BioSurface Technologies Corporation

Bio-inLine® Biofilm Reactor (IBR 500) Operator's Manual

The Bio-inLine® Biofilm Reactor is designed to facilitate biofilm growth for drinking and process water studies. The Bio-inLine® Biofilm Reactor (IBR-500) is an in-line biofilm reactor based on a modified Robbins Device (mRD) and holds 12 coupon plugs, each of which holds one ½" diameter disc coupon (same disc coupons as used in the CDC Biofilm Reactor® and Rotating Disc Biofilm Reactor). The primary Bio-inLine® manufacturing materials (PET and nylon) are compatible with drinking water and process water systems. The sample disc coupons are half-inch diameter, which when held by the Coupon Holder Plugs, sit flush with the interior wall of the channel. Removal of sample disc coupons is readily completed by shutting the isolation valves, removing the Coupon Holder Plugs with the provided removal tool, and loosening the setscrews holding the coupons in the Coupon Holder Plugs.

Model IBR-500 Bio-inLine® Biofilm Reactor

1. Reactor Specifications

The IBR-500 flow chamber is a ½" square channel. When properly assembled, the disc coupons will be surface flush with the top of the flow channel. The reactor is designed with an entry segment to facilitate flow stabilization past the entry fittings. Flow characterization is readily determined using standard flow models for square cross-section pipes.

The reactor without fittings installed is 24" long, 2" wide, and about 1.8" tall. Valves and entry/exit fittings are 3/8" NPT. Fittings and valves are included as pictured but can be easily removed and swapped out as needed.

2. Coupons

The Bio-inLine® Biofilm Reactor has been designed to accommodate standard 0.5" diameter disc coupons (0.5" diameter and 0.15" thickness). These sample disc coupons are available in more than 40 materials, and additional material options can be manufactured upon request. These sample discs are compatible with the CDC Biofilm Reactor® and Rotating Disk Biofilm Reactor. Sample disc coupons are held in the Coupon Holder Plugs with a stainless-steel set screw. A 0.050" hex tool is provided with the reactor to allow easy removal of the sample discs for microbial culturing and further testing. Methodologies for culturing and antimicrobial testing on these discs are available as part of the CDC Biofilm Reactor Standard Methods.

3. Reactor Assembly

NOTE: Overtightening screws or Coupon Holder Plugs will damage the reactor. Follow the below guidance for best results. If the Coupon Holder Removal pins show signs of loosening or bending, then too much force is being applied and the Coupon Holder Plugs are too tight.

The Bio-inLine® Biofilm Reactor consist of a PET flow chamber with lid, nylon Coupon Holder Plugs, silicone rubber gaskets, and 316 stainless steel isolation valves. The isolation valves are attached to the flow chamber with nylon fittings. The reactor lid holds 12 Coupon Holder Plugs that compress an O-ring to generate a pressure seal. The entry and exit ball valves are 316 stainless steel with PTFE seats.

The threaded adapters at the end of the reactor are nylon and use of a PTFE tape is suggested to create a seal. The thread on these nylon adapters is 3/8" NPT (American National Standard Pipe Thread or national pipe thread), which is a tapered thread. As the fitting is threaded into the reactor, the threads and PTFE tape are compressed together. The fittings should only be turned into place to make a seal, and they may not bottom out completely. Over-compression of the fitting into the end threads may stress the threaded port in the reactor end which can lead to fracturing of the reactor.

Each of the sample disc coupons is mounted in a recessed well on the underside of the Coupon Holder Plugs and held in place by a 4-40 set screw (316 stainless steel). Installation of the plugs into the reactor lid is facilitated by use of the provided 2-prong tool (Coupon Holder Removal Tool) that fits into the top of each of the plugs. The Coupon Holder Plugs seal into the lid by compression of the O-ring into a tapered groove. The Coupon holders do not need to be aggressively tightened. Turn the coupon holders by hand until the O-rings have started to engage. The Coupon Holder Removal Tool is then used to turn the coupon holders approximately a 1/2-turn to make the seal. The coupon holders will easily bottom-out to the reactor channel and compress the silicone seal. Aggressive turning of the coupon holders with

the wrench will bend the wrench prongs, create extra stress on the lid as the coupon holder bottoms out and forces the lid up against the screws, and is not necessary to seal the Coupon Holder Plugs to the lid ports.

