



X-Spiral 2.5

Membrane Nanofiltration System

capable of dewaxing, depigmentation/sugar removal, and solvent recovery

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X-Spiral 2.5

Key Features

- Permeation rates up to 60 gallons per hour for solvent recovery
- Removes up to 95% of solvent after initial extraction
- Capable of dewaxing or depigmenting over 10 kg of extract per hour
- Enables cold ethanol extraction at -20 °C with no decrease of product quality, increasing extraction throughput on your existing system
- C1D1 rated self-priming electrical pump enables easy operation
- Extremely flexible universal membrane housing allows use of any filter membrane - does not require the use of expensive proprietary membranes
- 4 independent filter chambers allow for any combination of membrane types
- Optionally, additional banks of 4 filter chambers can be added for maximum flexibility
- Low-cost of ownership: filters typically last 6-12 months and cost as little as \$400 each

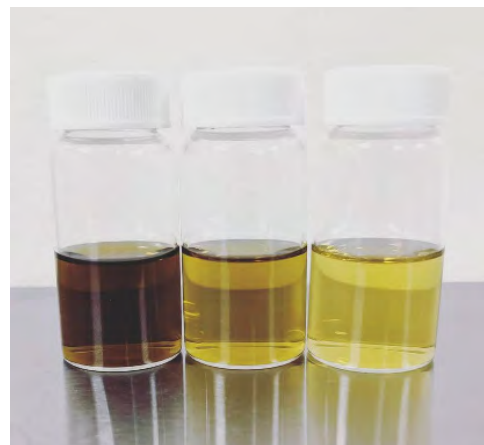
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X - S P I R A L

Advantages of Nanofiltration

In-line dewaxing ensures optimal product quality and purity throughout downstream processes, and eliminates the costly winterization process. Residue-rich crude can cause coking of distillation equipment, reducing efficiency of solvent recovery and molecular distillation. Sugar residues present in residue can cause clogging of gear pumps and check valves, leading to frequent cleaning and maintenance. By removing these contaminants prior to solvent recovery, maintenance of downstream equipment is greatly reduced, while enhancing product color, purity, and yield.



OSN: Low Energy, Low Temperature Solvent Recovery

Traditional solvent recovery methods require significant energy input in order to heat the miscella and then cool the vapors to condense the solvent. Over time, the electrical costs can add up, with large falling film evaporators requiring tens or hundreds of thousands of dollars a year in energy costs alone. Organic Solvent Nanofiltration (OSN) enables low-energy recovery of ethanol in a rapid, safe, and efficient manner, without exposing the product to excess heat.

OSN functions in a similar manner as reverse osmosis, specially designed filtration membranes have pores of a specific size. In solvent recovery applications, these pores are small enough that only ethanol can pass through; in dewaxing/depigmentation applications, the pores are large enough for solvent, terpenes, and cannabinoids to pass through. Pressure is used to overcome osmotic forces, enabling rapid concentration of the miscella.

Additionally, very little heat is generated in the process. Thus solvent recovery can be accomplished without decarboxylation of the target cannabinoids, enabling the large-scale production of quality shatters and crumbles from cold-ethanol extractors.



X-SPIRAL NANOFILTRATION

	Avg. Permeation Rate (gal/h)		Extraction Throughput (lb/h)
	Dewaxing, Depigmentation	Solvent Recovery	Assuming 1.5 lb/gal Ethanol
X-Spiral 2.5	30	60	90
X-Spiral 4	90	180	270
X-Spiral 8	400	800	1200

TECHNICAL DATA

Model	X-Spiral 2.5
Avg. Permeation Rate	30 gal/h (Dewaxing, Depigmentation) 60 gal/h (Solvent Recovery)
Equivalent Extraction Rate	90 lb/h
Cross-Flow Rate	9 gal/min
Electrical Requirements	3Φ 480 V, 60 Hz, 15 A
Hazardous Area Certification	C1D1 Rated
Membrane Compatibility	Compatible with all 2540 membranes
Dimensions (LxWxH)	53" x 31" x 43"
Weight	430 lb
Optional Chiller Electrical Requirements	3Φ 480 V, 60 Hz, 20 A

Optional Upgrades Include:

- Additional banks of housings enable non-stop operation
- Optional MTA chiller required for dewaxing functionality



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ABOUT US

Root Sciences is a global leader in the distribution of equipment and support services for processing facilities in the cannabis and hemp industries, representing premium extraction, distillation, and other post-processing technologies. Backed by years of hands-on experience in both growing and processing, Root Sciences' collective knowledge as a team of seasoned practitioners and process engineers is unmatched in the hemp/cannabis industry.

Frustrated by the limitations of traditional solvent recovery, in 2018 Zev Feinstein established Molecular Forces, utilizing his Masters in Polymer Science to develop cutting edge Organic Solvent Nanofiltration techniques for use in cannabis processing. With their deep background in chemistry, Molecular Forces uses the latest scientific technologies and knowledge of first principles to maximize efficiency. In 2021, Root Sciences and Molecular Forces began working together to introduce Organic Solvent Nanofiltration technology to the hemp and cannabis markets for use in cannabinoid applications. Together, the two companies provide best-in-class equipment for sustainable, scalable processing solutions.