Humboldt Alchemy Group Case Study - 2017016

United Science
extraktLAB Products & Services Case Study

Executive Summary

Our customer, Humboldt Alchemy Group (HAG), approached United Science in late 2015 seeking to create a high throughput manufacturing facility for extracted cannabis oils. They selected United Science as their principle vendor and consultant firm to help design and furnish their facility.

Important to Both HAG and United Science place a high importance on end-product quality and environmental safety. HAG's facility incorporates elements that ensure both.

Communication and teamwork were essential to success at HAG.

Within 10 days of receiving United Science equipment, HAG could:

- produce 150 grams per hour of raw oil
- create raw oil with an average of 77% total cannabinoid potency
- capture 94% of available cannabinoids in the dried plant material.

After expansion, HAG now can:

- produce 300 grams of raw oil per hour
- maintain the same recovery and potency levels
- include methods for in-process analytical quality assurance/control testing.

Background

Our Company

United Science Corp. provides products and services for extraction and separations science. Our company has traditionally served customers in basic science research and the food, beverage, pharmaceutical, and oil and gas industries. Based on our experience in these industries, in 2015 we launched the extraktLAB portfolio of products and services that specifically address CO2 extraction in the medical and recreational cannabis market. We have assembled a team of skilled chemists, engineers, and technicians for this primary purpose. This

team has developed GMP-equivalent extraction facilities throughout North America and Canada.

Our Customer

HAG was formed in 2015 by two principals, both farmers. HAG's objective was to create a manufacturing laboratory capable of producing up to 3,000 grams of raw extracted cannabis oil per day to supply the rapidly expanding medical marijuana market in California. Prior to establishing HAG, the principals had experimented with creating extracted plant-based products, but neither had any experience with CO2 extraction.

Discovery

Our team communicated extensively with HAG prior to signing a contract, discovering all customer concerns.

Primary Concerns

- Building best-practices for product and environmental safety
- Processing between 15 and 30 kilograms of dried trim per day
- Obtaining high cannabinoid recovery
- Creating high potency oils

Secondary Concerns

- Acquiring in-depth training on CO2 extraction
- Capturing as many of the available terpenes as possible
- Developing multiple products beyond standard winterized oil

By uncovering these concerns early, we were able to craft solutions to address each point.

Implementation

United Science and HAG quickly formed a close working relationship. Early on a crawl-walk-run philosophy was established. In this process, each step of implementation was followed by a review period that measured its effectiveness; subsequent steps were based on the success of the preceding action. In this way, United Science and HAG grew together. Our process went forward in two phases:

Phase I

- Discovering and identifying the customer's needs
- Confirming these needs and creating a proposal
- Designing a work process
- Commissioning and starting-up an Extrakt-110plus and associated equipment

Phase II

- Expanding with a second Extract-110plus
- Adding a CO2 recycling system
- Consulting on formulations (on-going)
- Implementing in-process analytics for quality assurance/control testing.

Solutions

Safety

United Science's care and attention to customer issues meant we could alleviate concerns important to HAG.

Pesticides

The principals of HAG had taken the time and effort to have their farms "Clean Green Certified." Clean Green farms follow all the sustainable practices of traditional organic farming, avoiding pesticides and other environmental contaminants. However, HAG intended to run products from sources other than their own farms. In these cases, HAG was concerned that pesticides may enter their machine and contaminate the flow path, consequently contaminating subsequent batches if the contamination was not recognized.

The initial machine installed at the HAG facility was the Extrakt-110plus with vented CO2 exhaust. This machine was designed to allow CO2 to exhaust to the atmosphere rather than run through a recycling system. With this design feature, CO2 can be used not only as a solvent to extract oil, but also as a cleaning agent, running through an empty machine, dissolving and exhausting potential contaminants in the system. While this step does not eliminate manual cleaning of the machine, it significantly reduces the risk of cross contamination between batches, helping HAG maintain their product's integrity.

CO2 Usage

HAG was concerned that overall CO2 usage may pose an environmental concern. Specifically, HAG was concerned that the California Air Quality Control Board (AQCB) may object to a CO2 machine vented to the atmosphere.

The United Science team provided HAG with documentation that CO2 was recognized by the AQCB as a non-toxic, non-pollutant and that CO2 represented a significantly lower risk to work environments than alternative forms of extraction involving volatile hydrocarbons. As part of the sales process, the United Science team and HAG presented this information to the local AQCB in Humboldt County in order to assure licensure of their facility.

