FORSTA FILTERS
Self Cleaning Water Filters

Innovative Design for Efficient and Reliable Filtration Solutions

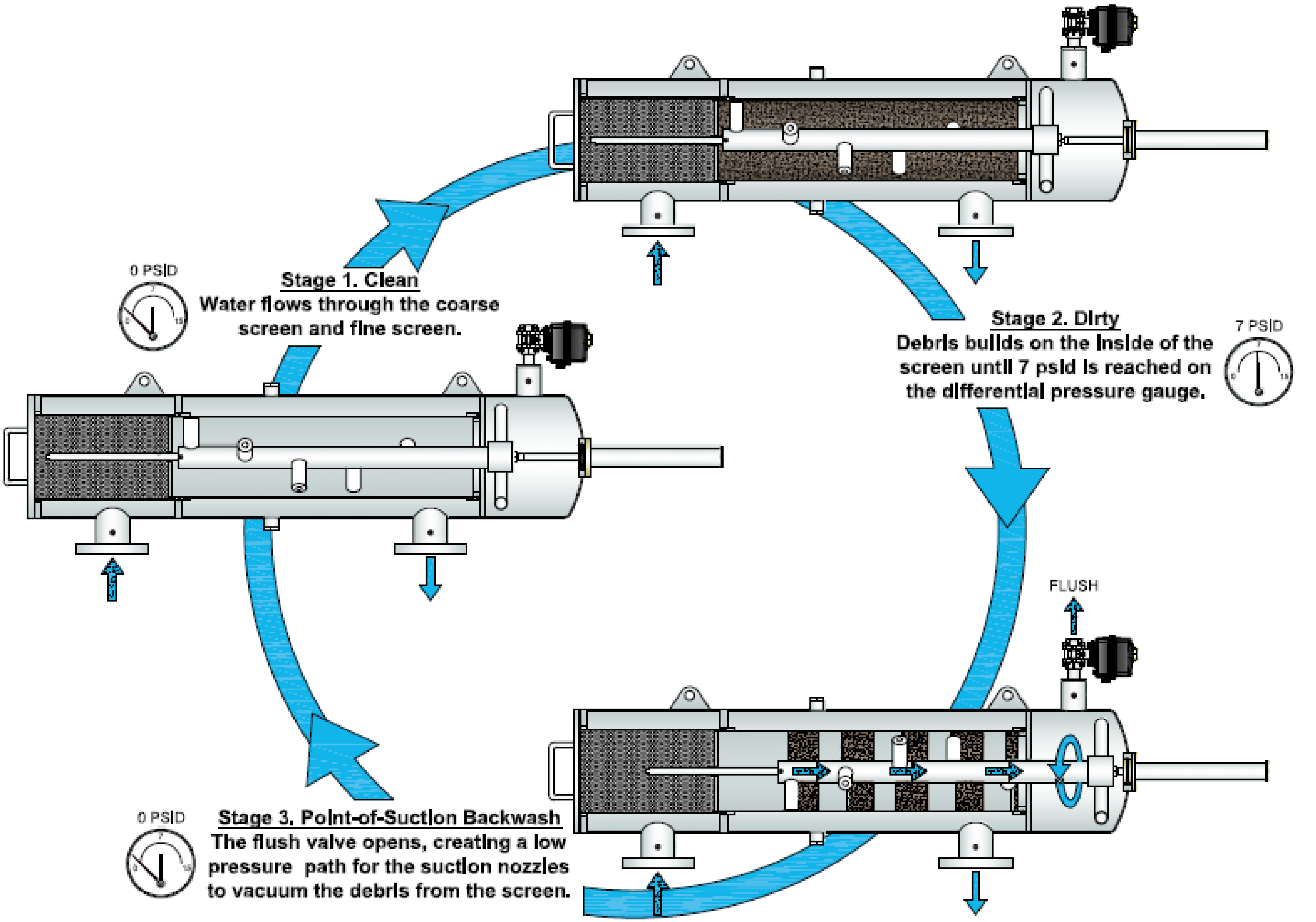
CORROSION RESISTANCE IN AUTOMATIC SCREEN FILTRATION

Replacement of corroded, low-grade filter components in BWMSs is commonplace. This presentation will focus on automatic self-cleaning filters used upstream of UV disinfection systems. The presentation will demonstrate how Fiberglass Reinforced Plastic, and high grade alloys have been utilized in saline lake beds, shipboard reverse osmosis