DrinkingWaves

AMERICAN MADE WATER PRIZE

U.S. DEPARTMENT OF ENERGY

CHALLENGE SOLUTION

Drinking fresh water directly from the ocean

DrinkingWaves

Simplified process from waves to reverse osmosis system eliminates energy conversions, motors, electricity and moving parts.

The two stage pressure boosting, non-motorize system channels the horizontal wave energy to press the seawater through the reverse osmosis filter.

Most wave energy converters operate on converting the wave's vertical force. DrinkingWaves uses the horizontal force. Neither is superior, but the advantage of going horizontal is the system can be located on the beach where users walk to system for easy access.

2. Team Introduction

Desalination Process Engineering Team

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3. The Problem / Opportunity

What	Problem Size	Who
Develop a small, modular, wave-powered desalination system capable of providing potable drinking water in disaster relief scenarios and remote coastal locations.	Wave energy-powered desalination systems could help to address coastal challenges such as resilience, disaster recovery, and water scarcity, especially if systems are competitive on price, water production, and reliability when compared to conventional alternatives.	Costal communities who want fresh water from the ocean in times of disaster recovery, and water scarcity.

Advantages

- **Walk-To Access**: Locating the desalination device at the beach so administrators can walk to it reduces deployment effort, maintenance costs and time to fresh water.

- **Modular**: A modular design reduces costs and effort to transport, assemble, operate and maintain the unit.

- **Few Moving Parts**: Costs to manufacture, operate, maintain and life expectancy are proportional to the number of moving parts in the device. This is true for all manufactured products. The DrinkingWaves design uses no motors. The pressure is generated using a two stage ram pump and high lifter pump - only moving parts are check valves and short travel pistons.

- **No Energy Conversion**: Efficiency and complexity is proportional to energy conversion steps. The DrinkingWaves design has no energy conversion steps making it efficient and simple: wave energy is applied directly to the reverse osmosis filter.

Solution

DrinkingWaves

- ✓ Located on the beach, it amplifies the wave pressure which presses the seawater through a reverse osmosis filter.
- ✓ A ram pump and high lifter pump combination generates the water pressure to feed the reverse osmosis filter.
- ✓ Simple design, few moving parts, no motor, easy maintenance
- ✓ Easy to install on the beach and use, walk-to access

Process Steps

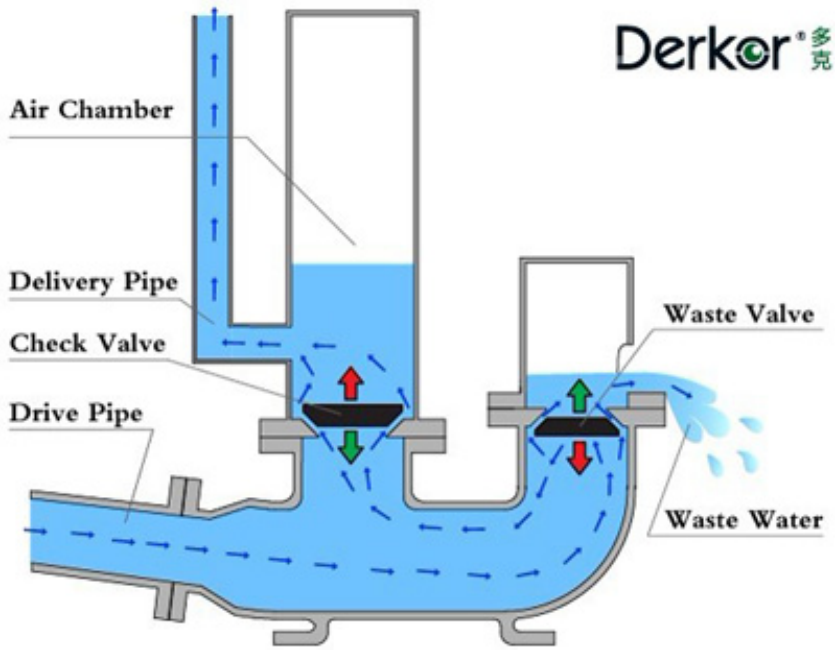
- ✓ wave -> screen -> funnel -> pre-filter -> low pressure accumulator -> Ram pump -> medium pressure accumulator -> high lifter pump -> high pressure accumulator -> RO filter -> fresh water distribution
- ✓ Funnel with wide opening and small exit boosts hammer effect
- ✓ Hydraulic ram and high lifter amplifies hydraulic pressure
- ✓ Accumulators change cyclic wave to constant RO feed
- ✓ Reverse osmosis filter
- ✓ Valves and pipes

