HOW CANNABIS BIOMASS REDUCTION IMPROVES PROCESSING PRODUCTIVITY BY UP TO 85% IN HYDROCARBON APPLICATIONS

Authored by Eric Vlosky, Rustin Porter, and Travis (TJ) Arnovick
Special contributions made by Eric Ward

Presented by The Original Resinator and Industry Processing Solutions

OUTLINE

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EXECUTIVE SUMMARY

The level of flexibility that closed loop cannabis hydrocarbon extraction offers laboratories is exceptional, however live resin, HTE, THCA, and their related SKUs made with traditional fresh frozen biomass processing methodologies suffer from inefficiencies that are currently seen as an unavoidable cost of doing business. The volume of cannabis flower required to fill closed loop columns presents operators with costly throughput challenges that even the largest commercial systems have to contend with on a daily basis. After conducting a significant amount of research to find a solution, a technique known as biomass reduction has been finally proven to dramatically reduce the amount of gas, labor, and time needed to extract live cannabis resin from its raw biomass.

By cryogenically separating out virtually all of the plant's valuable compounds while leaving the inert organic material behind before being run, operators can improve profitability essentially overnight while also creating additional downstream efficiencies that improve an operator's bottom line in multiple ways. Our data has shown that with all factors combined, our biomass reduction method can increase overall hydrocarbon extraction productivity by up to 85% compared to simply running fresh frozen by itself no matter what system or gas mix operators choose to use.

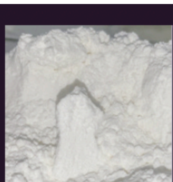
KEY FINDINGS

After running 2,800 pounds across 4 strains in 100 pound side-by-side batches of the same strain, through the same hydrocarbon system, comparing raw fresh frozen versus the same material biomass reduced into live sift, we discovered the following results with biomass reduction-first extractions:

- An **85%** reduction in labor hours
- Upwards of **80%** less butane used per run
- **6.66%** increase in yields on average (from fresh frozen to dry)

What continues to be more difficult to specifically quantify but our testing facility immediately noticed was in addition to these cost savings measures biomass reduction allows for, the full range of downstream effects from increased processing efficiency are tremendous.

SKUS MADE WITH BIOMASS REDUCED LIVE SIFT


THCA


HTE


LIVE RESIN


CRUMBLE / WAX


DIAMONDS

INTRODUCTION

In cannabis markets across North America, price compression and oversaturation have led to a paramount need for extractors to process their biomass as efficiently as possible. Out of all of the primary cannabinoid extraction methods available today, closed loop hydrocarbon processing is largely seen as the most versatile of them all when every factor is weighed that operators must contend with. With hydrocarbon extraction, biomass of any type can be made safely and quickly into a wide variety of valuable products, including from material that would otherwise be unusable in solventless processes due to pests, mold, or other contaminants.

Unlike earlier open blasting cannabis extraction techniques, modern closed loop systems that are situated within compliant C1D1 booths are extremely safe to operate. These machines are used across the world in licensed labs every day to churn out potent, delectable SKUs that consumers purchase en masse. According to Headset, in 2022 a record 34% of all concentrate category sales were made up of live resin alone[1], which appears to this day to be the most popular dabbable concentrate in the world by sales volume.

Hydrocarbon systems are capable of making much more than just live resin, wax, or crumble and are also commonly utilized to make high terpene extract (HTE) for vaporizer cartridges, isolated THCA for everything from edibles to vapes and more in conjunction with distillation, as well as diamonds among other more exotic products. In order to make the best of these options, fresh frozen, as opposed to dried or cured cannabis biomass is the go-to starting material since it's prized for its highly aromatic, "live" terpene profile. Maximizing the throughput of fresh frozen through closed loop hydrocarbon systems is an incredibly important pursuit for labs everywhere given thinning margins due to increased competition present in most legal markets.