desalination, plant desalination and produced water applications to minimize replacement components due to corrosion, to improve sustainability, and reduce maintenance and labor costs.

Industries Served

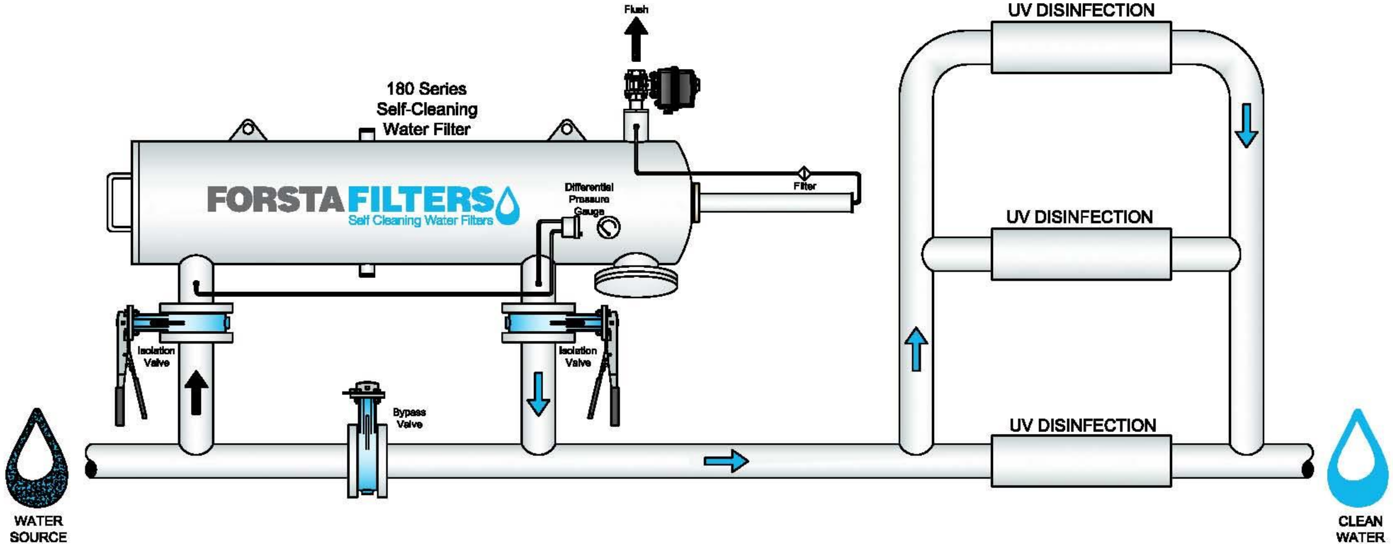
Industrial	Municipal	Irrigation
		
HVAC - Petrochemical Pulp & Paper - Sugar Metal-works - Plastics Seawater - Produced Water - Car Wash Food Processing - Power	UF Pre-Filtration Membrane Protection Drinking Water Wastewater Recycled Water/Reuse Desalination	Golf - Turf - Landscape Agriculture Greenhouse - Nursery

