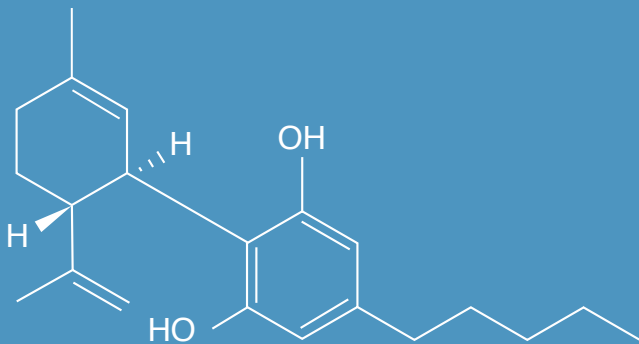
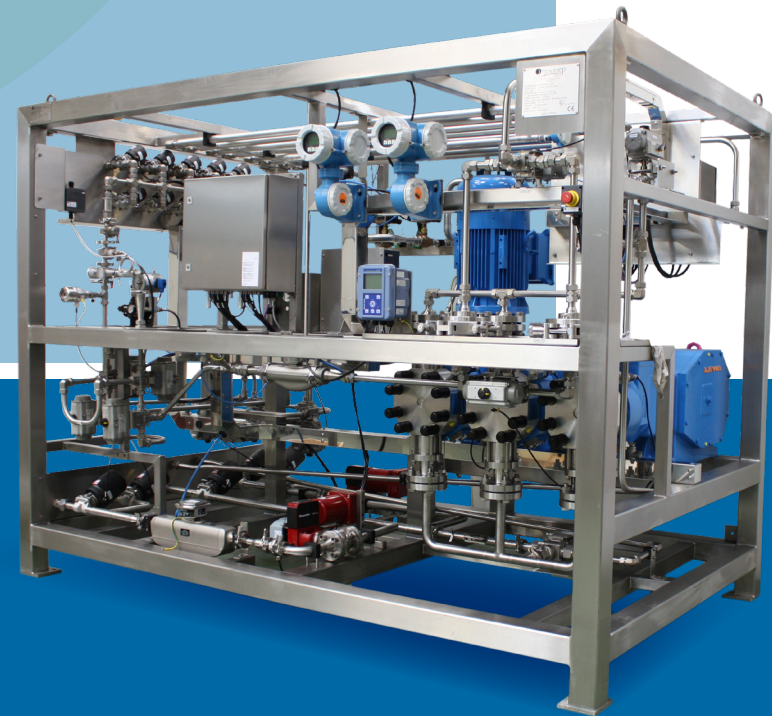
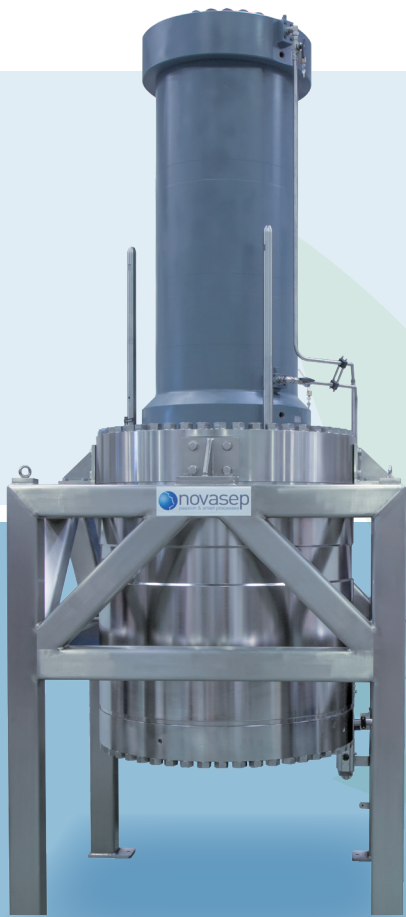