The lid O-ring seal only needs slight compression to make a water-tight seal. Overtightening the screws holding the lid in place not only stresses the sidewalls of the reactor but also bends the lid over the O-ring seal. Stress introduced into the plastic threaded sidewalls and lids will be accentuated when autoclaved, even if the screws were loosened prior to autoclaving. The lid screws should be installed finger tight around the perimeter of the reactor lid. The hex key (Allen wrench) provided is then used to turn the screws approximately a 1/2-turn. This compression should be sufficient to seal the reactor. The screws and coupon holders should be loosened to just a loose finger tight (loosen and then tighten with fingers just until engaged) when autoclaving.

The reactor should be assembled and tested for seal prior to autoclaving using a water flow rate similar to the flow rates that will be used during the experiment. Any leakage from ports or connections can be identified. If leakage occurs from the lid seal, each of the lid screws can be tightened another 1/4-turn (work in an alternating pattern around the lid screws, tightening the opposing screws on the lid to ensure even compression of the O-ring). Any leaks from the coupon holder seals can be remedied by turning the coupon holders an additional 1/8-turn or less using the provided Coupon Holder Removal Tool. If the unit does not seal using the described parameters, replacement of O-rings may be required.

4. Autoclaving Instructions

The Bio-inLine® Biofilm Reactor is made from black PET (polyethylene terephthalate) with nylon coupon holder plugs, silicone O-rings, and stainless steel screws. The reactor is fully autoclavable up to 121°C, at 20 minutes. Using temperatures or times past what is suggested may cause unnecessary stress to some materials and will not be covered under warranty. It is also recommended that the reactor not be placed directly on a cold surface after removal from a hot autoclave to minimize thermal shock to the PET material and lengthen the service life of the reactor.

NOTE: While the reactor is autoclavable, be aware that the black PET material will warp, degrade, and may eventually crack with use. This warping can be kept to a minimum if chemical sterilization is used in place of autoclaving. Check material compatibility sheets prior to using any harsh chemicals to ensure longevity of the reactor.

When autoclaving the reactor, it is recommended to use the slow (liquid) exhaust option. Any connected tubing should be open to the air to allow free exchange of steam to the surrounding environment. It is recommended that a gas-permeable material be used to cover the ends of the tubing, such as autoclave paper.

Loosen each of the metal lid screws until not engaged, finger tighten them without the hex key to just engaged. Loosen each of the coupon holders until they are just starting to engage the silicone O-ring seals. Autoclave inverted to ensure the coupons don’t fall out of the coupon holders during the expansion and contraction process associated with the heating cycle (materials may expand or contract at different rates, causing coupons of certain materials to become loose). Ensure the reactor is properly supported across the entire length. Lack of support could cause the reactor to sag or warp during autoclaving. Allow the reactor to cool inverted. Once the reactor has cooled, the reactor can be returned to the up-right position and

each of the screws and coupon holders re-tightened to the designations described in the assembly section. Once the reactor has cooled, and all fittings and screws retightened, the reactor is ready for installation into the flow system, and ready for use.

6. Pressurized Use

The Bio-inLine® Biofilm Reactor was designed to be used with water only. It has been tested up to 100psi and should not be used with higher pressures or with pressurized gasses (including air). When pressurizing the reactor for the first time, the system should be monitored to ensure no leaks or cracks have been introduced. BioSurface Technologies provides the fittings with PTFE tape to assist with sealing, but additional sealing may be required depending on assembly and use.