How it Works

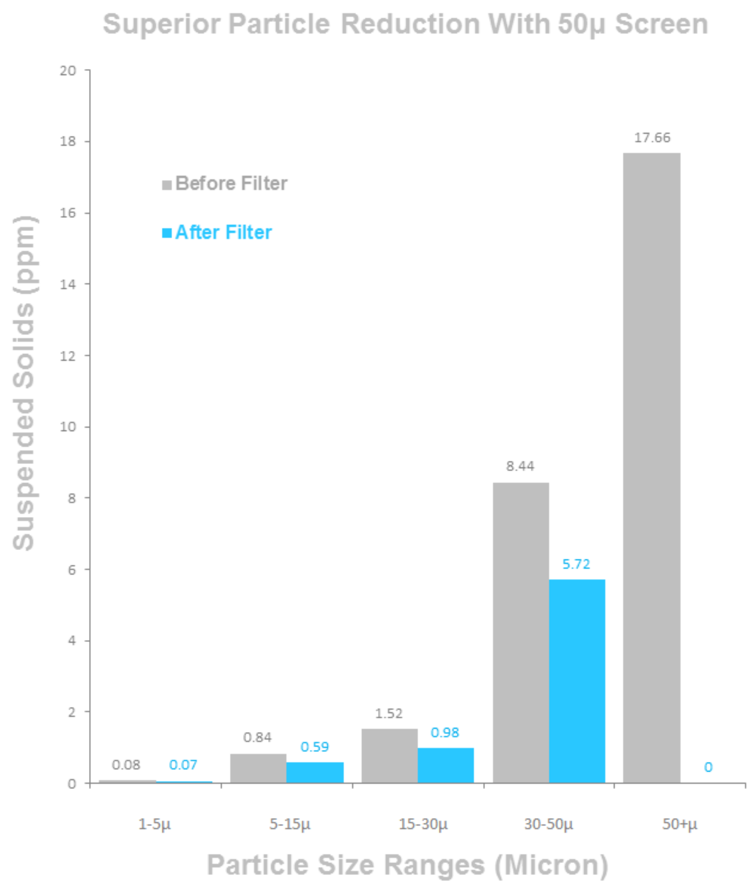


0 PSID
Stage 1. Clean
Water flows through the coarse screen and fine screen.
Stage 2. Dirty
Debris builds on the inside of the screen until 7 psid is reached on the differential pressure gauge.
7 PSID
FLUSH
0 PSID
Stage 3. Point-of-Suction Backwash
The flush valve opens, creating a low pressure path for the suction nozzles to vacuum the debris from the screen.

UV Protection



Particle Removal Efficiency



With 50 micron screens at Superior, TSS downstream of the filters was reduced from 28.53 ppm to 7.35 ppm.

In the 50 micron+ size range, particle reduction was 100%, from 17.66ppm to 0ppm after filtration.

Not only were 100% of particles removed above the degree of filtration, but one can also see a significant particle reduction of 25-50% in the 5-50 micron size range due to "the filter cake effect."

The filter cake effect simply describes the fact that degree of filtration becomes finer as a screen accumulates dirt (as pressure differential increases). This explains the 25% reduction in particles at the 5-15 range, for example.

Advantages vs. Bag & Cartridge Filters

- Automatic Backwash
- No Replacing Cartridges
- Less System Downtime
- Less Time Spent on Routine Maintenance
- No Waste from Disposable Bags and Cartridges

Advantages vs. Sand Filters

- Backwash does not Require Filter Bypass
- Does not Require Parallel Configuration
- Much Less Water Used for Backwash
- Durable Stainless Steel Design
- Predictable Solid Filtration Barrier

Advantages vs. Centrifugal Separators

- Predictable Solid Filtration Barrier
- Does not Require a Minimum Velocity
- Removes ALL Solids, Regardless of Density

Advantages vs. Disc Filters

- Static Filtration Barrier
- Much Higher Flow Rates
- Robust MOC
- No Need to Manifold Many Units in Parallel

Application Assessment

Relevant data:

Water Source

Flow Rate

Pipe Size

Operating Pressure

Total Suspended Solids

Particle Size Distribution

Chlorides (PREN requirements? Existing Materials?)

