



C B I O V E R S E A S I N C .



BIOWRAP
ROTATING BIOLOGICAL CONTACTOR

INTRODUCTION

Rotating Biological Contactor systems (RBC's) are widely applied in municipal and industrial wastewater treatment where a high degree of BOD and NH₃ removal is required. RBC technology is based on the "dynamic" fixed film principle in which media, mounted on a slowly rotating horizontal shaft, is alternately submerged in a tank of wastewater and then exposed to the atmosphere. Microorganisms attach themselves to the media where they oxidize organic pollutants contained in the wastewater.

RBC systems offer several significant advantages over other types of secondary treatment process including:

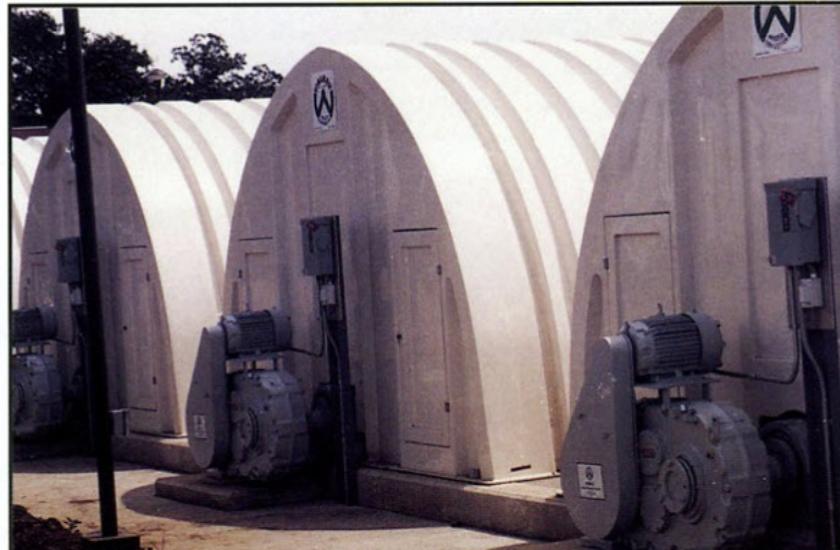
- **Low energy requirements**
- **Low space requirements**
- **Operational simplicity**
- **Low maintenance requirements**
- **Low system headloss**
- **High treatment efficiency**
- **Good resistance to shock loads**

RBC systems are applied in a variety of configurations including new plant construction, trickling filter or activated sludge plant upgrades and polishing for municipal treatment systems. They have also been used in the petrochemical, textile, food and beverage industries and others. RBC systems

available include smaller diameter treatment modules in steel tanks for commercial treatment applications to multiple full-size shafts for large treatment plants.

RBC systems are a proven, effective treatment alternative for biological reduction of organic pollutants.

The CBI Overseas Inc. (CBI) BioWrap is manufactured with technical support from CBI Walker, Inc. (USA), both companies are part of the CBI Group of Companies. CBI Walker, Inc. has a tradition of supplying mechanically and structurally sound equipment since 1946. Our BioWrap combines the largest structural components standardly available with superior design to produce a rugged RBC capable of the sustained performance you require in your plant. The CBI engineering staff will provide the designer with necessary assistance in developing the most efficiently sized RBC system for his particular treatment requirements. Our unique media arrangement provides the capability to custom design a system for any application.



The following pages will introduce you to our BioWrap RBC and highlight the beneficial features available with the BioWrap. For further information please contact your local Sales Representative or (CBI Overseas in Singapore).

GENERAL DESCRIPTION

The CBIO BioWrap utilizes a patented media and manufacturing process which provides a configuration that limits stresses in the polyethylene media to very low levels and provides a short flow path for air and water exchange through the media. The media is thermally welded in 36 inch wide modules in a continuous spiral wrapping process to produce a monolithic, self-supporting structure. The short flow path and open media construction also produce improved media scour and higher dissolved oxygen levels in the wastewater.

RBC's like any major item of wastewater equipment, must be built to last to maintain the successful performance of the plant. Competent manufacturers design their RBC's to provide reliable performance and longevity based on applicable codes. CBI Walker, Inc. was the first to design its RBC shaft based on the fatigue provisions of The American Welding Society Structural Steel Welding code D1.1, Chapter 10.