INDUSTRIAL CANNABINOID PURIFICATION



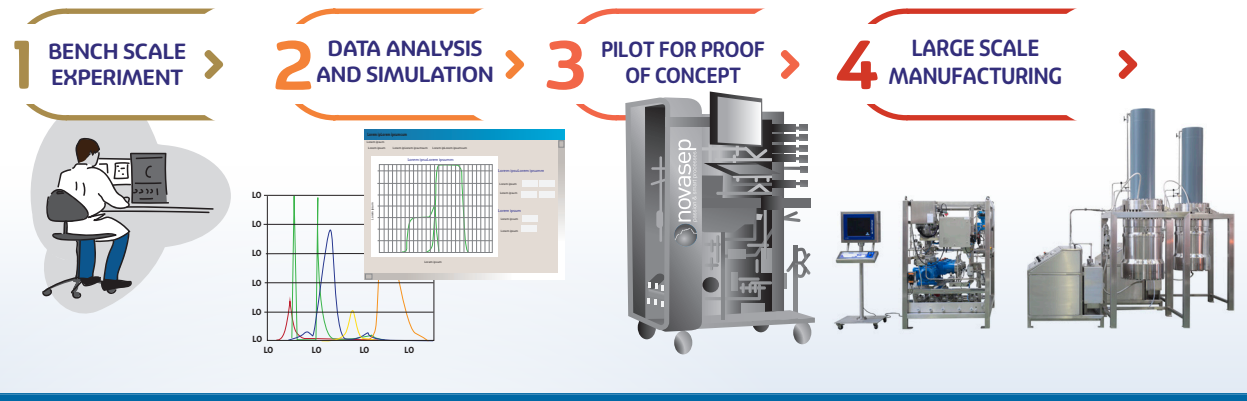
THE NOVASEP'S COMPETITIVE ADVANTAGES

Our ability to provide consulting services for feasibility, process development and pilot studies is invaluable. We have a recognized knowledge in various molecules purification: peptides, oligonucleotides, insulin, mAbs, viral vectors, vaccines, cannabinoids.

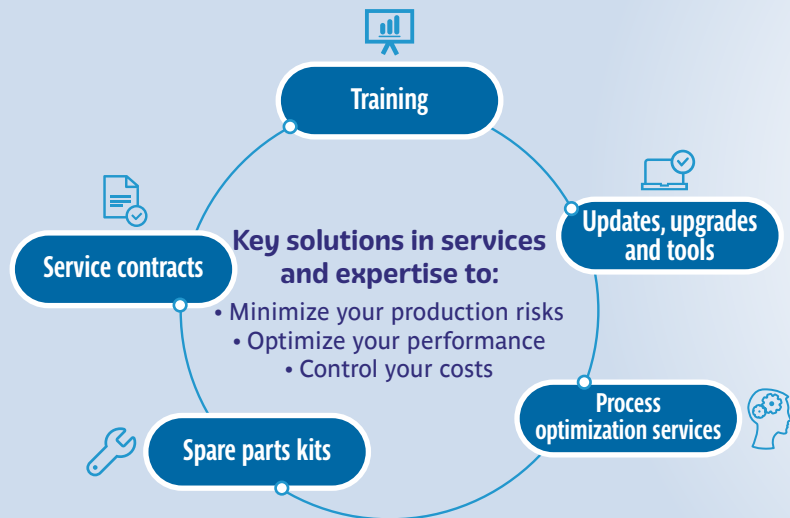
Novasep's reputation as the premier vendor for HPLC in the pharmaceutical industry and our expertise in purification and scale-up, both as an equipment vendor and CDMO*, make Novasep an ideal choice.

