



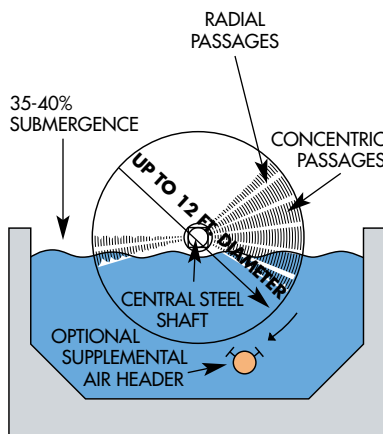
**USFilter**

*Taking care of the world's water.*

APPLYING THE  
ROTATING  
BIOLOGICAL  
CONTACTOR  
PROCESS

## DESCRIPTION OF THE RBC PROCESS

*The Rotating Biological Contactor (RBC) process is one of the more efficient fixed film wastewater treatment technologies. As such, it is well-suited for secondary and/or advanced treatment in municipal or industrial applications.*



CONVENTIONAL RBC PROCESS

*Front Cover: This 32 shaft air-driven RBC installation uses high density media, allowing it to provide more treatment on fewer assemblies.*



*Biomass is evenly distributed over the media surface.*

The process consists of large diameter steel or corrugated plastic media centered around a horizontal shaft, placed in a concrete tank. The media is slowly rotated (mechanical or air drive). At any given time during the rotation, about 40% of the media surface area is in the wastewater.

Organisms in the wastewater attach and multiply on the rotating media until they form a thin layer of biomass.

This shaggy, fixed film growth presents a very large, very active population for the biological degradation of organic pollutants.

During rotation, the media carries the biomass and a film of wastewater into the air where oxygen is absorbed. The dissolved oxygen and organic materials in the wastewater diffuse into the biomass and are then metabolized.

Radial and concentric passages in the media allow unrestricted entry of the wastewater and air throughout the unit's total surface area for continued growth of the biomass.

Excess biomass shears off at a steady rate as the media rotates. These solids are carried through the RBC system for subsequent removal in a conventional clarifier.

Biomass thickness ranges from 0.030 inch (0.75 mm) to 0.125 inch (3 mm) depending upon organic concentration, temperature and other process variables.

The RBC process demonstrated long term reliability in the 1970's. Today, more than 6,000 units are operating. Benefits of the process include:

- Consistent process results
- Stable operation – frequent supervision not required; microbial population accommodates organic and hydraulic fluctuations
- Lower expansion and retrofit costs – modular construction, reduced excavation costs
- Smaller footprint – due to short wastewater retention time
- Minimal headloss through system
- Very low energy consumption – on the order of 3 kW per 3,000 people
- Minimal maintenance – simple drive and bearing lubrication
- Reduced life cycle costs – as compared to suspended growth systems
- Simple operation – no recycle, less lab testing for process control
- Operator friendly

## APPLICATIONS FOR THE RBC PROCESS



*Process water used by one of the world's largest gold mines is treated by this USFilter RBC plant.*

*In new construction, the RBC process can accommodate flows ranging from 15,000 gpd to over 30 MGD. It is applied for organic carbon removal (BOD), nitrification, denitrification, or various combinations. It is compatible as well with applications requiring phosphorous removal. Typical applications are:*

- Municipal wastewater treatment
- Food and beverage wastewater treatment including meat packing, bakery, dairy, brewery
- Landfill leachate
- Refinery and petrochemical wastewater treatment
- Pulp and paper wastewater treatment
- Septage treatment
- Many general industrial wastewaters



*Series 300 RBCs have served this 27 MGD plant for more than 10 years.*

**In nitrification upgrades** for existing secondary treatment facilities, the RBC process can provide the required capacity in limited space. For any treatment plant expansion, the system's small footprint makes it advantageous, especially where space is at a premium.

**In many retrofit applications,** RBC units can be easily customized to fit existing rectangular basins and to accommodate increased flow capacities by adding or modifying the media configuration. Due to equipment design, the RBC system can be assembled on site or in a building.

**In upgrading trickling filter plants,** the RBC process can be installed in either

parallel or series with the existing system, for additional capacity or improved treatment levels. Usually, additional clarifiers are not required, and because of the RBC process's low head loss, further pumping can usually be avoided.

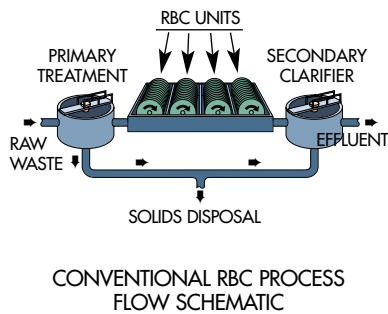
The process equipment is available with a mechanical drive; with a mechanical drive and supplemental air; or with an air drive only. Media is available as standard, medium or high density.

A conventional RBC with low density media, 25 feet long by 12 feet in diameter, offers over 110,000 square feet of media surface area. High density units provide over 165,000 square feet of fixed film surface.