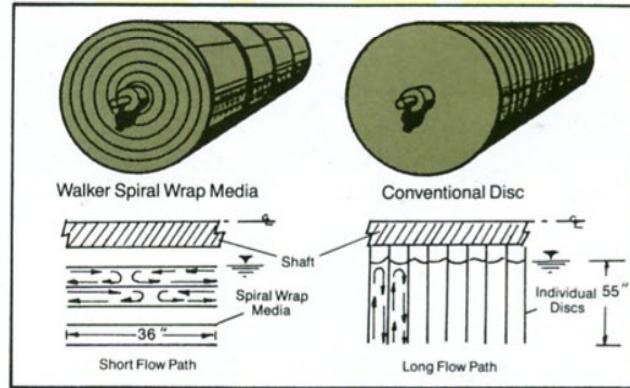
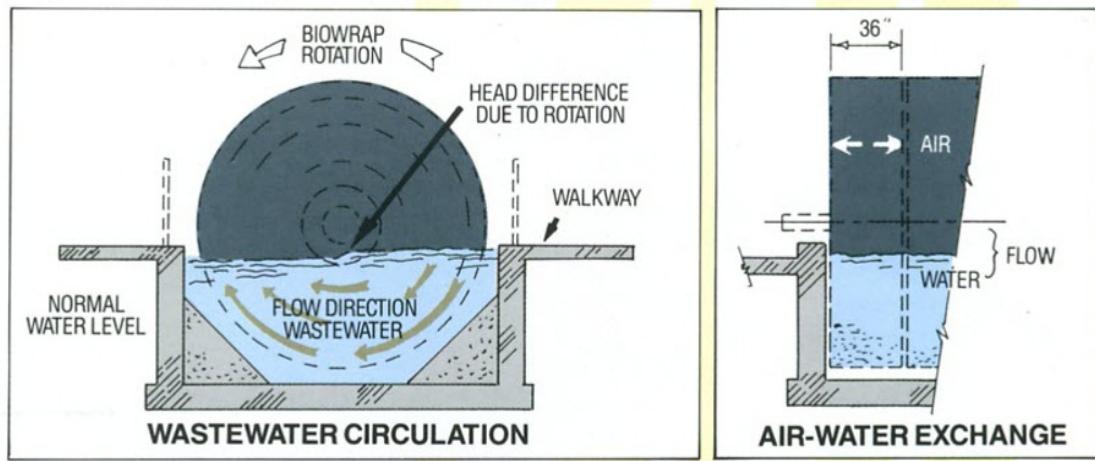
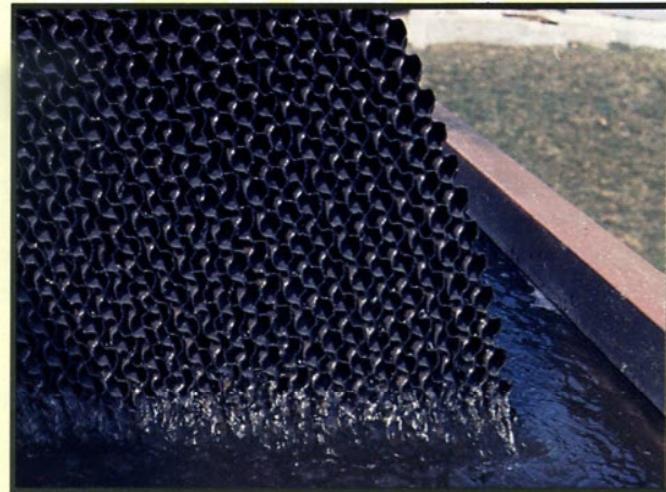
This design code is now widely recognised in the industry and by the USEPA as a necessary technique to assure reliable structural designs and is the basis of shaft design that is used for all BioWrap shaft configurations.

Low shaft and media stress levels, good quality control and competent design are built into the BioWrap to assure a design life of over 20 years.

Fabrication is strictly controlled with our in-house Q.A. program to assure that the quality designed for is built into each

BioWrap. Pipe for the main shaft is purchased from the mill fully tested, meeting the requirements of API5L. Stub end machining, welding and media fabrication are checked at each step in the manufacturing process. Design stress values have been fully confirmed with full-scale testing.