Step 1: Folding Funnel

Breaking wave on beach enters the 1 meter wide funnel and exits the .2 meter wide end at a higher velocity than the wave as the seawater enters the hose. The hose sends water to the hydraulic ram pump. Due to the venturi effect, the higher water velocity will enhance the water hammer in the hydraulic ram pump.

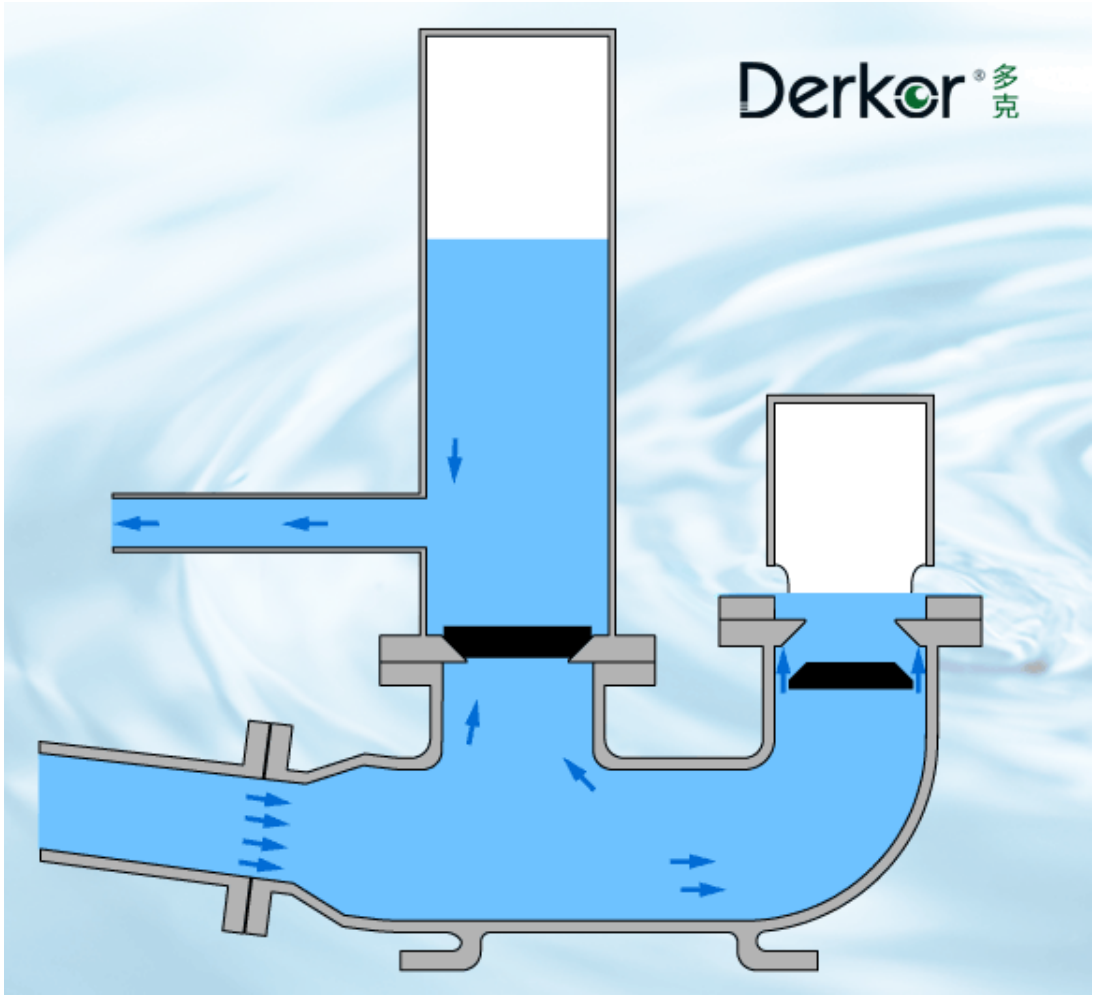
Step 2: Hydraulic Ram Pump

