

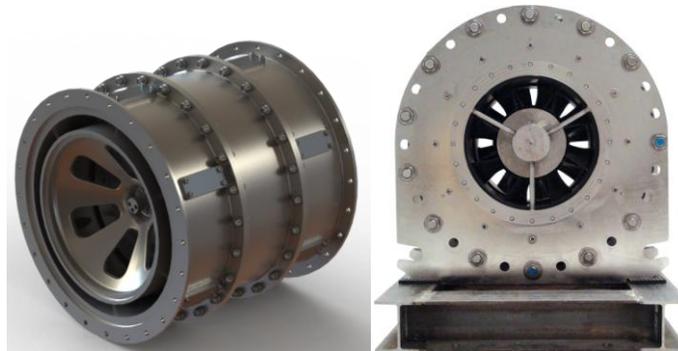
Black Pine Engineering MVC Compressor

Black Pine Engineering's modular compressor technology allows for disruptive performance for Mechanical Vapor Compression, achieving delta Ts higher than centrifugal compressors and turbofans, at price comparable with turbofans.

Black Pine Engineering's goal is to offer more efficient, scalable, and reliable turbo-compressors with a very quick ROI/payback period. Our compressors will allow for simplified integration, increased scalability, and economic viability in this space. MVC is the most energy-efficient means of evaporating water for water treatment or concentrating solids, but the high cost of efficient compression greatly limits MVC's ability to address the opportunity.

Our compressor is able to achieve much higher compression ratios than centrifugal compressors and turbofans. We uniquely allow MVC integrators to reach pressure ratios 3 or higher with a single compact compressor, corresponding with delta Ts of 30+C. This means that we can concentrate brackish mixtures with very high boiling point elevations. Our product is priced at a similar level with turbofans, but reaches higher efficiency (80+%) and pressure ratio.

Our MVC compressor is of an axial design, where the unique factor is we integrate permanent magnet motors into the hub of each compressor stage, allowing us to make independently driven, stackable compressor stages. The real disruption is that these stages can be produced in almost all applicable sizes and can be assembled modularly in order to efficiently scale up to the demands of any MVC specification.



Modular Compressor Prototypes

Therefore, no drive shaft, gear box are needed, as each stage is independently controlled by its integrated motor and variable frequency drive. This significantly reduces part count and maintenance cost. The compressor is very compact, and can be oriented vertically to easily integrate with existing evaporator equipment. The motor is isolated from the working fluid to prevent contamination. The footprint can be 1/3 or less than a centrifugal compressor. Each individual stage can be easily maintained, and stages can be replaced in as little as two hours.

Woven Wheel compressors have the potential to become an enabling technology for the broad application of efficient, scalable wastewater treatment. With the reduction of efficient high performance compression we can bring to the process, MVC systems can be employed in many more cases and more efficiently. The lower price of our system enables more TVR to MVR retrofit opportunities where previously the use of centrifugal compressors would be price prohibitive. Our solution would make the switch from far less efficient steam powered evaporators to MVC units more economically viable across the evaporator market. Much more brackish or dirty water can be purified using the MVC process, without the use of an additional steam powered evaporator or crystallizer. The compressor can be implemented for flow rates from 3000 CFM (10 cm diameter wheel) to 375000 CFM (1 meter diameter). We are currently finishing design of our first full-scale single stage prototype, to be completed in May.

US Patents No.: 7,938,627; 8,449,258; 8,506,254 with European equivalents