BioWrap shafts can be fitted with either standard density media modules for 100,000 ft.² or high density media modules for 150,000 ft.² or more of effective surface area. The spiral media module design incorporated into the BioWrap allows custom fabrication of shafts for specific applications. Process loadings, space availability, or existing structures may require special areas or special media diameters. The BioWrap can be fabricated to any diameter between 6 and 12 feet and any shaft length to 28 feet, using from one to eight modules. The following pages further discuss the advantages available with the BioWrap.



Benefits of Short flow path...

Excellent air-water circulation assures optimum BOD and N removal rates without the added expenses of supplemental dissolved oxygen. Uniform scouring velocities result in uniform bio-mass growth and sloughing-off rates.

The spiral wrap media configuration eliminates the need for media supports or torque transmitting structures which require periodic maintenance and produce localized stress concentrations.

FEATURES

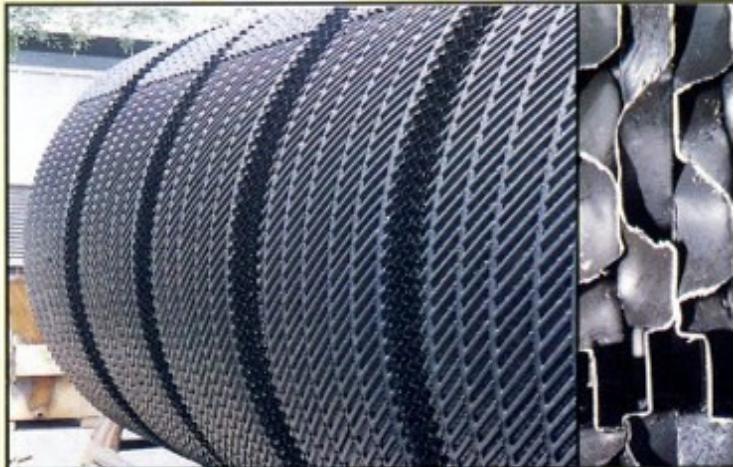
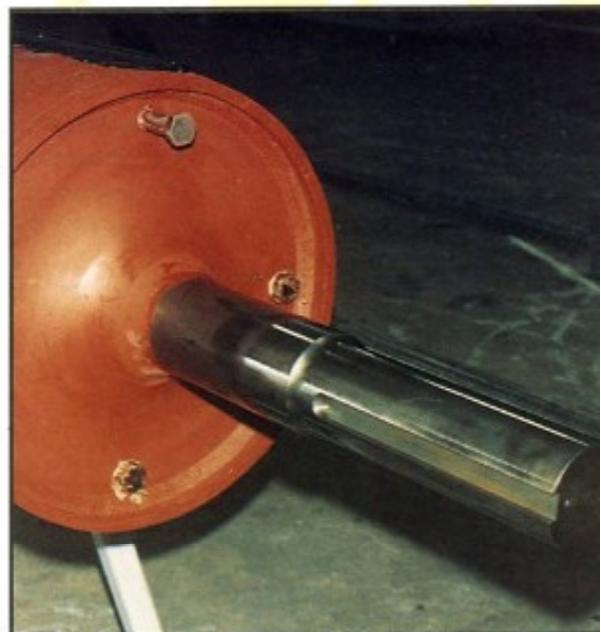
The main shaft for full size units is a minimum 30 inch diameter, 3/4 inch wall pipe section with one-piece cast steel stub ends. The stub ends are first machined over their full surface to remove all surface imperfections and then ultrasonically tested to locate and eliminate any casting flaws. With our unique media design, no welded media attachment collars or clips are necessary on the main shaft. This eliminates the potential for stress concentrations which exist at such discontinuous attachments. The BioWrap provides the largest shaft section modulus available in the industry at 492 in.³. This, combined with good welding design, produces low stress levels to insure long shaft life.