The hydraulic ram pump receives water from the funnel hose and boosts pressure about 5:1. The exit water feeds an accumulator which in turn feeds the high lifter pump. The ram pump is used extensively for residential and community water feeds, based on rivers and ponds. The prototype will use the Papa Pump, but the eventual pressure booster may be a custom designed alternative.



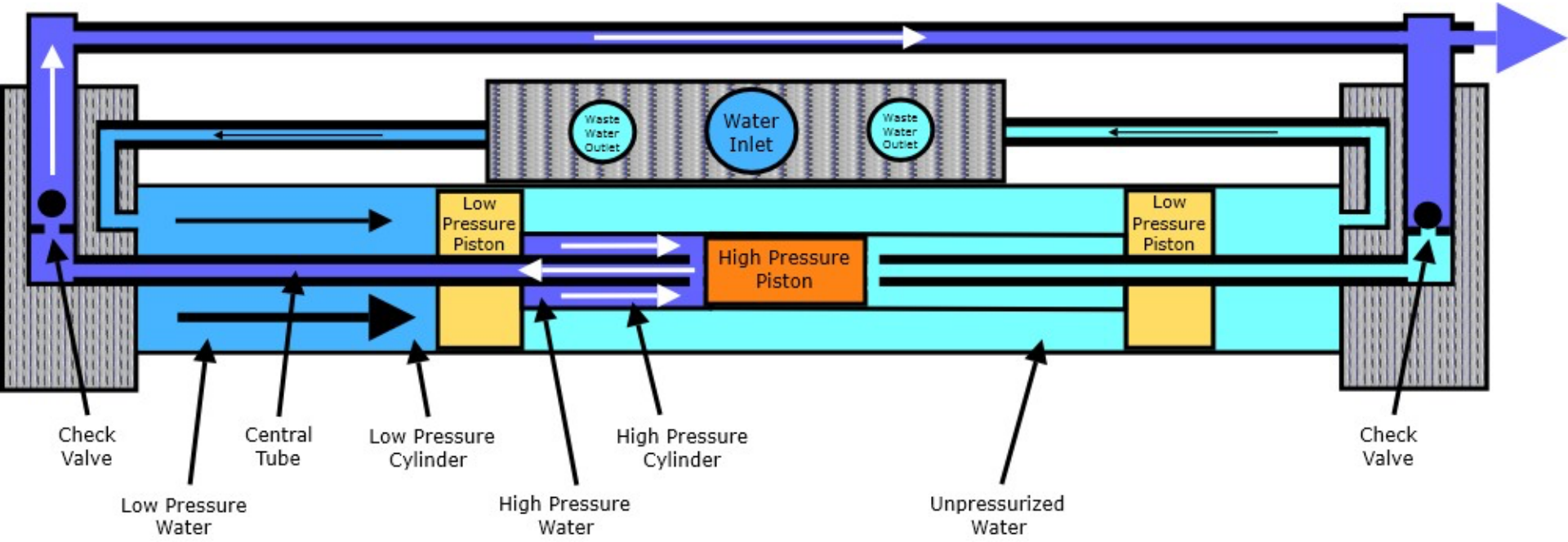
Step 2: Hydraulic Ram Pump

Animated image of how a Ram pump works. Click the image to start the animation.



