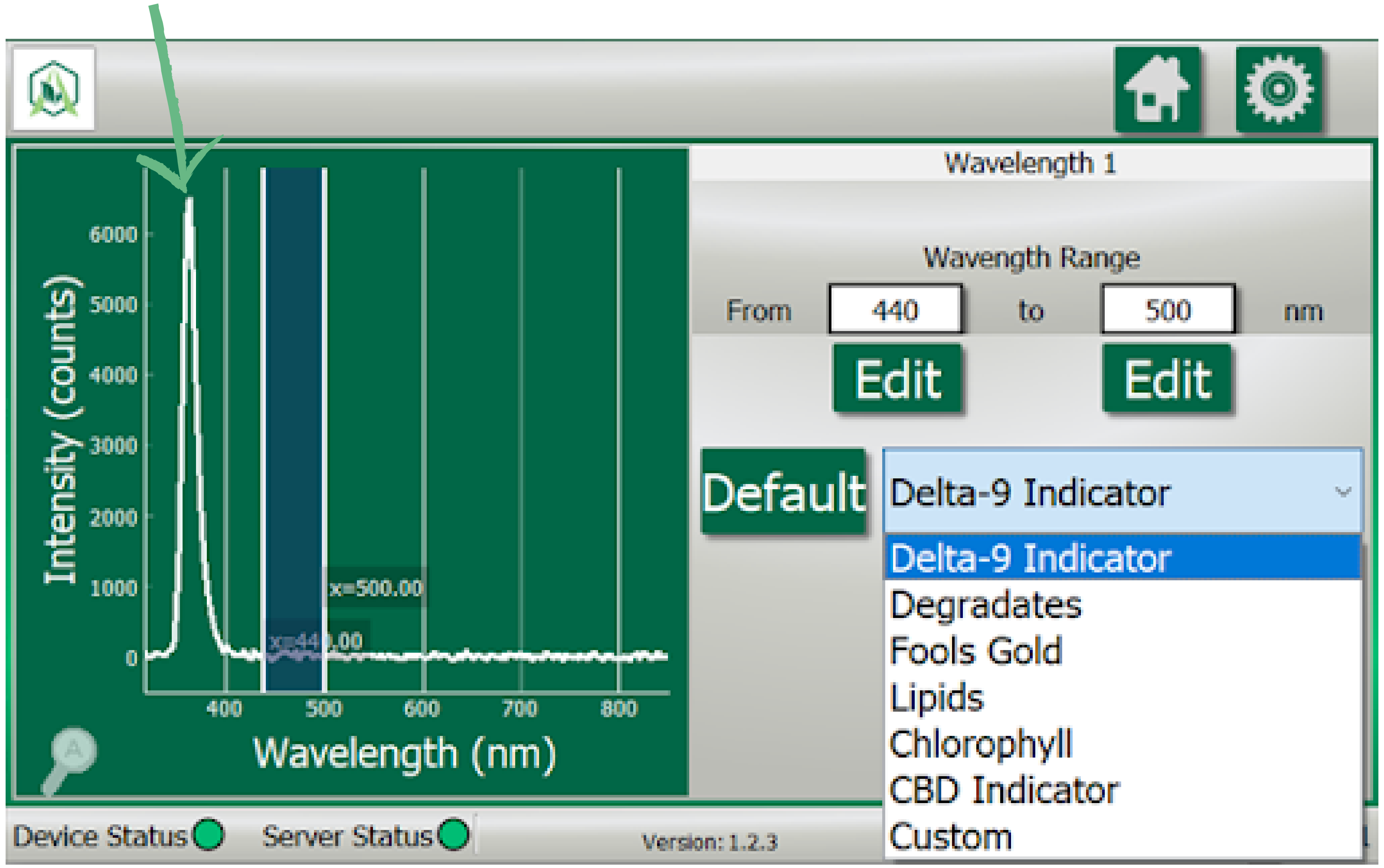
cannabis science and technology

MOLECULES

Molecules respond to light differently. The way that an extract responds tells us which molecule(s) — and how much of said molecule(s) — are present.

Our system excites fluids with light,

while simultaneously waiting for, and measuring, the response.



RETURN ON INVESTMENT

Our customers achieve a rapid ROI from using our technology:

- **Increase potency** by 3-5%
  —> increased market value
- **Decreased training time** by 33%
  —> decreased operational costs