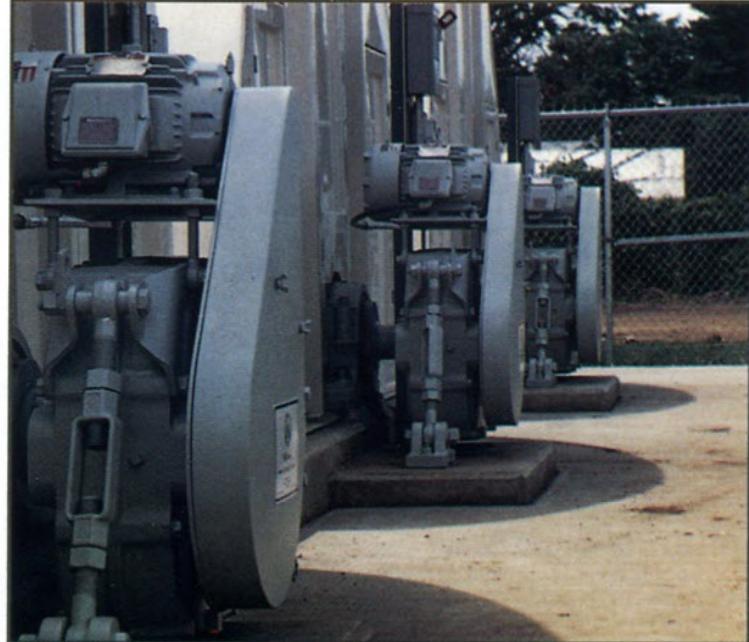
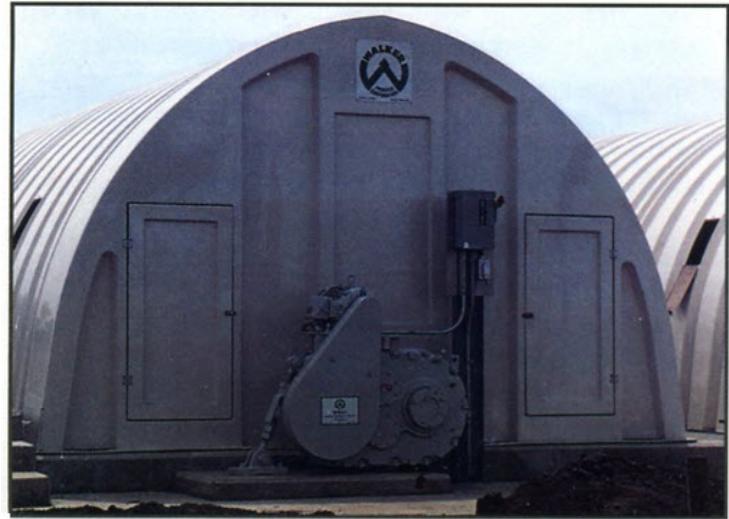
On smaller projects which have reduced media area requirements a 24 inch diameter, 11/16 inch wall thickness shaft is used if the same low stress levels can be maintained.

Bearings provided with the BioWrap are also the largest available in the industry at 7 inch diameter on full size shafts. This results in lower unit loadings and longer bearing life. Bearings are self-aligning, tapered roller or spherical pillow block units with a minimum AFBMA B₁₀ life rating of over 200,000 hours at normal rotational speeds and loads. Fixed bearings are used at the drive end, with expansion bearings on the idle end. The BioWrap is manufactured and shipped with bearings in place permitting offloading directly to the anchorage.



Media is vacuum formed, high density polyethylene continuously wound and thermally welded within itself to produce a self-supporting structure. Every point of contact in the media structure is welded to assure media strength. Tested weld strength exceeds all design operating loads by a factor of 10 or more. A two-part system provides positive attachment of the media to the main shaft with the use of stainless steel straps, and an epoxy adhesive. Media is stabilized with carbon black to resist exposure to ultraviolet degradation and maintain tensile strength. The short air-water flow path and open construction of the media has been shown to provide good media scouring action and somewhat higher dissolved oxygen levels than produced with a more closed type of media.





Direct mechanical drive is used with a triple reduction helical torque arm reducer mounted directly on the stub end extension. Positive mechanical drive has been shown to be the most reliable and energy efficient, RBC drive system available. The shaft mounted drive is a significant improvement over the chain and sprocket designs which require an oil bath chain guard submerged in the tank. The reducer is driven through V-belts by a 2 to 7.5 horsepower motor to produce the desired rotational speed. Although not normally necessary, speed variation can be obtained by changing sheaves, a more economical and trouble free method than using variable speed drives.

Fiberglass enclosures are usually added for protection of the process against weather and for temperature and odor control. Enclosures can be provided which also enclose the RBC drive, if desired. BioWrap enclosures are usually free standing arch sections with tongue and groove joints requiring no bolting for ease of assembly. Joint design should allow for air infiltration to provide oxygen for the biological process. Enclosures should be provided with access doors and inspection ports.