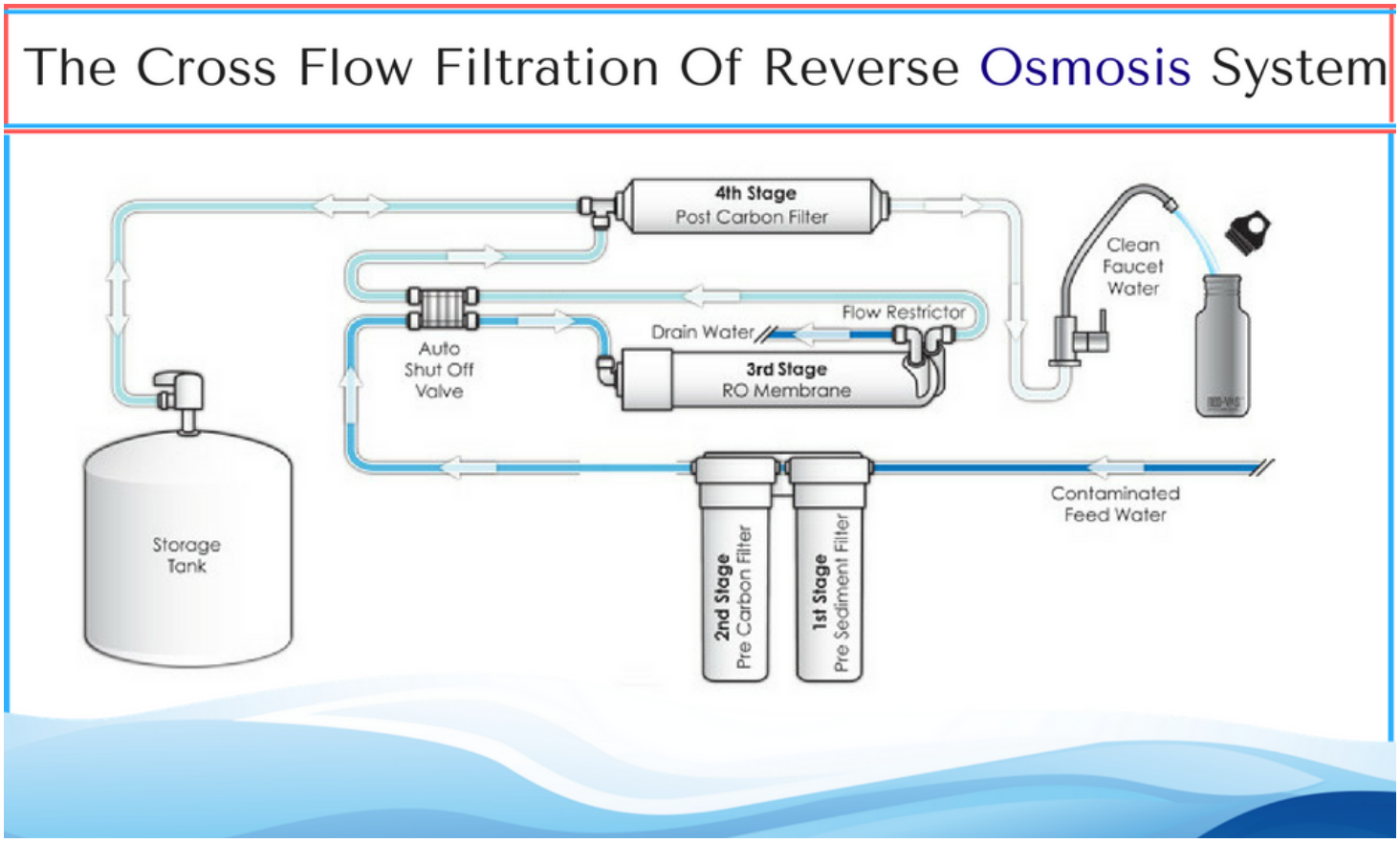
Step 3: High Lifter Water Pump

Below is a diagram of a high lifter water pump. The medium pressure water from the Ram pump is the input to the high lifter pump which boosts pressure about 9:1. The output of the high lifter pump goes into an accumulator which feeds the reverse osmosis filter. The high lifter pump is used extensively for mountain communities where there are high elevation changes. The prototype will use this device from www.humboldtsolarwaterpump.com, but the eventual pressure booster may be a custom designed alternative.