CHALLENGES WITH FRESH FROZEN BIOMASS IN CLOSED LOOP HYDROCARBON SYSTEMS

With all of the aforementioned benefits comes a real set of costs to operators, specifically related to the volume-related difficulties of cold storing and extracting from fresh frozen cannabis flowers. That's why many labs choose to simply run mostly trim or other easier to process biomass. Despite that, fresh frozen offers many advantages to processors over dry material, especially in terms of end product quality, however it contains anywhere from 75% to 85% water by weight. At scale, the additional raw volume fresh frozen imposes upon extractors adds up across all aspects of processing. Its use creates multiple productivity problems for operators, including:

1. Significant man hours to prepare socks for extraction, inserting them into columns, and removing them afterwards (up to every 5 min with 15-30 minutes run times, per column)
2. Substantial freezer space to accommodate the pre-packed socks so they are ready to be run, often in expensive deep cryo freezers that have significant utility requirements
3. Considerable volumes of butane or butane with other hydrocarbon gas mixes that lose around 10% per run even with advanced recovery systems
4. High utility costs to run deep chillers throughout the entire extraction process
5. Smaller final live resin extraction volumes compared to live sift runs

Most lab managers responsible for hydrocarbon systems are simply used to these headwinds and have implemented disciplined standard operating procedures to work around them as much as possible. Even with the most efficient habits though, every extractor that uses fresh frozen in their hydrocarbon system aims to get it blasted and purged as quickly as possible in today's hypercompetitive cannabis concentrates industry. Weaker, less efficient operators simply do not stay in business in mature markets.

Gas costs are especially onerous in the calculations of owners and managers, with the price per liter (equivalent to around 1.25 lbs) of butane running anywhere from $3 or more per in most places. Although figures vary, many extractors utilize at least 500 pounds of butane or gas for every 100 pounds of fresh frozen biomass. That equates to roughly 5 lbs of gas per lb of fresh frozen, and across 1,000 lbs of fresh frozen processed at a 10% loss rate with a cost of $3 per liter of butane, operators can typically expect to spend at least $1,200 or more in gas if they do not perform biomass reduction first. In some cases, especially for extractors in more remote areas further from city centers that have gas distribution facilities, the cost of hydrocarbon gasses can rise dramatically.

BUTANE COST AND USAGE TABLE WHEN PROCESSING FRESH FROZEN BIOMASS AVERAGES				
COST OF BUTANE	**LBS OF FRESH FROZEN**	**AVG LBS OF BUTANE NEEDED**	**BUTANE COST PER LB**	**TOTAL GAS LOSS COST AT 10% AVERAGE**
$2.75/liter	1,000	5,000	$2.20	$1,100
$3/liter	1,000	5,000	$2.40	$1,200
$3.25/liter	1,000	5,000	$2.60	$1,300
$3.50/liter	1,000	5,000	$2.80	$1,400

Although utility costs are difficult to generalize across broad geographical locations, what is more easily calculable are labor rates, which add up quickly over the course of days, weeks, and months. According to Vangst's 2024 Jobs Report[2], the average pay for manufacturing technicians is between $15 to $25 per hour, manufacturing supervisors sit at $25 to $36 per hour annualized ($50-$75k salary), and director level roles earn as much as $48 to $67 per hour annualized ($100-$140k salary).

Most labs tend to employ 2-3 staff members to run their hydrocarbon booths, not including packaging labor, which is often at least a director or supervisor plus one or two technicians. All in, this means most labs spend anywhere from $100,000 to $240,000 pre-tax on labor to run their closed loop hydrocarbon systems. With every minute being precious in the lab, operators understand that effective use of their staff is mission critical to their profitability. Any additional time that staff members can spend doing other tasks means more profits at the end of the year.

THE INTRODUCTION OF CRYOGENIC BIOMASS REDUCTION AS A SOLUTION

The core problem with fresh frozen biomass is its additional physical volume compared to dry which has already shrunk from passive evaporative or active lyophilized drying. As discussed, this means it takes more of everything to extract from it. The big question for all extraction methodologies is essentially the same: how does an operator separate the proverbial wheat (valuable resin) from the chaff (non-commercially useful organic material)?

Hydrocarbon processors we polled consistently said that if they could find an efficient way to do this with *live material,* they would be able to run fewer columns to get to the same end result. Many extractors are highly familiar with dry sift and kief, which has historically always been made from dry material, but are unaware that recent advances in extraction equipment technology have unlocked an entirely new technique to make *live sift*.