DESIGN CONSIDERATIONS

Proper evaluation and application of an RBC system requires careful consideration of many factors that affect system sizing and performance. The first step in properly designing a system is to determine the basic wastewater characteristics and effluent requirements. Design can be completed with the following parameters:

INFLUENT TO RBC SYSTEM

Flow, daily average	_____ M ³ /DAY
Flow, peak two hour duration	_____ M ³ /DAY
Flow, minimum	_____ M ³ /DAY
Total BOD ₅	_____ mg/l
Soluble BOD ₅	_____ mg/l
TSS	_____ mg/l
*TKN	_____ mg/l
*NH ₃ N	_____ mg/l
*Alkalinity (CaCO ₃)	_____ mg/l
Temperature/summer	_____ °F
Temperature/winter	_____ °F
pH	_____

* When ammonia nitrogen reduction is required.

EFFLUENT

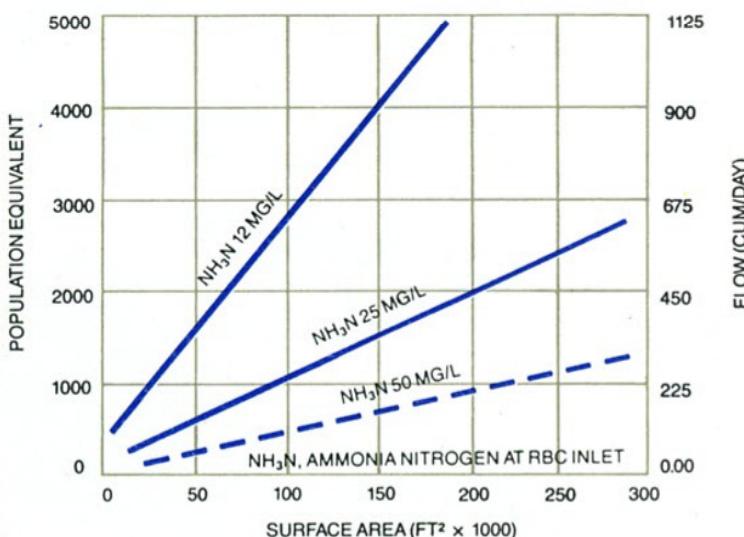
Total BOD ₅	_____
*NH ₃ N/summer	_____
*NH ₃ N/winter	_____

In evaluating these parameters, the designer will also rational apply loading values, temperature corrections, staging and other design considerations to arrive at the proper RBC system size and arrangement.

For purposes of allowing the designer to gain a rough approximation of the RBC system for his application, CBIO has developed sizing charts for determining surface area required for various BOD₅ and NH₃N loadings. These are preliminary design v of course, and the designer should contact his local CBIO repre for specific information. CBIO engineers will assist the designer a will perform a careful analysis of each particular application and provide specific information suitable for that application. Proper arrangement, staging and exact design application can significant affect the surface area selected from the charts. Consult CBIO or influent loadings beyond the limits of the curves.

SIZING CHARTS

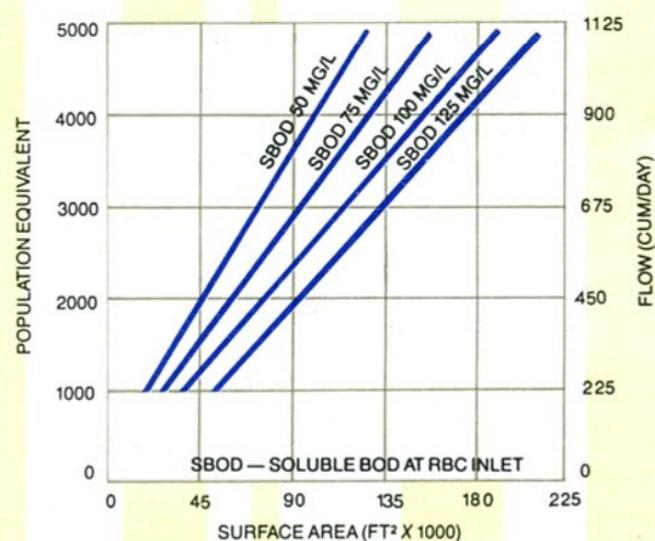
NH₃N REMOVAL FOR EFFLUENT NH₃N OF 4 MG/L