Water Temperature (Region)

Plant SWRO Desalination

Plant SWRO Desalination

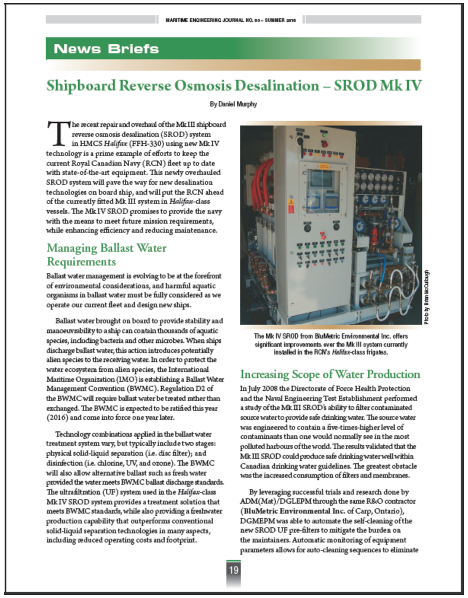
Produced Water

Produced Water

Saline Lakebed

Seawater RO Test Facility

Shipboard RO Desalination



MARITIME ENGINEERING JOURNAL NO. 80 – SUMMER 2016

News Briefs

Shipboard Reverse Osmosis Desalination – SROD Mk IV

By Daniel Murphy

The recent repair and overhaul of the Mk III shipboard reverse osmosis desalination (SROD) system in HMCS *Halifax* (FFH-330) using new Mk IV technology is a prime example of efforts to keep the current Royal Canadian Navy (RCN) fleet up to date with state-of-the-art equipment. This newly overhauled SROD system will pave the way for new desalination technologies on board ship, and will put the RCN ahead of the currently fitted Mk III system in *Halifax*-class vessels. The Mk IV SROD promises to provide the navy with the means to meet future mission requirements, while enhancing efficiency and reducing maintenance.

Managing Ballast Water Requirements

Ballast water management is evolving to be at the forefront of environmental considerations, and harmful aquatic organisms in ballast water must be fully considered as we operate our current fleet and design new ships.

Ballast water brought on board to provide stability and manoeuvrability to a ship can contain thousands of aquatic species, including bacteria and other microbes. When ships discharge ballast water, this action introduces potentially alien species to the receiving water. In order to protect the water ecosystem from alien species, the International Maritime Organization (IMO) is establishing a Ballast Water Management Convention (BWMC). Regulation D2 of the BWMC will require ballast water be treated rather than exchanged. The BWMC is expected to be ratified this year (2016) and come into force one year later.

Technology combinations applied in the ballast water treatment system vary, but typically include two stages: physical solid-liquid separation (i.e. disc filter); and disinfection (i.e. chlorine, UV, and ozone). The BWMC will also allow alternative ballast such as fresh water provided the water meets BWMC ballast discharge standards. The ultrafiltration (UF) system used in the *Halifax*-class Mk IV SROD system provides a treatment solution that meets BWMC standards, while also providing a freshwater production capability that outperforms conventional solid-liquid separation technologies in many aspects, including reduced operating costs and footprint.

Photo by Brian McCullough

The Mk IV SROD from BluMetric Environmental Inc. offers significant improvements over the Mk III system currently installed in the RCN's *Halifax*-class frigates.

Increasing Scope of Water Production

In July 2008 the Directorate of Force Health Protection and the Naval Engineering Test Establishment performed a study of the Mk III SROD's ability to filter contaminated source water to provide safe drinking water. The source water was engineered to contain a five-times-higher level of contaminants than one would normally see in the most polluted harbours of the world. The results validated that the Mk III SROD could produce safe drinking water well within Canadian drinking water guidelines. The greatest obstacle was the increased consumption of filters and membranes.