*Typical corrugated RBC media.*

*After primary treatment, the effluent flows to a multi-stage RBC process where fixed aerobic cultures absorb the dissolved organic matter from the wastewater. Part of the absorbed organic matter is oxidized into carbon dioxide and water, and part is synthesized into additional biomass.*



### BIOMASS RESPONDS TO ORGANIC CONCENTRATION

Each stage of media operates as a completely mixed, fixed film biological reactor in which there is a dynamic equilibrium between the rate of biological growth and stripped biomass. As the wastewater passes from stage to stage, it undergoes a progressively increasing degree of treatment by the different biological cultures that develop in the successive stages.

The initial stages of media, for example, receive the highest concentration of organic matter and develop cultures of mixed heterotrophic bacteria. As the concentration of organics decreases in later stages, nitrifying bacteria begin to appear along with various types of higher life forms such as protozoa, rotifers and other predators.

The stripped biomass and biofloculated suspended matter leave the last process stage along with the treated wastewater and flow to a secondary clarifier where the solids are separated for disposal. Clarified effluent passes on for disinfection or further treatment. Settled solids thicken to 2.5 to 3.0%; 4 to 5% if combined with primary solids.

The RBC process is operated on a once-through basis with no need for recycle of effluent. There is also no need for a sludge recycle, since the attached biofilm is continuously growing. The absence of recycle requirements provides for simple process operation. The use of simple drive components and media configurations results in very low energy and maintenance requirements.



*This is an example of the thinness of the fixed film biomass growth.*



*A major RBC installation is installed at a regional resort area near a major metropolitan city. Discharge is into an environmentally sensitive waterway.*

Molded fiberglass covers are recommended and are furnished with the units. Covers minimize the area to be enclosed and eliminate the need for operator entrance. They also prevent debris accumulation, prevent algae growth on the media, and provide process temperature control. Buildings can be constructed, but generally, the fiberglass enclosure alone has been the more cost effective choice.

*Design considerations for the RBC process have been established through extensive pilot plant testing and years of operating experience. Although a number of factors are taken into account, including media rotational speed, tank volume, residence time, etc., the primary design factors are:*

■ **Substrate Removal Kinetics.** Raw municipal wastewater contains about 1/3 soluble BOD, 1/3 settleable BOD and 1/3 suspended BOD; after primary clarification, the ratio is 1/2 soluble and 1/2 suspended BOD. Industrial wastewaters can contain 50 to 100% soluble BOD.

Because there is no sludge recycle and since suspended solids remain in the RBC reactor for such a short period of time (one to two hours), the oxygen demand of suspended solids is very low. As a result, soluble BOD is the controlling design parameter.

The principle mechanism of treatment (substrate removal) in the RBC process is the diffusion of soluble matter into the biomass, where it is metabolized. Suspended matter in the wastewater and sheared biomass have no effect on the rate of soluble substrate diffusion, and therefore do not affect removal levels.

■ **Hydraulic Loading.** Most domestic wastewater and many industrial effluents have soluble BOD levels of

100 mg/l or less; and can be easily treated by the RBC process. For most applications, the main effort associated with process design and equipment selection is to determine the surface area requirement for the biomass.

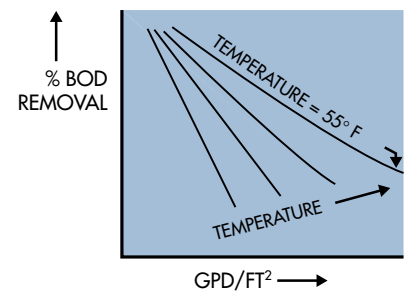
■ **Organic Loading.** Systems installed effectively treat high strength wastes such as industrial wastes or septage. These efficient, shock resistant systems often work where suspended growth systems are eliminated.

■ **Wastewater Temperature.** Below 55 degrees F, the treatment efficiency of the RBC process decreases for carbon and nitrogen control. For northern climates, supplied covers prevent major heat loss from the wastewater.

NO SLUDGE RECYCLE



*This RBC plant can be provided with supplemental air to reduce maintenance and energy requirements.*



RBC PROCESS PARAMETER  
WASTEWATER TEMPERATURE

*Both the RBC and activated sludge processes utilize similar biological cultures and can produce high degrees of treatment. The major difference is that over 95% of the RBC process's biological solids are attached to the media. And that leads to the following differences:*



*RBCs are installed around the world because of their simple and economical operation.*

■ **Process Stability:** Activated sludge requires efficient solids settling and adequate biosolids recycling for satisfactory operation. Hydraulic surges and organic shock loads also can cause prolonged upsets. The RBC process does not require recycling, and because the biomass is attached to the media, it is not affected by clarifier washouts or shock loadings. RBCs handle diurnal peak flows of 2.5:1 without process adjustment.

■ **Manpower:** The relatively simple operation of the RBC process leads to significant manpower savings, estimated at one-half when compared to the activated sludge system.