FRACTION FINDER
DISTILLATION PROCESS MONITORING SYSTEM

$4000 USD

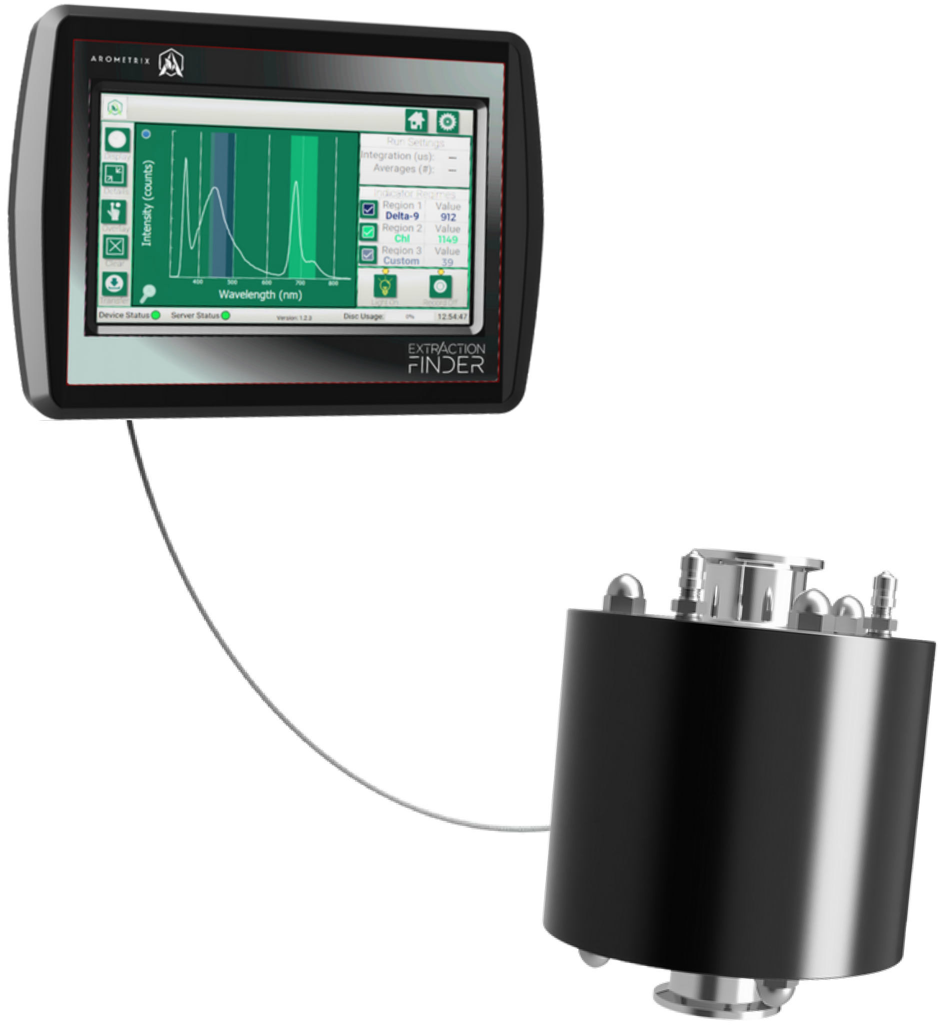
For botanical distillation

FRACTION FINDER ULTRA

$4814 USD

For botanical distillation
PLUS chromatography

EXTRACTION FINDER



$8450 USD

For botanical extraction
PLUS any metal-utilizing process

Utilized for multiple processes

Growing & Grinding

Extraction

Winterization & Filtration

Solvent Recovery