Process Design

United Science's experience in laboratory design and separation sciences was directly applied to HAG's work process.

Workflow and Equipment

Beyond simply providing an extraction machine, United Science contracted with HAG to help develop an extensive equipment list to address each stage of the work process. . This included specifying and training on grinders, vacuum ovens, and tools for winterization and solvent recovery. We also included methods for tracking products through the workflow and simple analytical techniques for measuring cannabinoid recovery and oil potency. We refer to this work collectively as Commissioning and Start-Up (CSU).

All CSU services were rendered on-site with HAG, ensuring that we saw the results first-hand. After the equipment arrived, the United Science team spent three days completing installs and six days commissioning the work process. United Science then developed a work process report, leaving HAG with instructions on each part of the work process, thus ensuring their continued success.

Validated Results

As part of the CSU package, United Science brought our own HPLC to the customer site. Through HPLC testing, we could measure the total cannabinoid content of plant materials and measure the cannabinoid content of the extracted oils. By doing so we could show the customer

the immediate success of our efforts.

Extraction

United Science's Extrakt-110plus machines out pace our competition and enable HAG to reach their desired production capacity.

Machine capacity

Because we developed a unique system that utilizes high flow pumps transferring 600ml/minute of CO_2, we saturate the material at a rate nearly 2X faster than other machines. As such, we run a 5-Liter extraction column in one hour, as opposed to running a 20-Liter tank in eight to ten hours. This means that in a four-hour period we produce the same as machines with tanks four times the size of ours.

Loading

One-hour runs mean that users touch the machine often, and this could pose challenges. But because we use a unique EZ-Load bag system, changing out runs is quick and efficient. EZ-Load bags are permeable sleeves that are loaded with plant material. When the run is over, the bag is removed. There is no need for packing material into the column directly and there is no need to vacuum out the column after a run is over. The entire unloading and reloading process can be completed in less than 10 minutes. This feature added to the efficiency of HAGs operations.

Terpenes

Another unique feature of the first Extrakt-110plus at HAG is that it offers a fourth collection stage or Terpene Collector. This collection system allows CO_2 to depressurize to the atmosphere, releasing terpenes, essential oils, and a substantial amount of THC that would normally be trapped in a recycling system. These captured terpenes and essential oils have come to be important as HAG experiments with formulations that re-incorporate them into finished goods.

Expansion

United Science's close working relationship with HAG enhanced their ability to expand capacity

and add functionality.

Recycling

As HAG became more adept at their workflow and their capacity increased, they added a second machine. The second machine installed at the HAG facility included a recycling unit. This decision was made based on the logistics of CO2 delivery to and storage at a rural location.

In addition, because HAG has redundant machines, the risk of cross-contamination between batches is minimized even more. If only running Clean Green products, both machines can be used. If running material from another source, the vented machine can be used and the recycled machine can still be operated for controlled products. As such, batches from different sources can be run in the same day.

Analytics

HAG's expansions have led them to include other processes within their facility. These include in-process analytics for pesticide screening and potency. This work also plays a major role in establishing Standard Operating Procedures (SOPs) so that product quality can be assured and controlled.

Formulations

HAG has begun to look at creating products beyond refined oils. In order to develop these products, United Science is providing formulation consulting. This work will entail analytical chemistry and our expertise in packaging/storage parameters. By creating formulated products, HAG will be able to reach a larger number of consumers.

Conclusions

HAG experienced great success using the United Science portfolio of extraktLAB products and services. The results they have achieved are remarkable when compared to other businesses in their market space.

By forming a team relationship with HAG, who previously had not operated a CO2 extraction facility, United Science was able to:

- develop a fully functional lab within 90 days of an order being placed

- begin producing salable oil within 10 days of equipment installation
- reach full production capacity and Phase II expansion in under a year’s time
- introduce in-process analytical techniques and formulations that lead the industry.

United Science and HAG share an exceptionally close working relationship. However United Science does not consider HAG unique. This is the type of relationship we endeavor to create with all our clients. This closeness is what allows us to create a detailed case study of our success.

The keys to this success, as well as to future success, are:

- Maintaining open and forthright communication
- Developing best-practices early and adapting to challenges as they arise.
- Creating a team atmosphere with the customer so that their input and guidance is as important as our own.