TEMPERATURE CORRECTION TABLE

TEMP. (°F)	TEMP. CORR. FACTOR
45	0.56
50	0.78
55	1.00

BOD REMOVAL FOR EFFLUENT SBOD OF 10 MG/L



TEMPERATURE CORRECTION TABLE

TEMP. (°F)	TEMP. CORR. FACTOR
45	0.73
50	0.87
55	1.00

FOOTNOTES

1. Charts are based on 60 US GPD/capita.
2. Temperature correction must be applied to values from charts below temperatures of 55 °F.
3. Effluent total BOD is 20 mg/l with soluble BOD of 10 mg/l.
4. Normally, and for purposes of approximation, standard density media is applied for BOD removal and high density media for NH₃N removal.
5. NH₃N removal chart assumes SBOD level is reduced to about 15 mg/l.
6. For purposes of approximation, add surface areas obtained from the charts for combined BOD and NH₃N removal. In actual practice this is generally conservative.
7. Flowrates may have to be adjusted prior to entering the charts if the peak to average ratio exceeds 2.5.
8. Consult CBIO for values not listed in the charts, for specific design applications, and staging arrangements.

EXAMPLES

Example 1: (BOD removal only)

Flow = 675 M³/DAY

SBOD = 125 mg/l (RBC influent)

TBOD = 20 mg/l (effluent)

Winter temperature = 45 °F

From chart; 135,000 ft² is required applying temperature correction;

$$\frac{135,000}{0.73} = 184,930 \text{ ft}^2$$

Use two standard density shafts

@ 93,000 ft² each; 186,000 ft² total; two parallel tanks.

If temperature correction is not required two standard density shafts

@ 67,500 ft² each 135,000 ft² total; two parallel tanks.

Example 2: (BOD and NH₃N removal)

Flow = 1000 M³/DAY

SBOD = 50 mg/l (RBC influent)

NH₃N = 12 mg/l

TBOD = 20 mg/l (effluent)

NH₃N = 4 mg/l

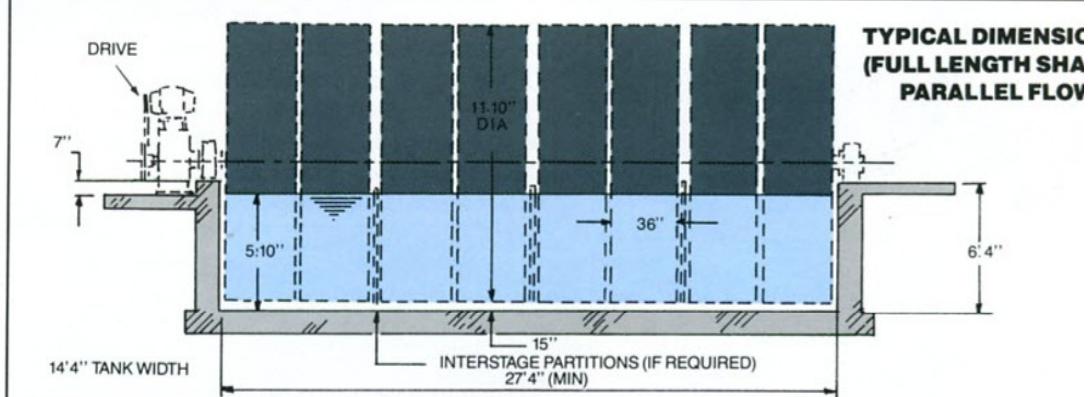
Winter temperature = 45 °F

From charts and applying correction factors;

For BOD removal; $\frac{115,000}{0.73} = 157,500 \text{ ft}^2$
required

For NH₃N removal; $\frac{185,000}{0.56} = 330,400 \text{ ft}^2$
required

Use two standard density shafts @ 100,000 ft² each; two high density shafts @ 150,000 ft² each; 500,000 ft² total; two parallel tanks.





CBI Overseas Inc. (CBIO) offers design and supply of rotating biological contactors (RBC's) commonly used for biological removal of carbonaceous BOD. CBIO operates with technical support from CBI Walker, Inc. (USA) and manufactures the units (known as the "BioWrap") at its Singapore facility. The "BioWrap" is specifically designed to provide superior structural characteristics while offering enhanced process performance through a unique spirally wound media arrangement.



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