Full Plate Distributor Vessel = Truly Green Water Treatment

By Douglas M. Horner and Michael P. Mormino

'Go green' efforts have recently become a major public initiative as a 'new' idea. Yet many water treatment dealers have experienced firsthand the negative impact water contamination has had on the environment for years. Their professional insights and expertise have led many to be proactive in demanding green water treatment solutions that will help the environment and in turn, benefit their customers.

Manufacturers and distributors have been responsive to these requests, engineering a multitude of products, systems and techniques that purport to reduce environmental impact and lower energy consumption.

One efficient green product is the full plate distributor vessel, currently the only one of its kind in the industry for residential and light commercial applications. It achieves optimal backwashing and cleaning action of medias by utilizing a high-flow, lift-and-bed fluidization that creates a scrubbing action and distributes water throughout the bed.

A brief history

The water treatment industry in the early 1950s almost exclusively utilized steel pressure vessels to build their systems. In 1954, Structural Fibers was incorporated and Jim Horner began to develop fiberglass reinforced products (FRPs). His efforts eventually found application in the water treatment industry as seamless, fiberglass-reinforced pressure vessels, which signaled the end of the residential steel vessel market. Culligan was the last high-volume steel manufacturer, well known for their triple-hull tanks.

By the late '60s and early '70s, the FRP-style vessels dominated the world residential water treatment market. Other companies, such as Apex and Park International, joined the field of manufacturers. During this time, engineering advances in manufacturing technologies led the industry's move toward blow mold and wind style pressure vessels.

Figure 1. Full plate distributor self-cleaning nozzle design

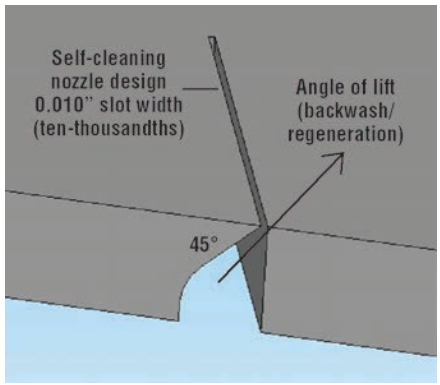
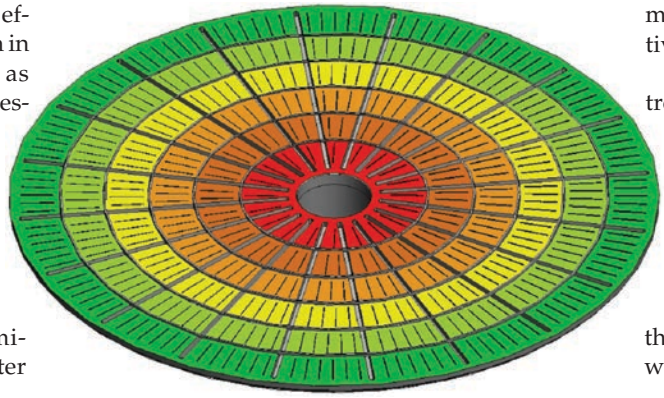


Figure 2. Full plate distributor design showing radial open area increase

Array (starting at center)	Percent increase of open area with respect to Array No. 1
Array No. 1	—
Array No. 2	100
Array No. 3	200
Array No. 4	300
Array No. 5	400
Array No. 6	500

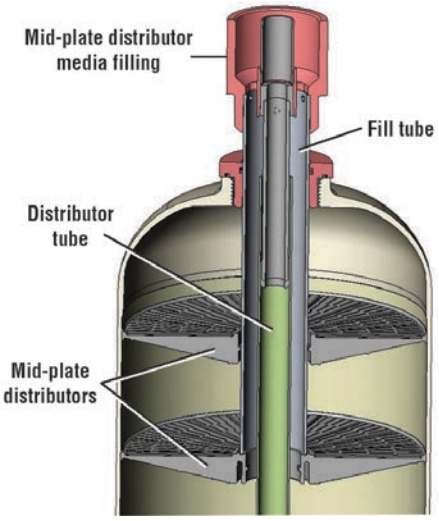


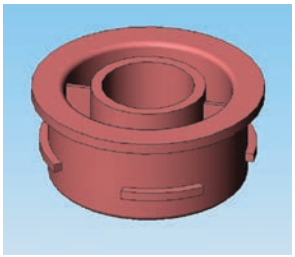
Advances in winding technologies enabled the development of larger commercial pressure vessels with both threaded and flanged openings. Commercial fabricated steel pressure vessels have utilized elaborate distribution systems to carefully control the flow of water in and out of the vessels. Their higher flow rates required carefully controlling the flow (through the vessels and the media) to ensure effective and complete water treatment.