■ **Flexibility:** Periods of low flow are troublesome to activated sludge plants. Also, because of the process's size requirements, expansions and upgrades are difficult/costly. RBC facilities, on the other hand, when loaded less than design, typically achieve excellent effluents without additional con-

trol. Due to its modular construction, low hydraulic head loss and shallow excavations, the process is comparatively easy to upgrade and expand.

■ **Maintenance and Power Consumption:** These two items are the most attractive features of the RBC process when compared to the activated sludge process. RBC energy consumption is approximately 25% of the activated sludge requirement.

■ **Ease of Nitrification:** The RBC process can achieve any degree of nitrification with only a single settling tank and without sludge recycle. Activated sludge plants usually require far more elaborate treatment stages to achieve nitrification.

■ **Sludge Characteristics:** Sludges produced by the RBC process settle well, permitting shallower secondary clarifiers designed for higher overflow rates. Activated sludges are prone to settling problems, and require a compaction zone for sludge recycling, leading to larger clarifiers.

RBC DESIGN IS

EASY TO UPGRADE



The Surfact Process increases capacity and minimizes construction costs for either new or upgrade applications.

For upgrades, retrofits and expansions, the Surfact Process provides more treatment without requiring additional space, by installing a fixed film RBC (or SBC) system in an existing activated sludge tank. Alternatively, incorporating sludge recycle into an existing RBC process at some installations can achieve similar results.

■ **The Surfact Process:** BOD removal and nitrification in a single treatment step, and an increase in treatment capacity ranging from 50% to 150%.

Converting to the Surfact Process is attractive because treatment capacity can be increased quite economically since the hybrid, combined system provides additional biomass and also offers bionutrient removal capability.

The slow rotation of the RBC unit greatly augments oxygen transfer into the suspended growth such that total air requirements with Surfact are significantly reduced. In some cases, as much as a 50% reduction in air requirements (and costs) is realized.

Installation of an RBC system into existing aeration basins usually requires only minor concrete modifications and the addition of a few support girders. Existing air diffusers and the rotation of the RBC unit normally supply the necessary aeration to the biofilm. However, supplemental air can be added if required.

■ **SBC process:** The Submerged Biological Contactor process operates in a deep tank with 70% to 90% of the media immersed in wastewater (vs 40% for a typical RBC unit). The increased submergence

combined with the air-drive rotation of the SBC has dramatic economic and operating benefits. This big brother to the RBC, with media diameter up to 5.5 meters, also has over twice the surface area per unit.

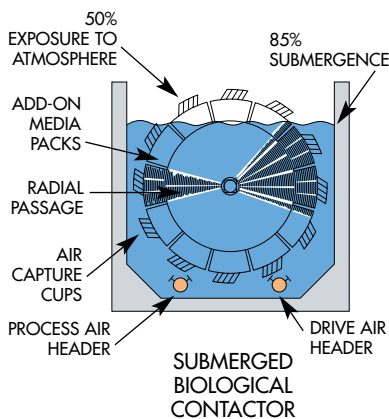
For a typical application (compared to RBCs, activated sludge, etc.), fewer SBCs and less land are required; energy costs are low; and maintenance hours are relatively insignificant. Process benefits of the SBC include long term operational stability, effective biofilm control and odor control.

■ **Solids Contact:** A derivative of the Surfact Process; incorporates sludge recycle to the last RBC stage. The process increases suspended solids capture in the secondary clarifier by bioflocculating the sloughed biomass with the recycled solids, yielding a clear effluent.

■ **Primary treatment upgrades:** Large rectangular primary clarifiers can be upgraded by installing RBCs in the upper portion of the tank.

The result combines secondary treatment and clarification in existing tankage. Benefits include significant savings on construction costs by eliminating the need for additional clarifiers and maximizing available land.

SURFACT PROCESS REDUCES  
TOTAL AIR REQUIREMENTS



The SBC Process represents state-of-the-art RBC technology.

*USFilter offers a wide range of replacement parts for its RBC systems and for systems manufactured by others. Please consult us for obsolete manufacturer's units, as the capability exists to retrofit stock items to obsolete designs to keep the units running smoothly. Most are in stock with next-day shipment available.*

Components include:

- Media Packs
- Air cups
- Bearings
- Supplemental air assemblies
- Coarse bubble diffusers
- Fine bubble diffusers
- Reducers, drive components
- Hydraulic and electronic load cell kits
- Shaft lifting devices
- Fiberglass covers

#### PILOT TESTING

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Bench and full scale pilot units are available to test performance of a typical wastestream or to verify a particular application. Units are completely self-contained, ready for hookup to wastewater and effluent supply lines.

#### PACKAGE PLANTS

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Complete package plants designed to your effluent requirements are available. They include primary treatment, RBC secondary treatment, secondary clarifiers, tertiary filtration and disinfection, as appropriate. Turnkey installations can be provided for subdivisions, housing complexes, hotels and commercial buildings. Package plants range in size from 15,000 GPD to 150,000 GPD.



*Standard package plants are available in a wide range of sizes and can be shipped worldwide.*

To find out more about how to put USFilter to work for you, contact us at:

**USFilter**

*Taking care of the world's water.*

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