*CDMO: Contract Development & Manufacturing Organization

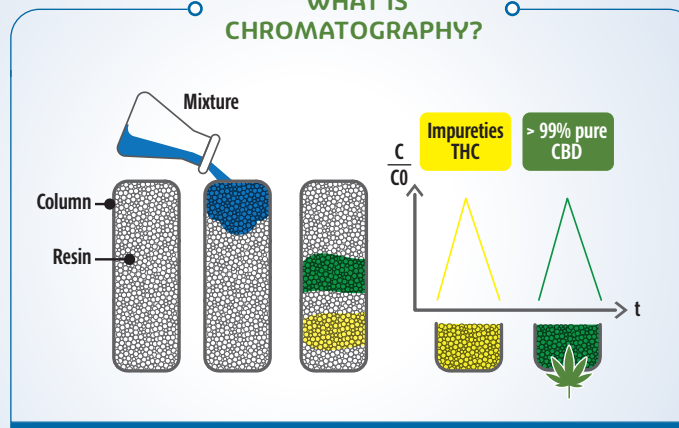
Novasep offers a complementary range of equipment & technologies of chromatographic purification and a fully integrated solution from **Process Development to Manufacturing**:



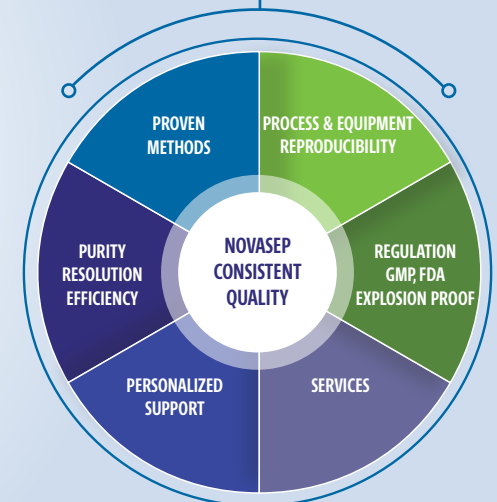
YOUR PARTNER TO MAINTAIN OPERATION EXCELLENCE



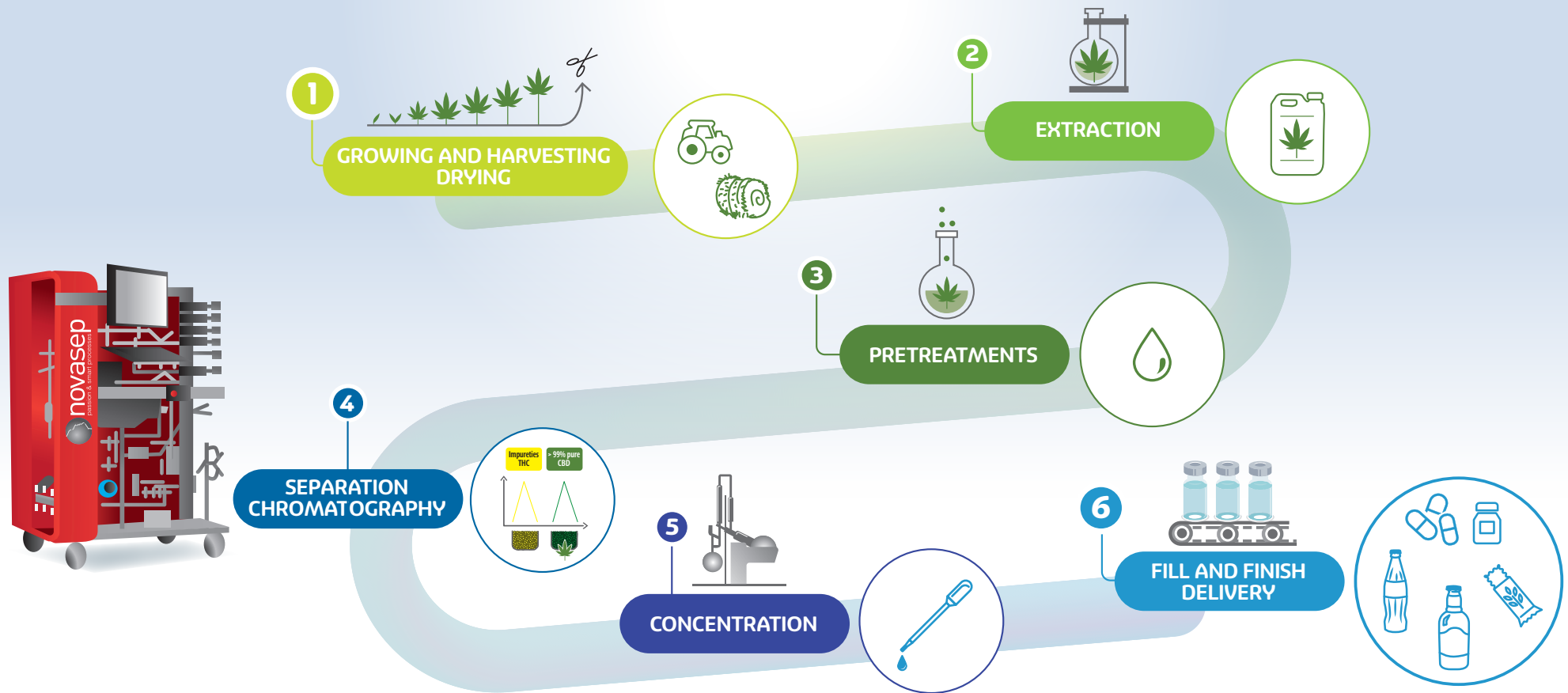
WHAT IS CHROMATOGRAPHY?