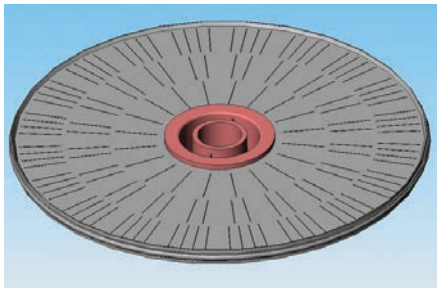
Commercial steel vessels had an advantage, in that sophisticated distribution systems could be readily fabricated inside the vessel prior to final dome assembly. FRP, blow mold and wind seamless composite vessels all required that internal distribution components fit through the vessels end fittings. These ranged in size from 2.5 inches (residential standard) to a maximum of six inches for commercial vessels. This limited both the design and the effectiveness of the distribution systems. Washed pea gravel and garnet, filled around and above the distributors, was one method used to improve their effectiveness.

In the 1980s, Brunner Corp. introduced a residential pressure vessel composed of multiple tank liner components that allowed for the installation of a flat plate style distributor in the bottom dome of the vessel. Many today remember vividly the plant tour that Lance Fitzgerald conducted introducing this revolutionary concept. The plate was injection molded and was com-

Figure 3. Mid-plate distributor fill assembly and center adapters







prised of a polymer mesh cloth adhered to the plate assembly, which was then glued into the bottom dome assembly. This style of distributor did not require gravel under-bedding to achieve the same flow and softener capacity effectiveness.

In the 1990s, Hague Quality Water International developed and introduced a multi-part injection molded pressure vessel that advanced the plate distributor concept to the next level by including both a bottom plate and the new concept of mid-plates that would allow non-mixed, multi-media beds to be contained in a single vessel. This plate assembly also utilized the molded plate with a mesh screen as the separation device.

Today

Recently, another significant advancement of the bottom plate concept was introduced. Advances in computer aided three-dimensional design and precision CNC tooling have allowed for the bottom plate to be molded complete as a one-piece unit. With precise, uniform molded 10-thousandths (0.010") wide slots in a specific concentric grid pattern, it allows the designer to specifically control the flow of water through the plate more effectively than with a random gravel bed and cone style distributor (see Figure 1). The slot grid pattern is carefully modeled, much like true fractal distributors, previously only available in fabricated commercial vessels.

Increased bed capacities via uniform influent flow can be achieved, alleviating the premature breakthrough caused by channeling. Heavy filtration medias can now be backwashed at rates that are more consistent and in line with the flow rates of the majority of residential wells and homes, creating further system design options.

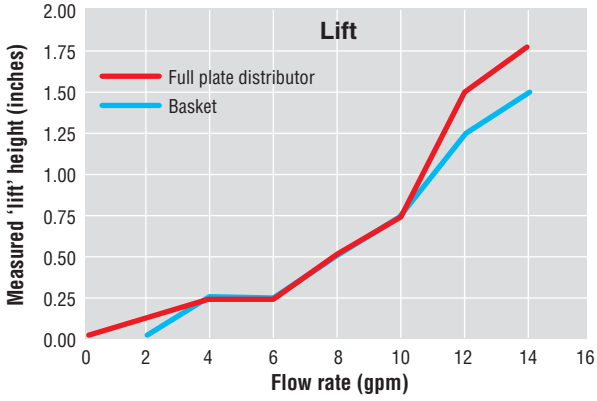
This new full plate distributor design has greater than 1.5 times the open area of a standard cone style distributor, decreasing pressure drop across the system (see Figure 2). The flow slots are specifically aligned and angled to more effectively and consistently fluidize the media bed during backwash and regeneration, utilizing a self-cleaning nozzle design. Initial testing has shown that backwash flow rates can be reduced by a minimum of 30 percent over cone and gravel style distribution systems.

With advances in composite pressure vessel manufacturing, the limitations on access to the internals of a residential or light commercial vessel are no longer defined by the openings of that vessel. Now, everything can be integrally placed inside the vessel prior to final fabrication and winding, allowing for a distributor plate design that can maximize flow and design characteristics. Bottom and mid-plate distributors can now be designed at the factory and consistently located to the customer's specific needs, while medias can still be easily removed for re-bedding (see Figure 3).

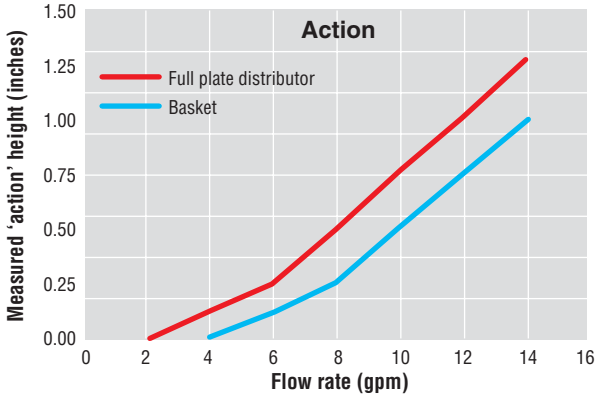
Lab tested

Independent third-party testing of standard basket distributors with underbedding versus the full distributor plate vessel without underbedding is graphed in Figure 4. Using this data, backwash rate can be reduced in this system design from 13 gpm/min to seven gpm/min, conserving thousands of gallons of water annually per system.