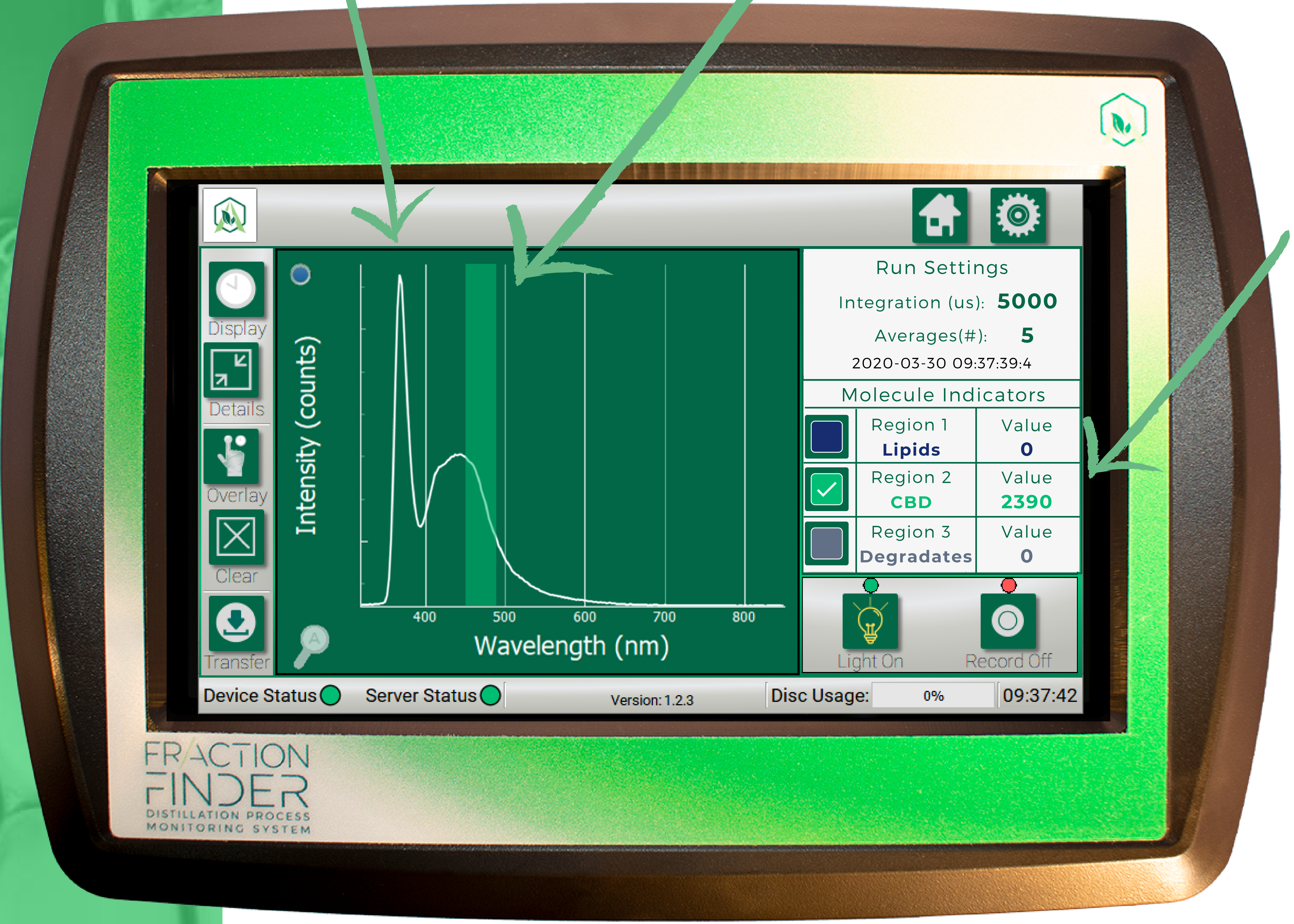
Fractional Distillation

Chromatography

Here's an example

Our system's exciting signal

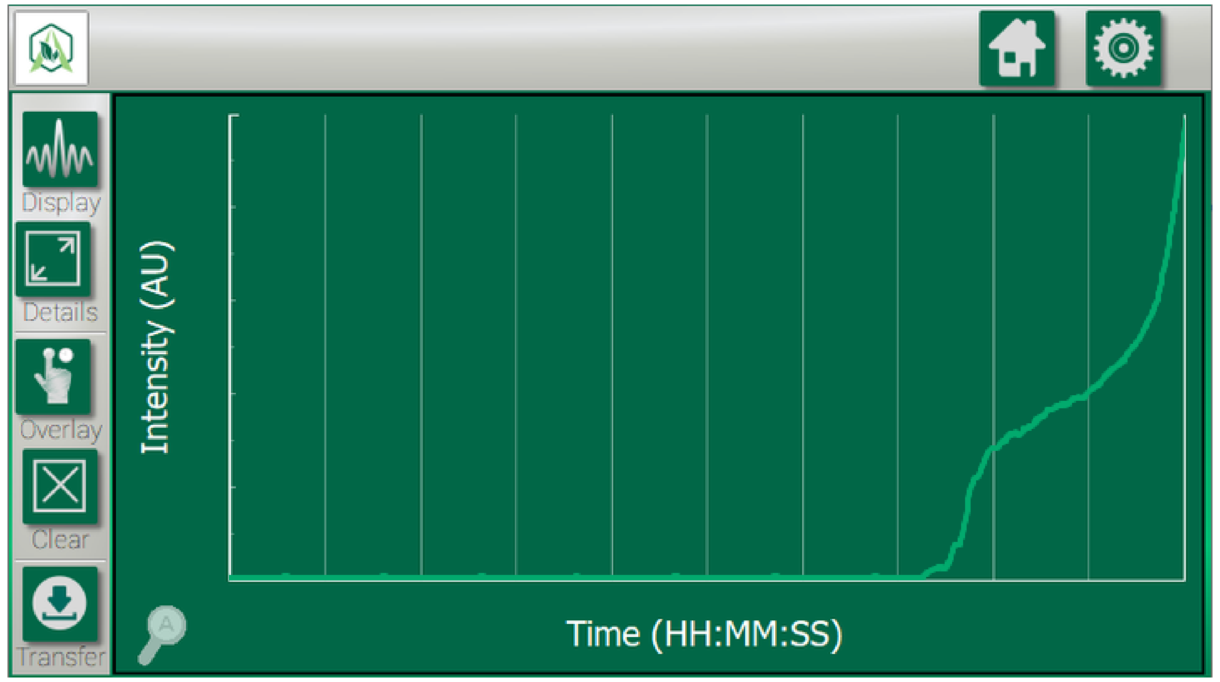
CBD's signal



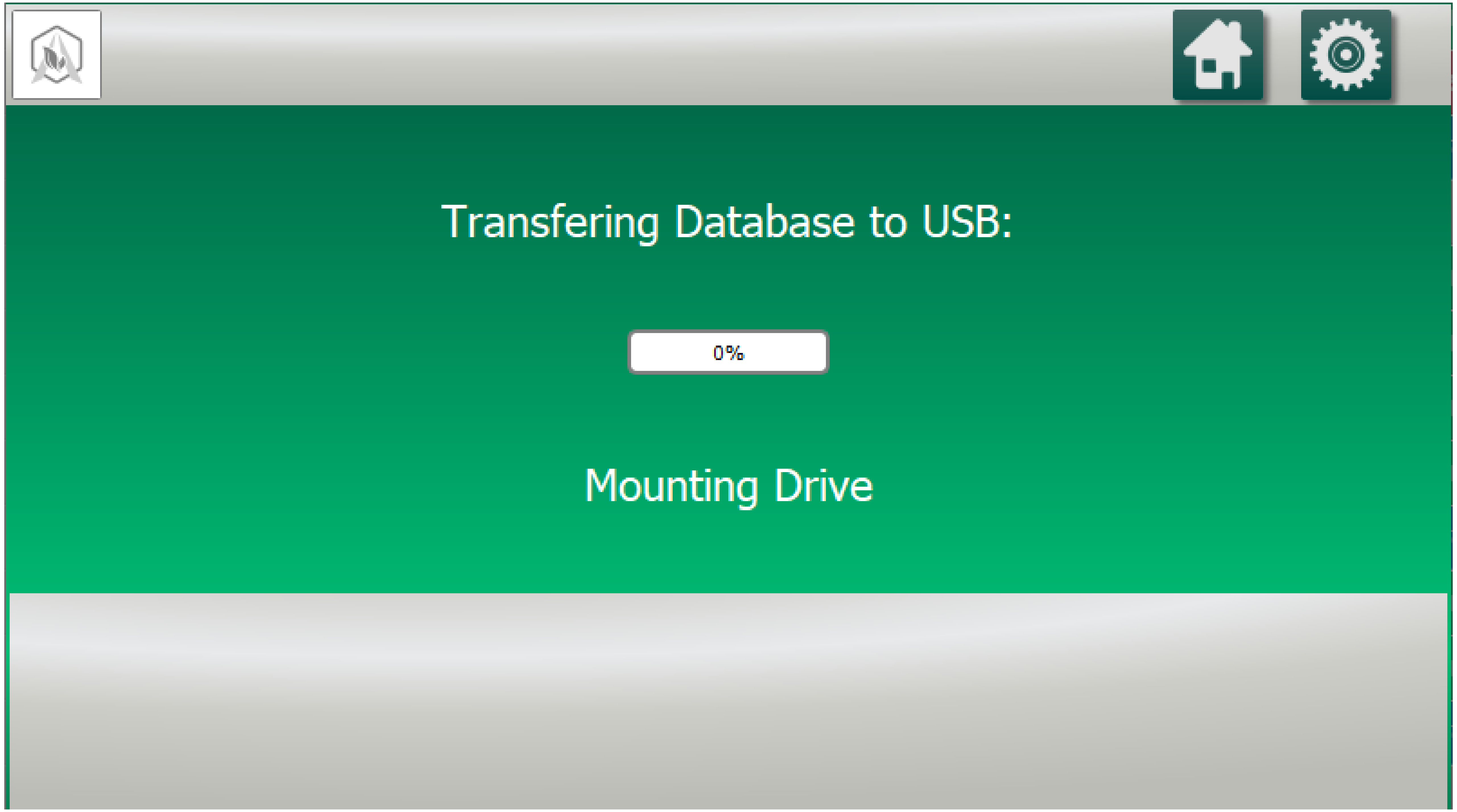
CBD's intensity values

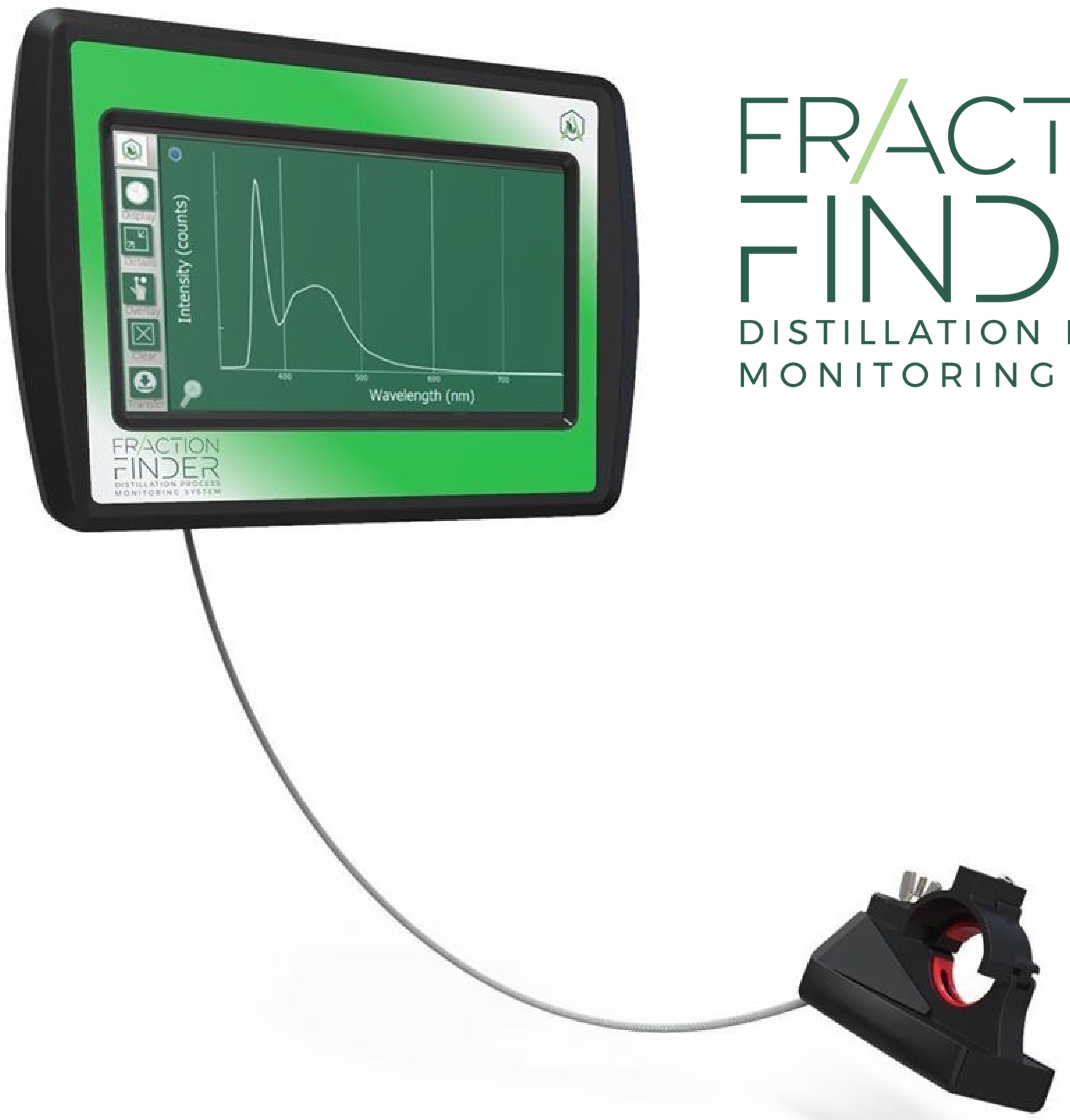
Alternative graphing view

Track intensity over time



Data Logging





FRACTION
FINDER
DISTILLATION PROCESS
MONITORING SYSTEM

Featured:

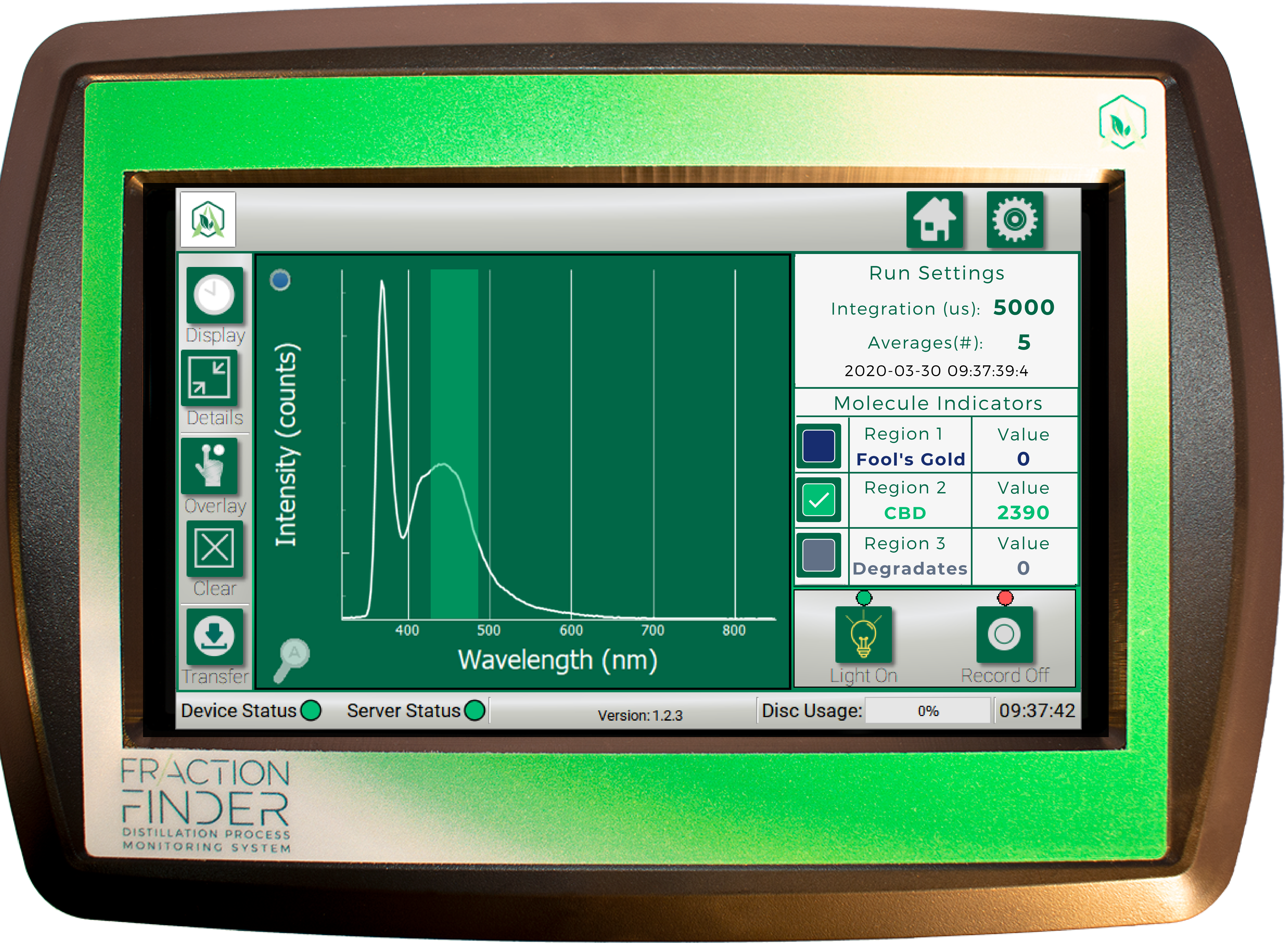
Lab Society 12L Short Path Distillation

SHORT PATH DISTILLATION

KNOW WHEN TO CHANGE FLASKS

Track the start & end of the main distillation fractions:

- **"Heads":** Terpenes and "Fool's Gold"
- **"Main Body" (aka "Heart"):** Cannabinoid of interest
- **"Tails":** Degradates & darker pigments



Head, Body, & Tail

FRACTION FINDER

Now compatible

Featured:

Lab Society HVE Thin Film Distillation

WIPED / THIN FILM DISTILLATION

KNOW THE QUALITY OF EACH LINE

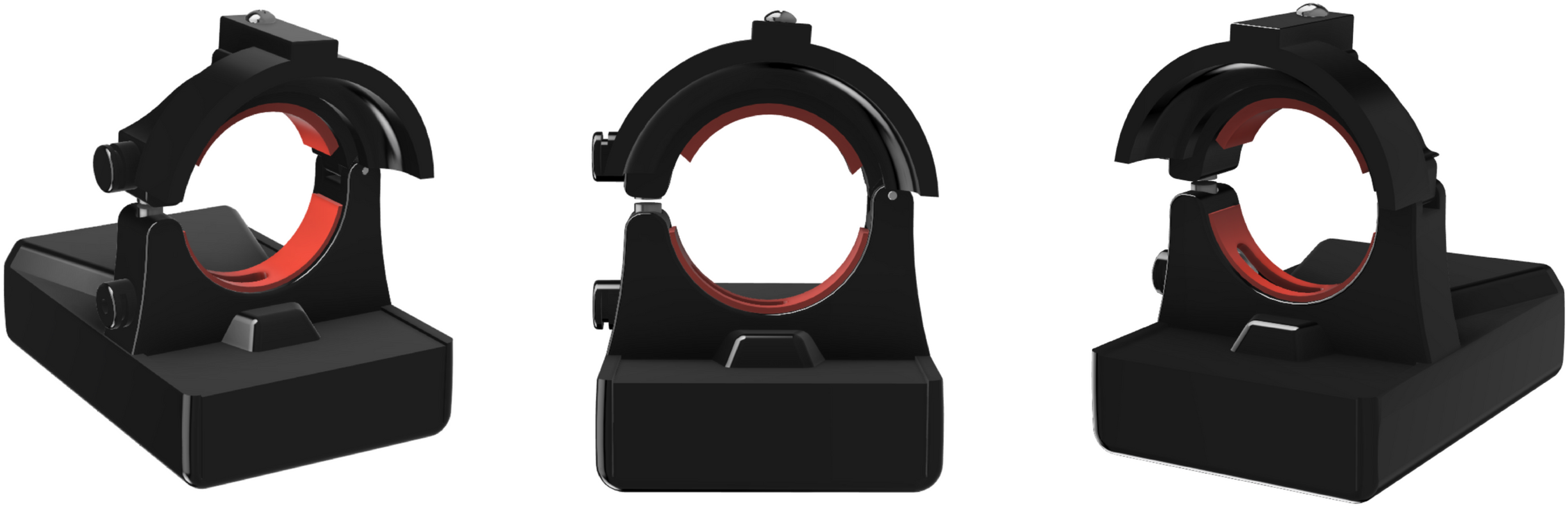
Track exactly what is passing through your line(s):

- **Collection line:** Prevent the collection of trace amounts of "undesirables" (ex: Degradates)
- **Rejection line:** Prevent the rejection of trace amounts of "desirables" (ex: CBD)


VTA
www.vta-process.de
Germany
A100
B100
W130
PIW130
V131
V130
LVO 100
07/19/19
FRACTION FINDER

FRACTION FINDER ULTRA

ULTRA = 10X more sensitive



Featured below:

Summit Research Chroma Column

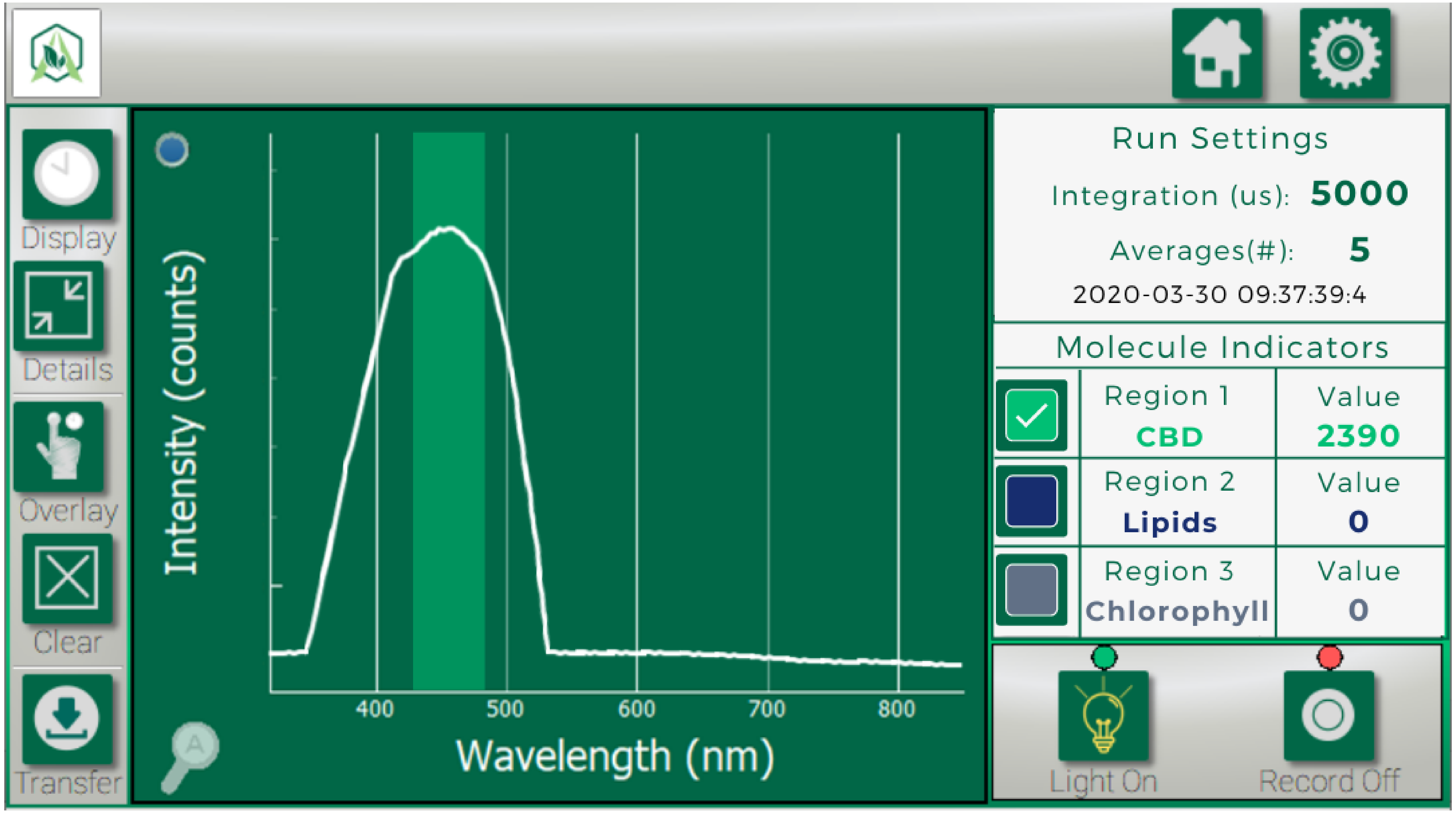
CHROMATOGRAPHY

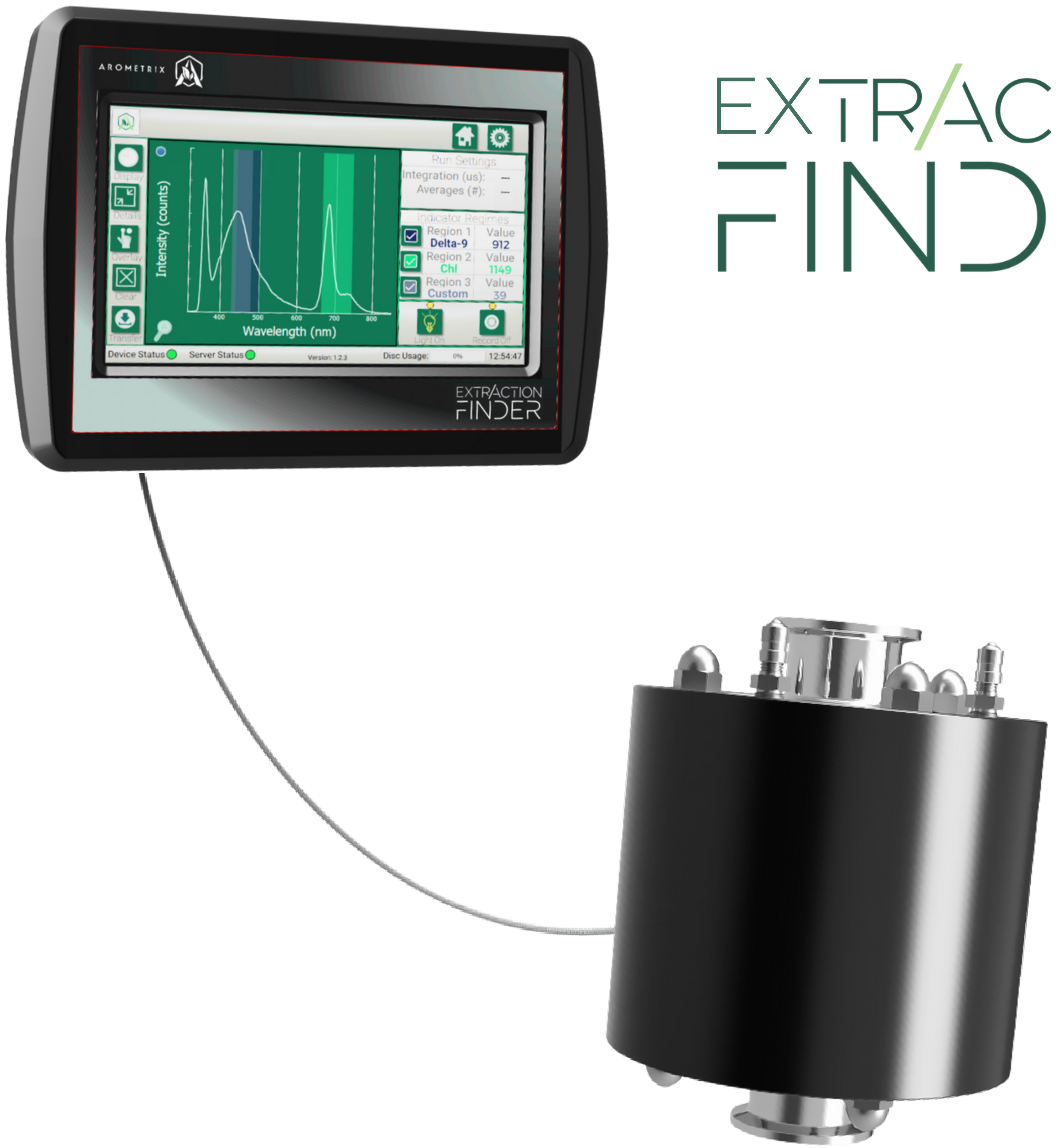
KNOW WHEN EACH FRACTION ELUTES

Track the emergence of individual Cannabinoids:

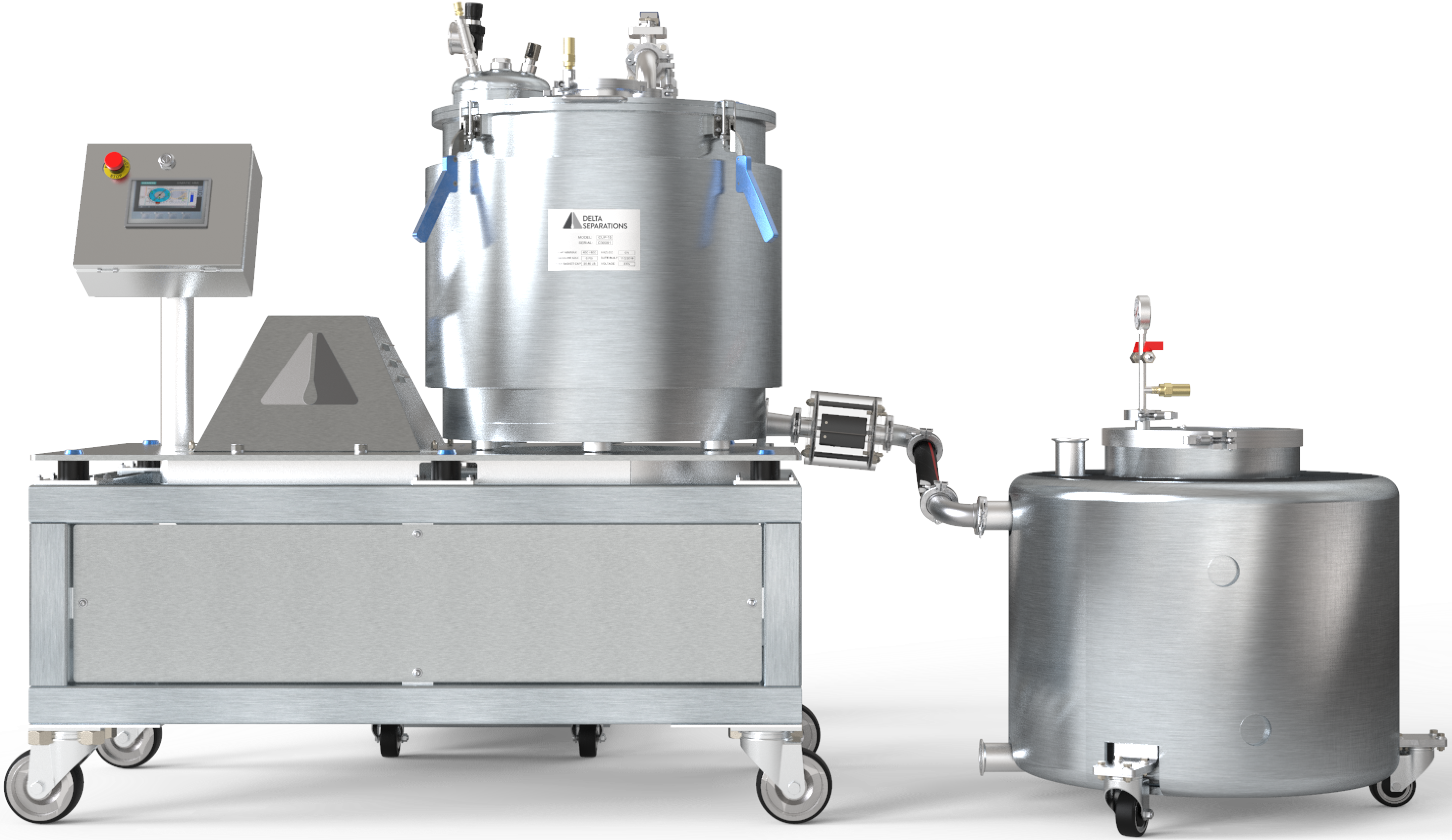
- **Normal Phase:** Track THC, then track CBD
- **Reverse Phase:** Track CBD, then track THC
- **Color Remediation:** Tracks levels of dark pigments, such as Chlorophyll, Lipids, and Degradates