This ancient method of extraction is the core of our pioneering efforts in what is technically known as “biomass reduction”. This technique takes the same pre-frozen fresh biomass laboratories would run for their hydrocarbon or even solventless processing and subjects it to ultra cold cryogenic temperatures around -150°F to -325°F in a specialized rotary drum apparatus. These temperatures are only achievable in highly advanced machinery capable of using liquid nitrogen and temperature rated 400 micron screens.

Early attempts to sift live exterior trichomes and internal inflorescence resins from fresh frozen biomass were deemed largely ineffective on account of low total cannabinoid recovery rates which in many ways stemmed from preexisting biases towards a solventless mindset that prizes finely sieved trichomes in the 72 - 120μm range. This was largely due to not processing the biomass at cold enough temperatures and through too fine of micron sifting screens with existing sieving solutions that were designed for dry, not fresh frozen, biomass. By sharply reducing the temperature of using the cryo sieving process with a much larger aperture screen, the wet biomass is flash frozen, partially broken up, and mechanically separated into a kief-like powder which preserves the exact same live essence and full spectrum consumers demand as if it were still in its whole fresh frozen form.

The biomass reduced live sift, which is now being referred to as “Nitro Sift”, can then be processed through any brand or style of closed loop hydrocarbon extraction system just like standard fresh frozen. Using this special form of live sift is highly conducive to extractors existing methodologies and requires minimal changes to process compared to their current parameters, including the ability to use the exact same butane or butane plus propane mixes. While it does require slightly more gas to run per individual column, extractors can now process around 20 pounds or more of biomass reduced live sift per 4’ x 6” column instead of 8 to 12 lbs of fresh frozen, which is the average equivalent of 100 pounds of fresh frozen.

BIOMASS REDUCTION AND HYDROCARBON PRODUCTIVITY ENHANCEMENTS

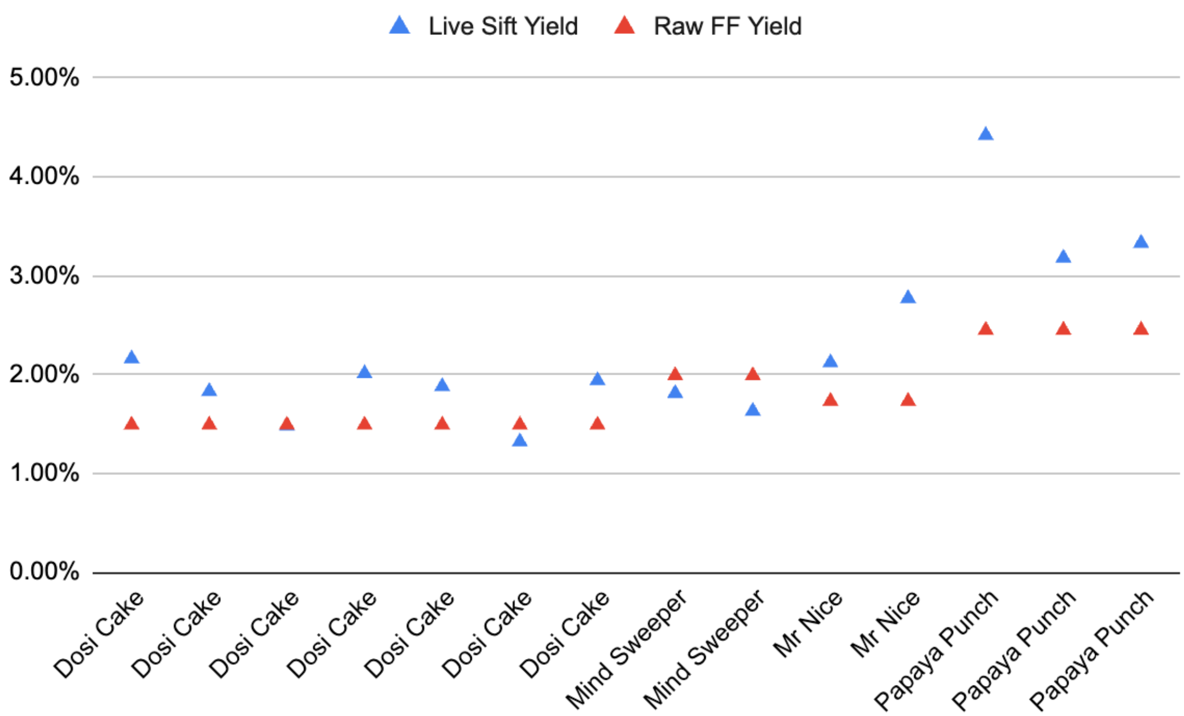
To properly evaluate the prospective productivity differences between employing biomass reduction techniques against standard fresh frozen, multiple variables were assessed to determine what the net efficiency and cost disparities were between the two.