By leveraging successful trials and research done by ADM(Mat)/DGLEPM through the same R&O contractor (**BluMetric Environmental Inc.** of Carp, Ontario), DGMEPM was able to automate the self-cleaning of the new SROD UF pre-filters to mitigate the burden on the maintainers. Automatic monitoring of equipment parameters allows for auto-cleaning sequences to eliminate

19

Custom automatic self-cleaning water filter for shipboard reverse osmosis desalination (SROD). The M2-90 U-Stamped ASME model filters are custom fabricated from Duplex Stainless Steel, made to withstand corrosive seawater environments.

According to a recent news brief in **Canada's Maritime Engineering Journal**, the new automatic self-cleaning filters utilized in the Mk IV shipboard reverse osmosis desalination (SROD) system in HMCS Halifax (FFH-330), outperform conventional solid-liquid separation technologies in many aspects, including reduced operating costs and footprint. According to BluMetric's Managing Director of Military Systems, James Thomas, the level of pre-filtration on the new Mk IV SROD allows for continuous operation in littoral waters without any decrease in system performance or increase in operating costs or maintenance.

Mining

Filter Housing/Component Materials

- Powder Coated Carbon Steel
- Stainless Steel Grades 304L, 316L, 904L
- Duplex Stainless
- Super Duplex
- SMO 254
- Hastelloy C276
- Fiberglass Reinforced Plastic (FRP)
- Various Polymers & Thermoplastics

www.forstafilters.com | PO Box 341830, Los Angeles, CA 90034 | info@forstafilters.com | 888.9-FORSTA | Ph: 310.837.7177 | Fx: 310.837.6477 FORSTAFILTERS Self Cleaning Water Filters

Screen Options

Sintered Mesh
on Perforated Plate

Stainless Steel 316L, 904L

High Flow Wire Mesh

Reinforced Perforated Plate

Screen Options

Multi-Layered Diffusion Bonded Wire Mesh

Stainless Steel 316L, 904L

Alloy 20, Inconel, Monel, Hastelloy C276, SMO 254

Outstanding Effective Screen Area

High Flow Design

Screen Options

Wedge Wire Slotted Screen

Stainless Steel Grades 304L, 316L, 904L

Duplex Stainless, Super Duplex Stainless

Alloy 20, Inconel, Monel, SMO 254, Hastelloy C276

Ideal for Applications with Fibers

Extremely Robust Design

Surface Finishes/Processes

Mill Finishes

Mechanical Smoothing/Polishing

Sandblasting

Beadblasting

Electropolishing

Pickle Passivation

Chemical Vapor Deposit (CVD)

Hydrogen Annealing

Data on Recent Stainless Alloys

MODERN DEVELOPMENT

In the early 1980's, a *second generation* of duplex steels was introduced with improved welding properties mainly through nitrogen alloying. The most common duplex grade today is EN 1.4462 or 2205 (UNS S31803/S32205), which has a nominal composition of 22% Cr, 5%Ni, 3% Mo, and 0.16% N. This steel is used in a great number of applications in a wide variety of product forms. Many of the grades have become commonly known by a number that reflects their typical chromium and nickel contents, e.g. 2205 with 22% Cr and 5%Ni. The 2205 alloy is a nitrogen-enhanced duplex stainless steel alloy. The nitrogen serves to significantly improve the corrosion resistance properties of the alloy, which also exhibits a yield strength that is more than double that of conventional austenitic stainless steels; especially in the welded condition. Earlier duplex alloys have had moderate resistance to general corrosion and chloride stress-corrosion cracking, but suffered a substantial loss of properties when used in the as-welded condition. The 2205 duplex stainless steel provides corrosion resistance in many environments that is superior to the AISI Type 304, 316 and 317 austenitic stainless steels. This duplex stainless steel is often used in the form of welded pipe or tubular components, as well as a formed and welded sheet product in environments where resistance to general corrosion and chloride stress corrosion cracking is important. The increased strength creates opportunities for reduction in tube wall thickness and resists handling damage.