WE PROVIDE YOU WITH QUALITY



CANNABINOIDS PROCESS STEPS

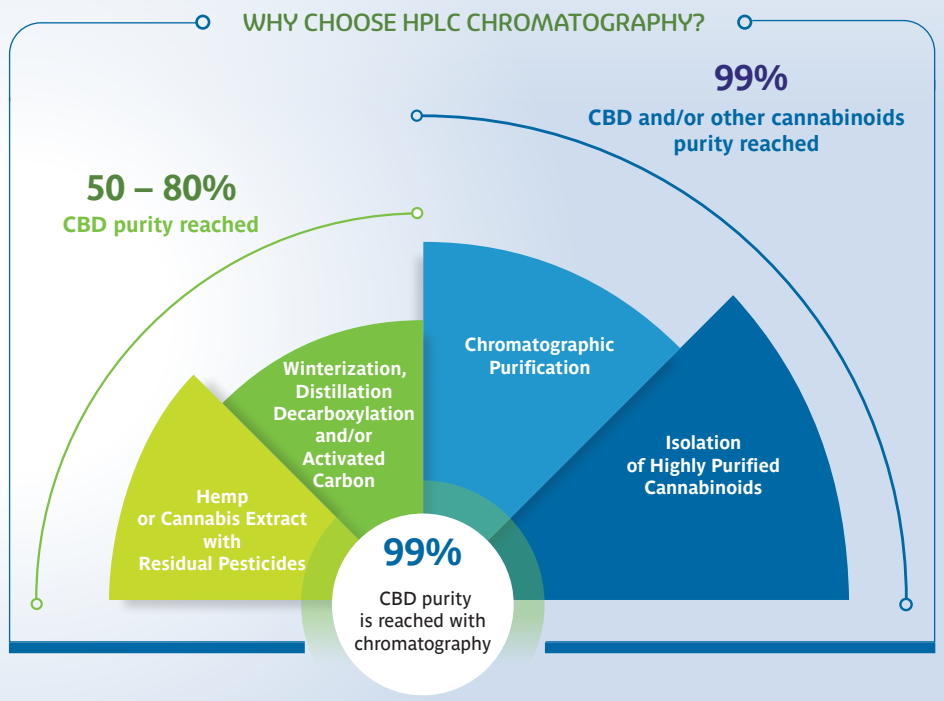
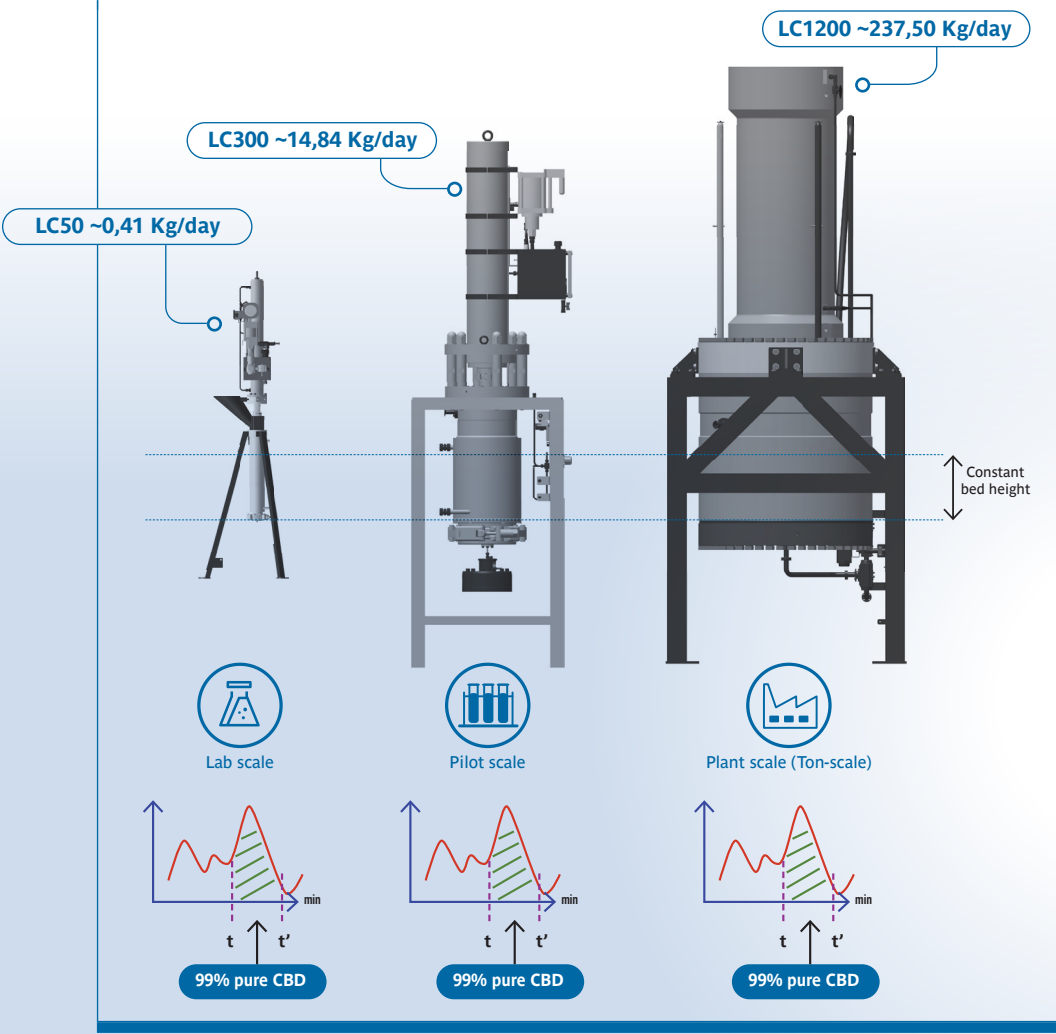


Novasep has already developed processes in the cannabinoid industry:

- THC remediation
- CBD and rare cannabinoids isolation

SCALABILITY AND PURITY

Chromatography is the best technology for large scale production.
AT ANY SCALE THE PROCESS METHOD IS EXACTLY THE SAME.
 It allows you to **REDUCE THE DEVELOPMENT TIME,**
MINIMIZE RISKS and thus **ENSURE PRODUCT QUALITY.**



CHROMATOGRAPHY TECHNOLOGIES COMPARISON



- HPLC** High Performance Liquid Chromatography
Liquid mobile phase and solid stationary phase
Based on component adsorption
- FLASH** Medium pressure liquid chromatography
Liquid mobile phase and solid stationary phase
Based on component adsorption
- CPC** Centrifugal Partition Chromatography
Liquid-liquid chromatography technique
Based on partition coefficient
- SFC** Supercritical Fluid Chromatography
Supercritical fluid mobile phase and solid stationary phase
Based on component adsorption
SFC method can be easily converted to HPLC

HPLC technology is the cost effective solution for high production scale of high purity product.