Step 4: Reverse Osmosis Filter

The exit pressure from the high lifter pump will be between 300 and 400 PSI. This pressure will push the seawater through the RO System shown below. The output of the RO system will be a freshwater tank and distribution system.

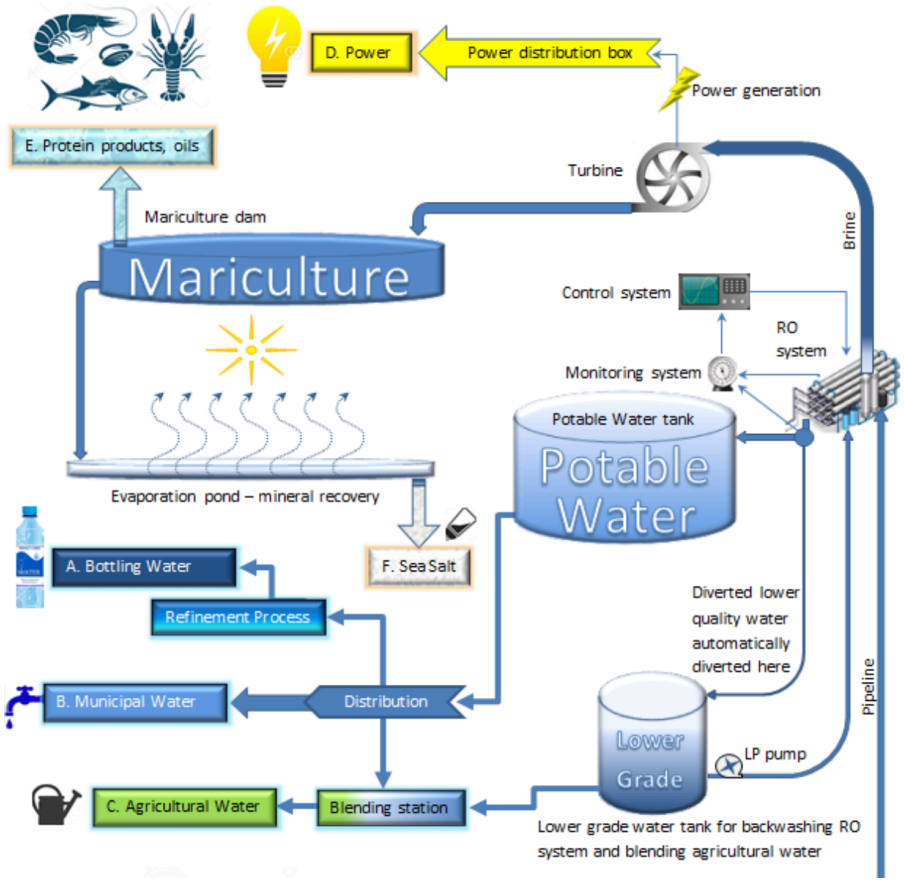


Output Volume Controlled by Array

The output volume can be controlled by adding pumps in an array. There would be an array of funnels whose output are connected into a common accumulator, the output of an array of hydraulic ram pumps would feed a common accumulator, and again an array of high lifter pumps would feed a common accumulator that would feed an array of RO filters.

Business Value

Beyond desalination, DrinkingWaves system generated high pressure water can drive multiple benefits. Graphic from www.impactfreewater.com



Aftermarket Opportunities

Beyond desalination, DrinkingWaves system generated high pressure water can be used for the below industries:

- Sustainable Agriculture
- Government Entities
- Non-Profit Organizations
- Off-Grid Communities
- Public Parks
- Golf Courses
- Fish Farms
- Water-Treatment Facilities
- Home Owners Associations