Figure 4. Backwash comparison of full plate distributor vessel versus standard basket distributor vessel with under-bedding



Flow rate	Full plate distributor	Basket
0	0.000	0.000
2	0.125	0.000
4	0.250	0.250
6	0.250	0.250
8	0.500	0.500
10	0.750	0.750
12	1.500	1.250
14	1.750	1.500



Flow rate	Full plate distributor	Basket
0	0.000	0.000
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4	0.125	0.000
6	0.250	0.125
8	0.500	0.250
10	0.750	0.500
12	1.000	0.750
14	1.250	1.000

10-inch diameter vessel; 0.66 cu.ft. KDF 55; water temp. 52°F (Independent third-party testing: Data provided by KDF Fluid Treatment, Inc.)

Mike Trammell of Watts Water Quality Products, Inc. described the company's independent third-party testing of the device. "Using a full plate distributor tank, we have been able to increase the salt efficiency by nearly 80 percent over the generally accepted industry standard for conditioning systems. Its unique features allow us to employ assembly and operational techniques that were previously unavailable to independent OEMs. The average salt efficiency of a standard unit with gravel under-bedding is 3,333 grains per pound. We have been able to consistently achieve an 80 percent increase in grains per pound, reducing the amount of salt discharged to the environment—all gained through this system design."

Water and salt savings will be realized in filter and water conditioners through required flow rate reductions (see Figure 5); efficiencies gained through universal plate distribution.

Summary

With the current studies between NOWRA and WQA and water savings regulations being watched in all states, a new tank technology that improves on current designs is significant. A full plate distributor vessel can enable dealers to take the next step and rewrite the book of water treatment.

About the authors

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About the company

♦ *ENPRESS® LLC is a worldwide leading manufacturer of composite pressure vessels for use in water treatment. ENPRESS tanks are manufactured with an industry-exclusive liner design and formulation that offer superior benefits and features and is 100 percent 'Made in the USA'. For more information about the Vortech® (the full plate distributor discussed in this article) or any other products offered by ENPRESS, visit www.enpress.com or call (866) 859-9274.*

Figure 5. System comparison data, bottom distributor plate system versus cone and under-bedding conditioning system

The system	
Full plate distributor tank	**Standard tank**
One cubic foot of 10 percent resin	One cubic foot of 10 percent resin
No gravel underbed required	Five lbs. of gravel underbed required
5,600 metered valve	5,600 metered valve
Distributor plate on bottom	Standard one-inch distributor tube
3/4" hard water service line	3/4" hard water service line
55 psi incoming pressure	55 psi incoming pressure
52 degree incoming city water	52 degree incoming city water
Incoming flow rate 15 gpm	Incoming flow rate 15 gpm
2.0 gpm drain flow control	2.0 gpm drain flow control
0.5 brine line flow control	0.05 brine line flow control
Standard piston	Standard piston

The results	
Full plate distributor tank	**Standard tank**
Bed expansion in backwash 10.5 inches of lift	Bed expansion in backwash five inches of lift
Time to lift bed to full expansion at 2.0 gpm = 2.0 min.	Time to lift bed to full expansion at 2.0 gpm = 4.25 min.
Four min. backwash time = 8.0 gal.	Eight min. backwash time = 16.0 gal.
Mineral bed had a lot of turbulent action	Bed had little turbulent action
Fast rinse reduced from six to two min. at 2.0 = 4.0 gal.	Fast rinse had to stay at six min. at 2.0 = 12.0 gal.

Notes on system comparison and results	
Full plate distributor tank	**Standard tank**
Water used during backwash and fast rinse = 12.0 gal.	Water used during backwash and fast rinse = 28.0 gal.
Water used to fill brine tank = 3.0 gal.	Water used to fill brine tank = 3.0 gal.
Water used in slow rinse = 27.0 gal.	Water used in slow rinse = 27.0 gal.
Total water used for complete cycle = 42.0 gal.	Total water used for complete cycle = 58.0 gal.
Flow rate at 10.7 psi drop = 12.7 gpm	Flow rate at 10.7 psi drop = 11.6 gpm

Example of usage for family of four on 20-grain hard water
60.0 gal. per person per day x four = 240.0 gal. of water per day
240.0 x 20.0 grains of hardness = 4,800 grains of hardness removed per day
4,800 grains removed ~ capacity of 28,200 grains capacity = 5.88 days between regenerations
5.88 ~ 30 days per month = 5.10 regenerations per month
5.10 per month x 10.0 lbs of salt (medium setting) = 51.0 lbs of salt used
5.10 regenerations x 42.0 gal. used = 214 gal. used per month down the drain
214.0 gal. per month = 7.13 gal. per day savings, equivalent to each person in the family flushing a low consumption toilet (1.6 gal.) one time less per day.

This system could have gone to a low water piston and saved another four gal. of water off of the backwash rates. Distributor plate bed expansion reached at two gpm at two min. and 10-1/2 inches of lift, compared to standard tank of two gpm at 4.25 min. and five inches of lift. Backwash time can be reduced from eight to four min. Fast rinse cycle could have been reduced from six to two min., saving eight gal. of water per regeneration.

(Independent third party testing: Data provided by Abendroth Water Conditioning Inc.)