CBD COMPOUND OVERLAPS WITH SOME IMPURITIES, REQUIRING HIGH-RESOLUTION SEPARATION PROVIDED BY HPLC TECHNOLOGY

Best choice for cannabis purification

CRITERIA	TECHNOLOGY	HPLC	FLASH	CPC
Development time		Good	Very good	Medium
Resolution		Very good	Bad	Medium
Efficiency		Very good	Bad	Medium
Purification capabilities		Very good	Bad	Bad
Equipment cost		Medium	Good	Good
Maintenance cost		Very good	Very good	Medium
Operational cost		Medium	Very good	Very good
Solvent consumption		Bad*	Medium	Very good
Scalability		Very good	Medium	Bad

* Solvent consumption without recycling
 Solvent consumption is "Good" with Novasep recycling solution

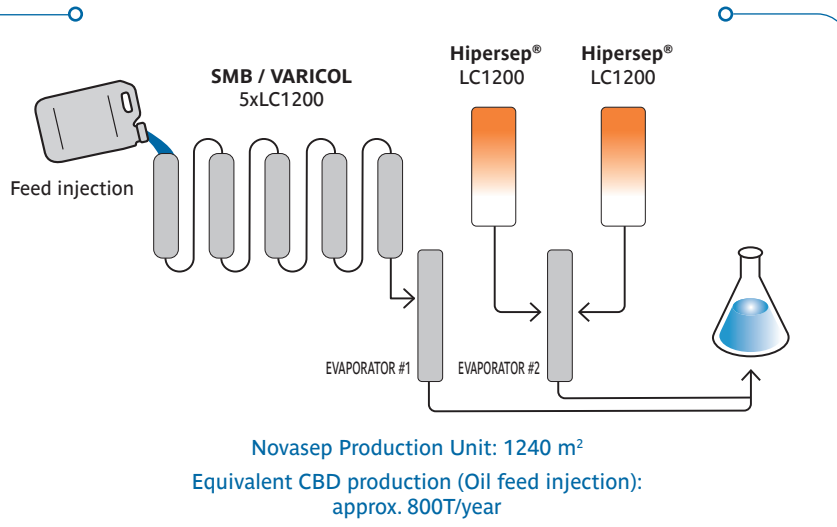
HPLC THE ONLY TECHNOLOGY THAT GUARANTEES TON-SCALE



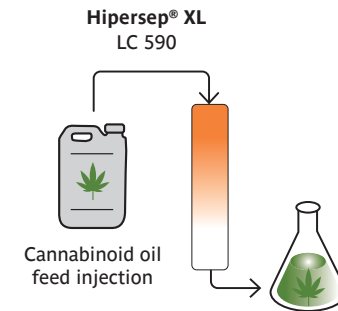
Industrial chromatography unit Varicol (5 columns LC1200) at Novasep Mourenx site (France)



Industrial scale evaporator at Novasep Mourenx site (France)



Hipersep[®] XL with LC590 at Novasep Chasse-sur-Rhône site (France)



	Skid Flowrate (L/h)	Typical Prochrom [®] column diameter (mm)	Productivity range (kg/day) in Batch mode	Productivity range (kg/day) in Cyclojet
Hipersep [®] XL	500-1600	590/800	29-106	212-318

PROCESS TECHNOLOGIES OFFER

NOVASEP TECHNOLOGIES RESPOND TO YOUR NEEDS

Productivity*
x2
Less eluent consumption*

STACKING INJECTIONS

Optimized frequency injections on a single column. Cycle time reduced for purification of cannabinoids under isocratic elution.