Nevertheless, the extraordinary corrosion resistance (and other properties) of 2205 may be greater than is required in some applications. In certain SCC applications, while 2205 would provide an acceptable technical solution, it may not be an economical replacement alloy for Type 304, 316 or 317 stainless steel. The higher cost of 2205 is due primarily to the amounts of the alloying elements nickel (nominal 5.5%) and molybdenum (nominal 3%). Thus, it is desirable to provide a weldable, formable duplex stainless steel that has greater corrosion resistance than the Type 304, 316 or 317 austenitic stainless steels (see Table 1), and has a lower production cost than the commonly used 2205 duplex stainless steel.

Taken From Recent Patents on Mechanical Engineering 2008, 1, 51-57

Tables 1. Corrosion and Mechanical Properties of Some Stainless Steels: Duplex 2205, Austenitic Type 304, 316 and 317 and Duplex Developed Under the Patent of Ref. [11]

Alloy	Chemical Comp. (wt. %)		PCR	SCC	Mechanical Properties		
	Ni	Mo	CPT	CSCC	0.2 % PS	TS	El (%)
2205	4.5-6.5	2.5-3.5	35ºC	20ºC	450 MPa	620 MPa	25
Type 304*	8-10.5	--	--	-2.5ºC	205MPa	515 MPa	40.0
Type 316*	10-14	2-3	15ºC	-3ºC	205 MPa	515 MPa	40.0
Type 317*	11-15	3-4	19ºC	2ºC	206 MPa	517 MPa	35.0
US6551420B1[a]	3.0 - 4.0	1.5 - 2.0	31ºC	**	572 MPa	786 MPa	37

PCR: Pitting Corrosion Resistance; CPT: Critical Pitting Temperature (ASTMG-48A); CCCT: Crevice Corrosion Critical Temperature (ASTM G48B); 0.2%PS: 0.2% offset Proof Strength; TS: Tensile Strength;
* ASTM minimum. ** Not specified in the patent. [a] Ref. [11].

PREN/W

Taken From Recent Patents on Mechanical Engineering 2008, 1, 51-57

It is common to define the corrosion resistance of duplex grades by their pitting resistance equivalence number [3] (PRE_N) as defined by Eq. 1:

$$PRE_N = \%Cr + 3.3\%Mo + 16\%N \qquad (1)$$

While this number does not provide an absolute value for corrosion resistance and is not applicable in all environments, it does provide an overview of the expected resistance to pitting corrosion in an aqueous chloride solution. Some alloys contain an addition of tungsten, which is another element that acts to increase the pitting resistance of stainless steels. For these alloys, the pitting resistance is expressed as PRE_W, according to Eq. 2:

$$PRE_W = \%Cr+3.3\%Mo+1.65\%W+16\%N \qquad (2)$$

The PRE_N or PRE_W number is commonly used to classify the family to which an alloy belongs. In general, materials having a pitting resistance number in the low 30's or lower are classified as lean duplex grades, those with PRE's in the mid 30's such as 2205, are classified as standard duplex, and those with PRE's of 40 or more are known as superduplex alloys [13]. Table **3** gives examples of different stainless steels grades, i.e. duplex, austenitic and superaustenitic grades with their main alloying components and the $PRE_{N/W}$ number.

The superduplex grades with a pitting index $PRE_{N/W}$ >40, contain 25% Cr, 6.8% Ni, 3.7% Mo and 0.27% N, with or without Cu and/or W additions (SAF 2507, UR52N, DP3W, Zeron100). This is the most highly alloyed grade for wrought products, and is specially designed for marine, chemical and oil engineering applications, requiring both high mechanical strength and resistance to corrosion in extremly aggressive enviroments (chloride-containing acids etc.).