Same software, stronger signals





EXTRACTION FINDER


DELTA
SEPARATIONS

EXTRACTION

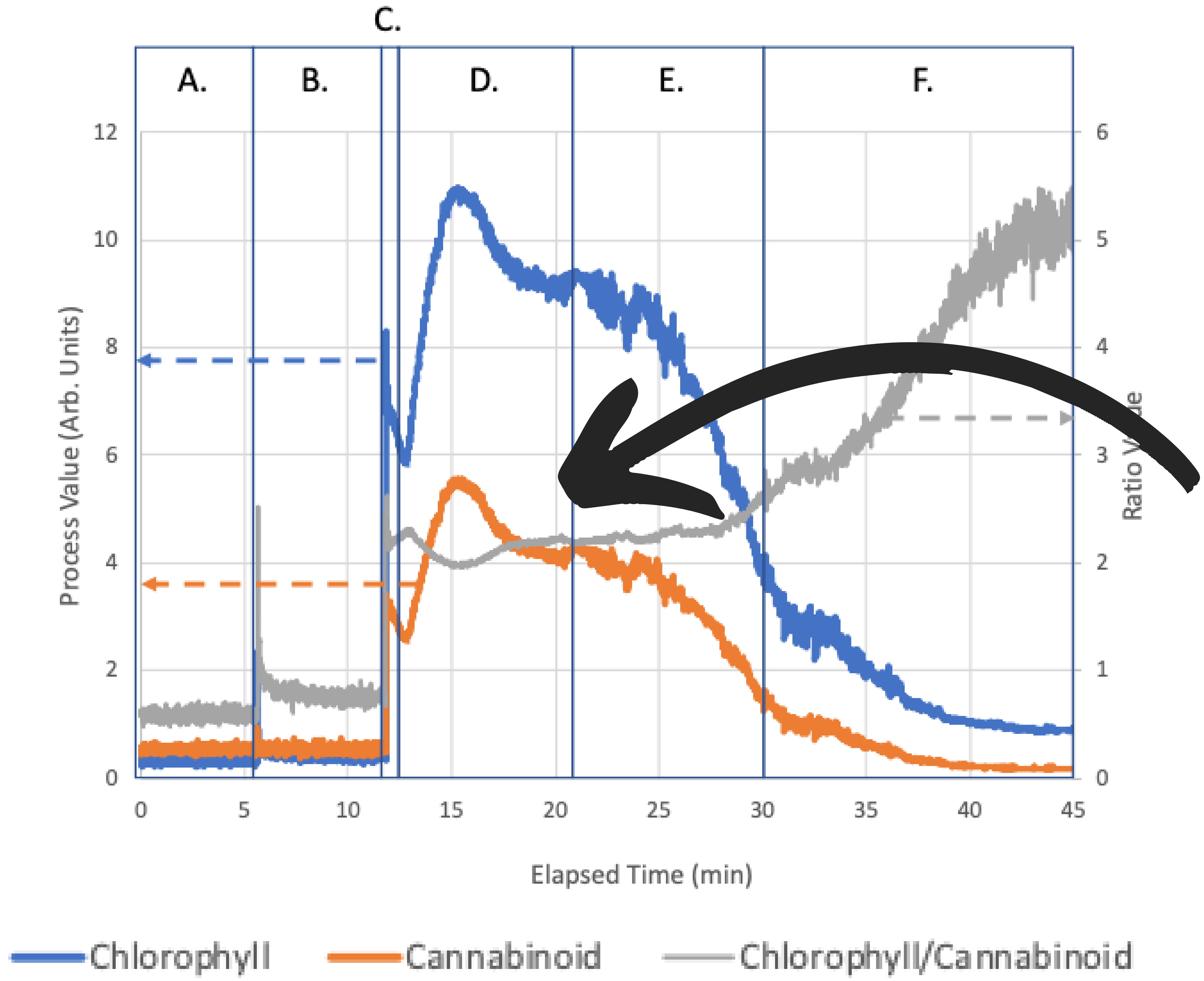
KNOW WHEN SOLVENT IS SATURATED

Track the progress of the extraction to its end:

- **Monitor molecular levels over time:** Acidified Cannabinoids, Chlorophyll, and Lipids
- **Know when it's complete**: Know when the solvent has extracted all the plant's Cannabinoids
- Install **wherever** you want to monitor molecules

Featured below: Model 1 XF

Delta Separations CUP 30 Extractor



A. FILLING SYSTEM (FLOW OFF)

B, AGITATION THEN SOAK (FLOW OFF)