Productivity*
x2-x5
Yield & Purity*

CYCLOJET PROCESS

Consists in recycling the non-resolved part of the chromatogram, injecting the feed and collecting the purified products at each cycle on a single column. This binary separation method is especially adapted for THC remediation.

Productivity*
x2-x5
Less eluent consumption*

SMB / VARICOL PROCESS

Varicol is a multicolumn continuous chromatography system particularly well adapted to purify streams from any complex mixture binary fractionation using isocratic elution. This binary separation method is especially adapted for large scale THC remediation.

* Compared to HPLC batch

NOVASEP CHROMATOGRAPHY PROCESSES

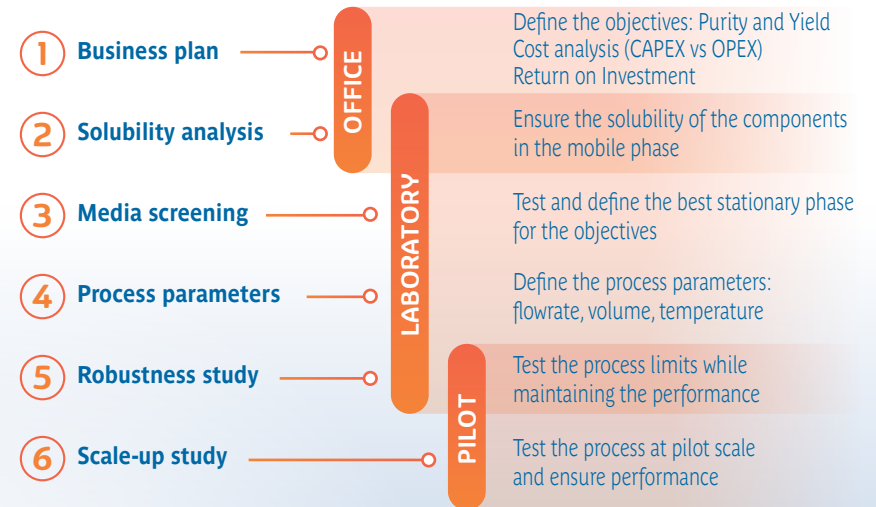
Our solutions to fit your needs

	Batch	Stacking injection	Cyclojet	Varicol®
● CBD isolation	🌿	🌿	🌿	🌿
● THC remediation	🌿	🌿	🌿	🌿
● Cannabinoids isolation	🌿	🌿	🌿	🌿
● Pesticides remediation	🌿	🌿	🌿	🌿
● Operating time	←	Batch operation	→	Continuous operation
● Production capacity	🌿	🌿	🌿	🌿
● CAPEX	🌿	🌿	🌿	🌿

