

X-Spiral 4

Membrane Nanofiltration System

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

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X-Spiral 4

Key Features

- Average permeation rate of 90 gallons per hour
- Capable of dewaxing or depigmenting over 6 kg of ethanol extract per hour
- Enables cold ethanol extraction at -20 °C with no decrease of product quality, increasing extraction throughput on your existing system
- Ultra-low energy dual-pump design enables incredibly efficient solvent recovery, with one-third the energy consumption of other Organic Solvent Nanofiltration (OSN) units
- Removes up to 95% of solvent after initial extraction
- Extremely flexible universal membrane housing allows use of any filter element - does not require the use of expensive proprietary membranes
- Available with either pneumatic or electric pumping system
- Pressures up to 1000 PSI and cross-flows up to 40 GPM
- Low-cost of ownership: filters typically last 6-12 months and cost as little as \$800 each

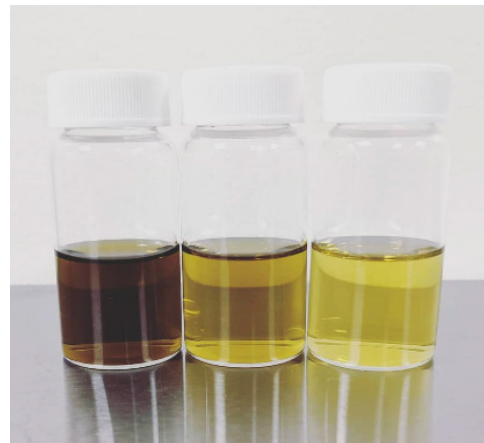
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X - S P I R A L

Advantages of Nanofiltration

Room temperature 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.

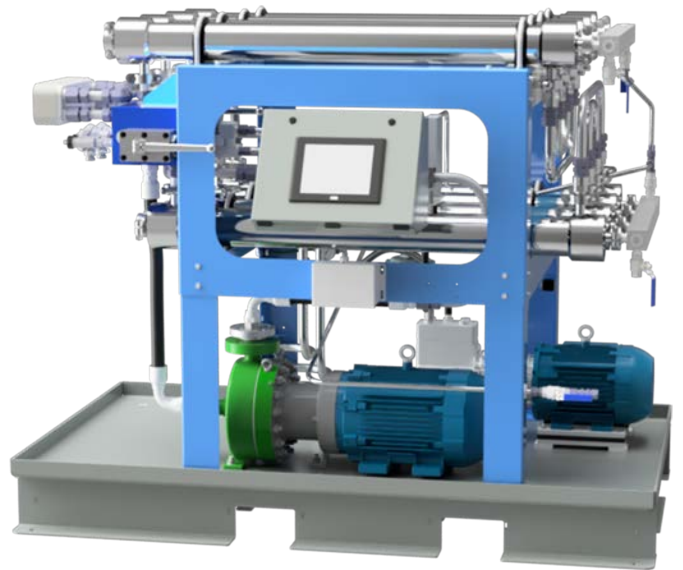


OSN: Low Energy, Low Temperature Solvent Recovery

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 4
Avg. Permeation Rate	90 gal/h (Dewaxing, Depigmentation) 180 gal/h (Solvent Recovery)
Equivalent Extraction Rate	135 lb/h
Cross-Flow Rate	40 gal/min
Air Requirements	n/a
Electrical Options	3Φ 460 V, 60 Hz, 15.2 A
Hazardous Area Certification	Class 1 Division 2
Membrane Compatibility	Compatible with all 4040 membranes
Dimensions (LxWxH)	88" x 46" x 54"
Weight	600 lbs

Optional Upgrades Include:

- Additional bank of housings enables dual-function (switchable) operation.
- Electric pumps allow for air-free operation in Class 1 Division 2 environments



+1 (206) 452-1130
www.rootsciences.com

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.