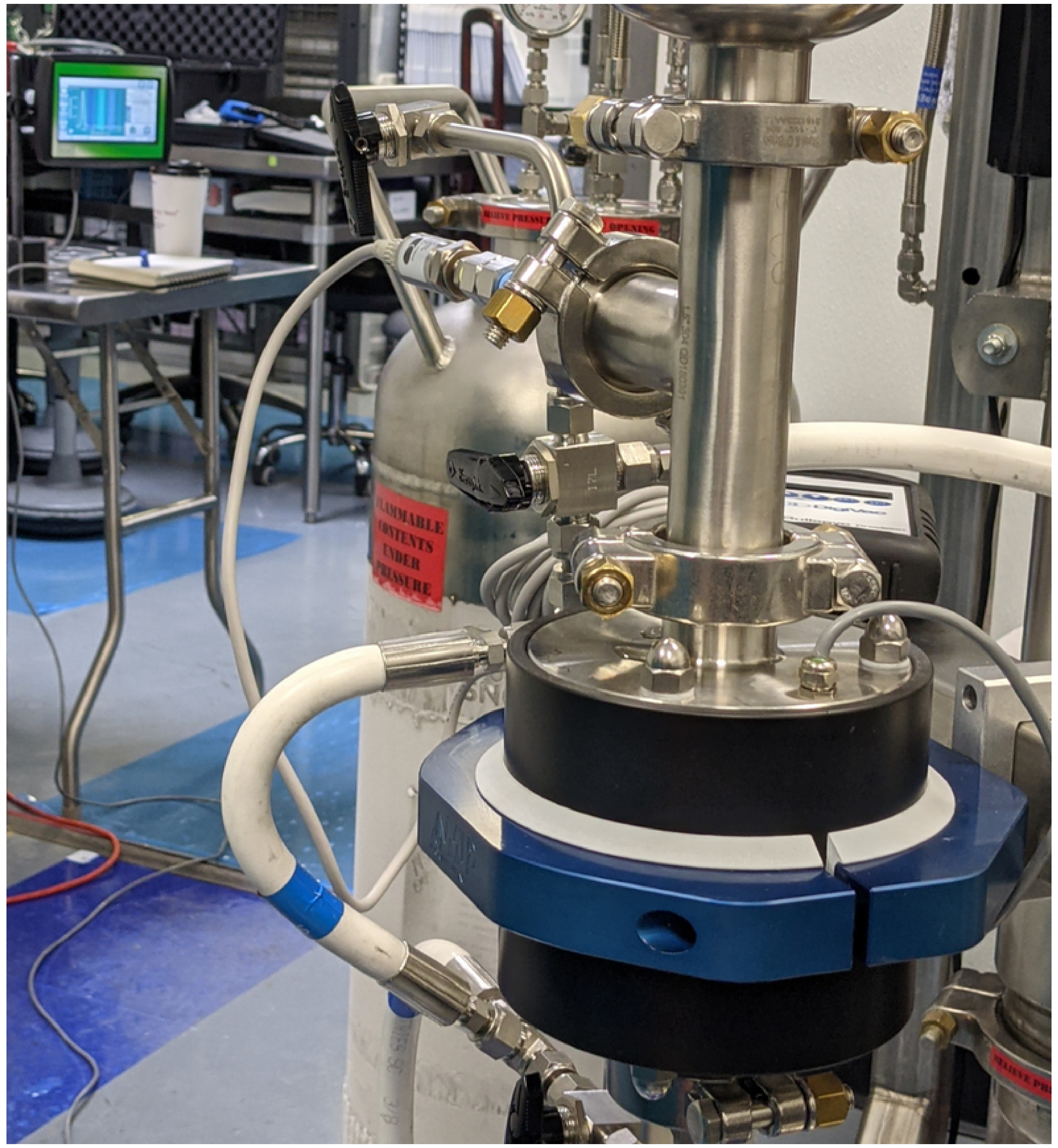
C. FLOW STARTED/ EQUILIBRATING FLOW

D. RECIRCULATING

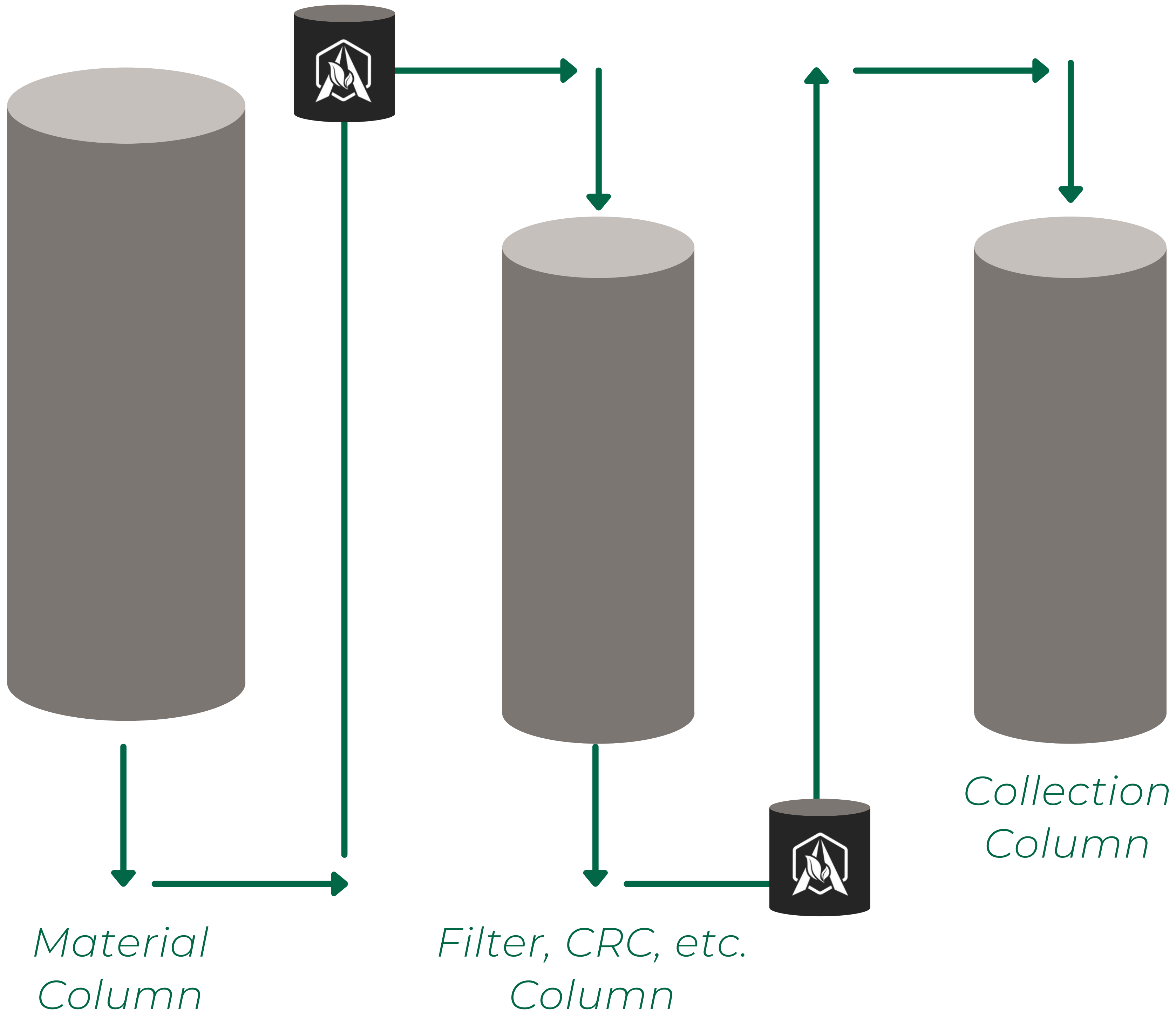
E. EMPTYING SYSTEM USING N2 GAS

F. EMPTYING RESIDUAL ALCOHOL FROM EXTRACTOR RESERVOIR

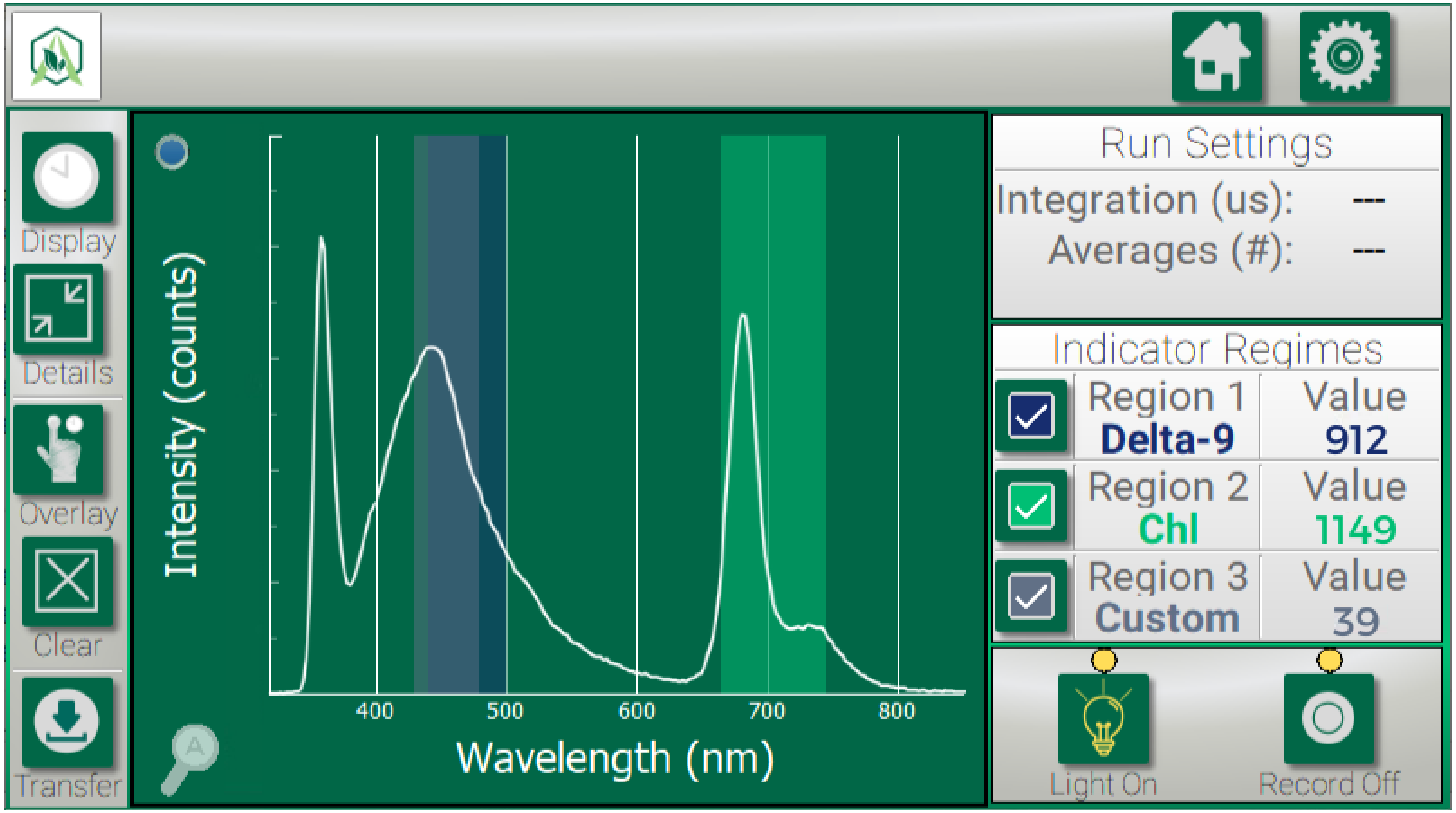
Welcome to the future of extraction



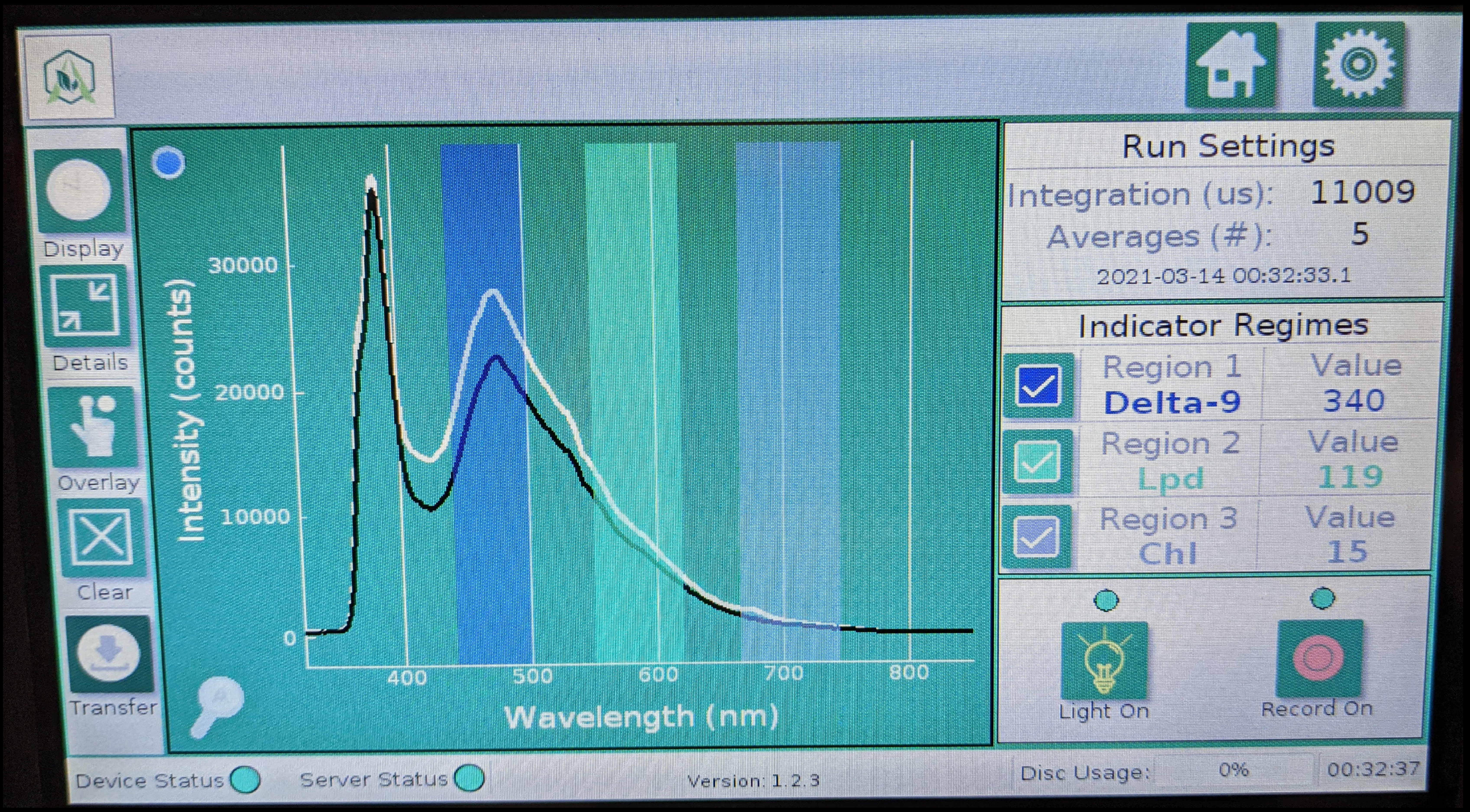
Examples of installation locations



Cannabinoids - Chlorophyll - Lipids



Display
Details
Overlay
Clear
Transfer
Intensity (counts)
30000
20000
10000
0
400
500
600
700
800
Wavelength (nm)
Run Settings
Integration (us): 9413
Averages (#): 5
2021-03-14 00:31:16.1
Indicator Regimes
Region 1 Delta-9 Value 312
Region 2 Lpd Value 115
Region 3 Chl Value 13
Light On
Record On
Device Status
Server Status
Version: 1.2.3
Disc Usage: 0%
00:31:20


Display
Details
Overlay
Clear
Transfer
Intensity (counts)
30000
20000
10000
0
400
500
600
700
800
Wavelength (nm)
Run Settings
Integration (us): 11009
Averages (#): 5
2021-03-14 00:32:33.1
Indicator Regimes
Region 1 Delta-9
Value 340
Region 2 Lpd
Value 119
Region 3 Chl
Value 15
Light On
Record On
Device Status
Server Status
Version: 1.2.3
Disc Usage: 0%
00:32:37

Display
Details
Overlay
Clear
Transfer
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Intensity (kAU)
Overlay
16:30:00
16:31:40
Time (HH:MM:SS)