In the following real world scenario, 2,800 pounds of outdoor grown fresh frozen biomass were processed through the same closed loop hydrocarbon system at a licensed laboratory in northern Washington in August, 2024, from 4 different strains (Dosi Cake, Mindsweeper, Mr. Nice, and Papaya Punch). For consistency and accurate data comparisons, 14 total 200 pound batches were run side-by-side. In each test, 100 pounds were blasted as typical fresh frozen biomass, and the other 100 pounds were run after being biomass reduced into live sift using an Original Resinator XLS Pro with identical system parameters for the live sift column.

Multiple temperatures ranging from -75°F to -275°F were tested during biomass reduction activity with run times ranging from 5 to 30 minutes in our initial tests, with most times ranging from 20 to 30 minutes in the bulk of our data collection as shown on the next page. Future testing revealed that 15 minutes at -150°F ended up being the sweet spot for most strains. While yield results varied, once our specific XLS Pro biomass reduction parameters were fully dialed in, potentially large increases in final yield were observed compared to standard fresh frozen runs in addition to significant reductions in gas and labor costs. The average yield increase across all strains in our 2,800 pounds of testing when using biomass reduction was 6.66% from fresh frozen to dry†, final SKUs.

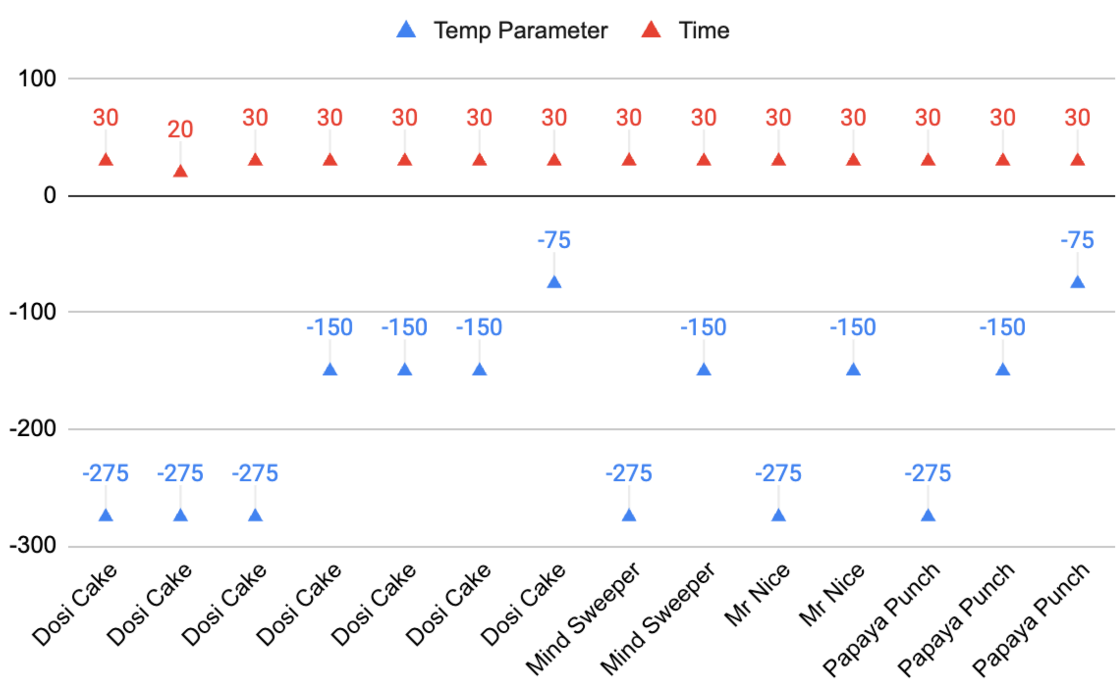
RAW FRESH FROZEN VS. BIOMASS REDUCED YIELDS