PREN/W

Table 3. $PRE_{N/W}$ Number for Different Duplex Steel Grades, Austenitic and Superaustenitic Steel Grades

Grade	UNS	C	Cr	Ni	Mo	W	Cu	N	$PRE_{N/W}$
Lean Duplex	S32101	0.03	21.5	1.5	0.3	-	-	0.22	25
	S32304	0.02	23	4	0.3	-	0.3	0.10	25
Standard Duplex	S31803	0.02	22	5.5	3.0	-	-	0.17	35
	S32205		22.5	5.8	3.2	-	-	0.17	36
Superduplex	S32750	0.02	25	7	4.0	-	0.5	0.27	43
	S32760	0.03	25	7	3.5	0.6	0.5	0.25	42
Superaustenitic									
904L	N08904	0.02	20	24.5	4.2	-	1.5	0.05	35
254 SMO	S31254	0.02	20	18	6.1	-	0.7	0.20	43
Austenitic									
304L	S30400	0.02	18.2	8.1	0.3	-	-	0.07	20
316L	S21600	0.02	16.3	10.1	2.1	-	-	0.07	24
317L	S31703	0.02	18.4	12.4	3.2	-	-	0.07	30

Fiberglass Reinforced Plastic (FRP)

Corrosion Resistance

High Strength, Lightweight

Dimensional Stability

Parts Consolidation and Tooling Minimization

High Dielectric Strength and Low Moisture Absorption

Minimum Finishing Required

Low to Moderate Tooling Costs

Design Flexibility

Benefits and Features of FRP/Composites

There can be many benefits obtained by the use of FRP/ Composites. These benefits and characteristics should be considered early in the design process.

Corrosion Resistance

FRP/Composites do not rust, corrode or rot, and they resist attack from most industrial and household chemicals. This quality has been responsible for applications in corrosive environments such as those found in the chemical processing and water treatment industries. Resistance to corrosion provides long life and low maintenance in marine applications from sailboats and minesweepers to seawalls and offshore oil platforms.

High Strength, Lightweight

FRP/Composites provide high strength to weight ratios exceeding those of aluminum or steel. High strength, lightweight FRP/Composites are a rational choice whenever weight savings are desired, such as components for the transportation industry.

Dimensional Stability

FRP/Composites have high dimensional stability under varying physical, environmental, and thermal stresses. This is one of the most useful properties of FRP/Composites.

Parts Consolidation and Tooling Minimization.

A single FRP composite molding often replaces an assembly of several metal parts and associated fasteners, reducing assembly and handling time, simplifying inventory, and reducing manufacturing costs. A single FRP/Composite tool can replace several progressive tools required in metal stamping.

High Dielectric Strength and Low Moisture Absorption

The excellent electrical insulating properties and low moisture absorption of FRP/Composites qualify them for use in primary support applications such as circuit breaker housings, and where low moisture absorption is required.

Minimum Finishing Required

FRP/Composites can be pigmented as part of the mixing operation or coated as part of the molding process, often eliminating the need for painting. This is particularly cost effective for large components such as tub/shower units. Also, on critical appearance components, a class "A" surface is achieved.

Low to Moderate Tooling Costs

Regardless of the molding method selected, tooling for FRP/Composites usually represents a small part of the product cost. For either large-volume mass-production or limited runs, tooling cost is normally substantially lower than that of the multiple forming tools required to produce a similar finished part in metal.

Design Flexibility

No other major material system offers the design flexibility of FRP/Composites. Present applications vary widely. They range from commercial fishing boat hulls and decks to truck fenders, from parabolic TV antennas to transit seating, and from outdoor lamp housings to seed hoppers. What the future holds depends on the imagination of today's design engineers as they develop even more innovative applications for FRP/Composites.








Integration in a BWMS

Forsta is actively pursuing partnerships with developers/manufacturers of complete ballast water management systems (BWMSs) for testing and evaluation in accordance with IMO and USCG ballast water discharge standards.

Contact Forsta Filters today to inquire about product availability for upcoming certification procedures.