Run Settings
Integration (us): 2764
Averages (#): 5
2021-03-29 16:32:21.0
Indicator Regimes
Region 1 Delta-9
Value 1565
Region 2 Lpd
Value 319
Region 3 Chl
Value 29
Light On
Record On
Device Status
Server Status
Version: 1.2.4
Disc Usage: 0%
16:32:25

Industry Trends

CONSUMER DEMAND FOR EXTRACTS

Concentrate sales increased by over 40% in 2020, and prices are rising in the face of the increased demand.
- MJBizDaily, 2021

Marijuana Concentrates on the Rise Across Industry

SHIFT TOWARD IN-HOUSE ANALYTICS

Extractors are breaking their reliance on outside testing, and acquiring equipment to get a faster idea of quality. - Analytical Cannabis, 2019

Why Cannabis Extractors Are Bringing Testing In-house

FDA CANNABIS-GMP GUIDELINES ARE COMING...

The FDA does not have any guidelines specific to the Cannabis industry... ***yet***. Companies want to stay ahead of GMP reqs.
- CS&T, 2020

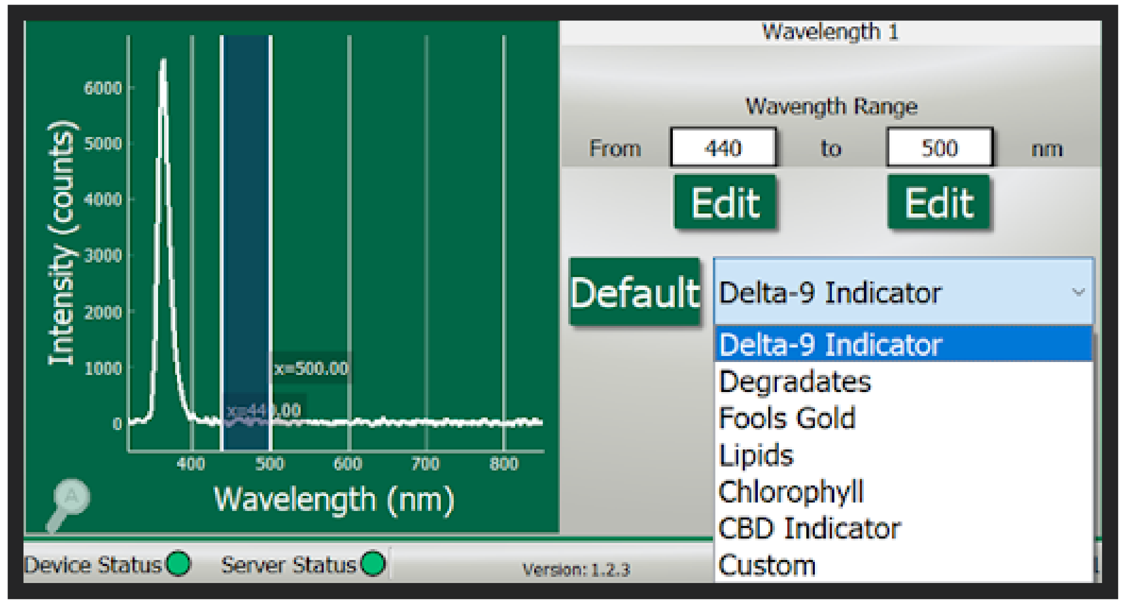
Engineering Considerations for the cGMP Manufacture of Hemp and Hemp Products

NOW

NEXT

FUTURE

Innovative real-time molecular monitoring for refinement



Revolutionary, real-time tracking of C1D1 extraction, filtration, CRC, etc.

The ultimate source of process traceability for cGMP compliance

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