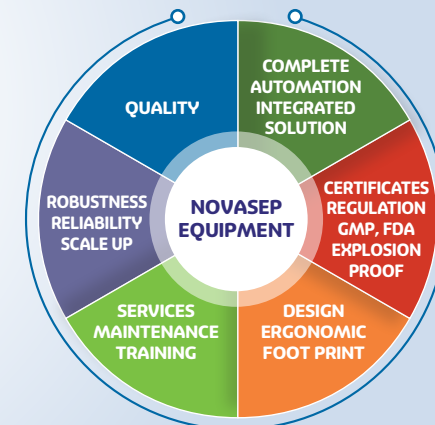
🌿 Excellent 🌿 Great 🌿 Good

Our equipment are cGMP compliant

SELECTING PREPARATIVE CHROMATOGRAPHY



THE WORLD LEADING PREPARATIVE HPLC SYSTEM FOR THE CANNABINOIDS MARKET



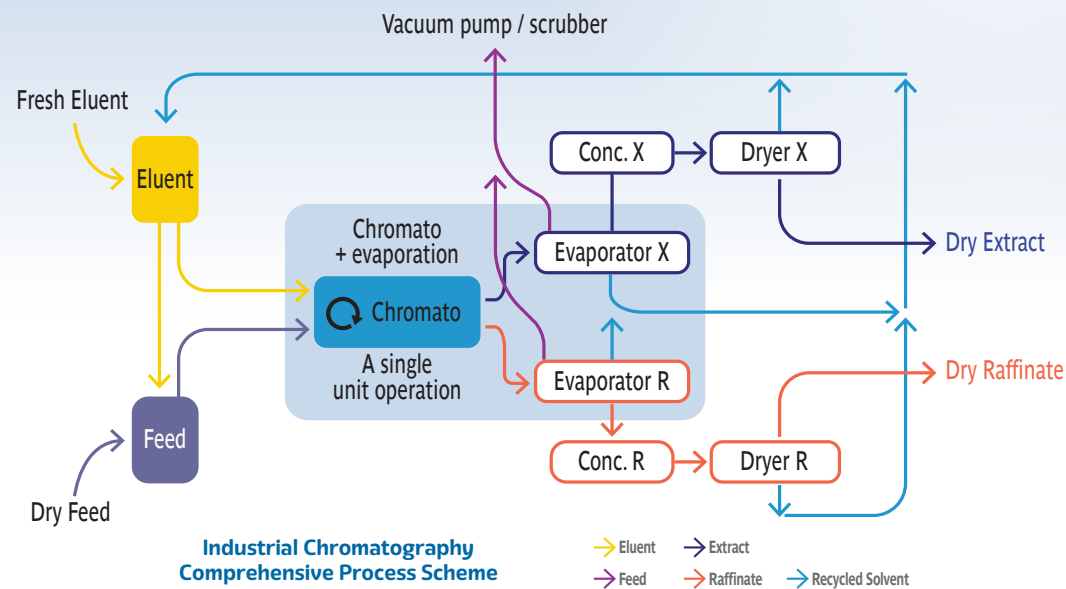
SOLVENT RECYCLING

Cannabinoids poor water solubility implies the use of large amounts of organic solvent.



Industrial scale evaporator at Novasep Mourenx site (France)

SOLVENT SAVING FOR LARGE SCALE SYSTEMS



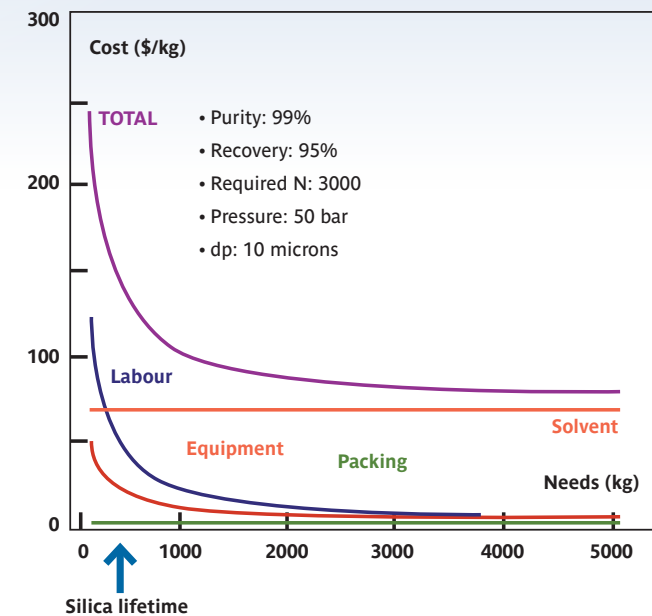
Industrial Chromatography Comprehensive Process Scheme

Technologies:

- 20-50L rotavaps for small scale
- Falling film evaporator (FFE) or thin-film evaporator (TFE) for medium and large scale evaporation

WHY IS IT IMPORTANT TO RECYCLE SOLVENT?

Without recycling, solvent cost (\$/kg) is constant and not depending on the production scale.
When scaling up, the solvent cost is relatively high compared to other costs.
Solvent recycling solution must be evaluated to reduce cost when scaling up.







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