(WET TO DRY PERCENTAGES)



TIME AND TEMPERATURE PARAMETERS FOR EACH BATCH

(TIME IN MINUTES, TEMPERATURE IN FAHRENHEIT)



RESULTS

Across all strains, the averaged final results ended up at a 1.8% live to dry final yield for the standard fresh frozen processed batch, and 2.28% live to dry final yield for the biomass reduced batch (a 6.66% wet to dry final increase†) while only taking 100 pounds of butane per run, or approximately 80% less butane than its non-biomass reduced comparison alongside an astounding 85% reduction in combined man hours. Even when the added liquid nitrogen costs are factored in for biomass reduction activities, the delta in combined gas costs is still around 50% less compared to just running raw fresh frozen due to the inexpensive, sustainably captured nature of LN2.

In the following examples, which are based on the real word tests we performed but are blended into easy to understand averages, biomass reducing fresh frozen before blasting it in a closed loop hydrocarbon system is demonstrably faster and less expensive across all variables for extractors.

<u>Single Strain 100 Pounds of Fresh Frozen Biomass Reduced Example Workflow Breakout</u>

1. First, the fresh frozen biomass batch is run through an Original Resinator XLS Pro to perform biomass reduction. This takes approximately one hour and 250 pounds of liquid nitrogen, which costs $50 (500 pounds of liquid nitrogen runs around $100).
2. The net yield of the biomass reduction was just over 20 pounds of live sift, which was filled into a single standard 4’ x 6” column sock, with the remaining spent material sent to waste.
3. The 20 pound live sift socks required 100 pounds of butane to run, which cost $3.50 per liter, or $2.80 per pound, and 90% of which was recovered for a total butane loss cost of <u>$28</u>.
4. After a 30 minute run time, the final yield of the material is 30%, or 30 pounds of raw, unpurged live resin.
5. This entire processing effort takes two trained lab technicians around 4 total man hours, or 2 each. At a $30 per hour fully burdened labor rate, the man hour rate is approximately <u>$120.</u>

VERSUS

<u>Single Strain Standard 100 Pounds of Fresh Frozen Example Workflow Breakout</u>

6. The fresh frozen biomass is loaded into 10 different socks at 10 pounds of material per.
7. Then, the socks are loaded into a 2 column system, which requires loading and unloading approximately every 30-45 minutes, five times over.

8. The 100 pounds of fresh frozen across 10 different loaded and run socks required 500 pounds of butane, which cost $3.50 per liter, or $2.80 per pound, and 90% of which was recovered for a total butane loss cost of $140.
9. After approximately 4 hours of total run time, the final yield of the material is 28%, or 28 pounds of raw, unpurged live resin.
10. This entire processing effort takes two trained lab technicians around 16 total man hours, or 8 each. At a $30 per hour fully burdened labor rate, the man hour rate is approximately $480.

CONCLUSION

Although every processor is going to run their lab in different ways, the fundamental goals of processing fresh frozen biomass are similar for most operators. Any possible advantage to increase take home margins, more pricing leverage with stores, reduction in processing costs, and related factors all contribute to the better bottom line figures when biomass reduction is employed. Based on these factors and through our comprehensive analysis, we've confidently demonstrated that biomass reduction technology should be strongly considered in all closed loop hydrocarbon extraction use cases.

HOW TO CONTACT THE ORIGINAL RESINATOR

Thank you for reading our white paper on biomass reduction! If you'd like to learn more about how this process could help your lab or to review the data from our processing studies, contact us through one of the following convenient methods to talk to an extraction expert today. We're based out of Santa Rosa, California and have been in the cannabis post-harvest and extraction solutions space since 2015, with roots in the industry going back much further.

EMAIL: INFO@THEORIGINALRESINATOR.COM

PHONE: 1-877-RESINATOR (737-4628)

ONLINE: WWW.RESINATOR.COM

SOURCES AND NOTES

[1]Cannabis Concentrates: An Analysis of Category Data & Trends from Headset

[2]Vangst Jobs Report for 2024

†When processing live or fresh frozen biomass versus dry biomass, the final yields need to be adjusted accordingly due to an average of 75% loss of water weight from wet to dry material.

The raw data for this white paper is available upon request to qualified individuals. Please contact us for more information.

An example of live biomass reduced sift