METHOD FOR SEALING HOLLOW FIBER MEMBRANES

Cross-Reference to Related Applications

This application is based on and claims priority to U.S. Non-Provisional Application Serial No. 13/421,326 filed on March 15, 2012 which is hereby incorporated herein by reference.

Background of the Invention

1. Field of the Invention

The present invention is related to the field of hollow fiber membranes and hollow fiber filtration modules.

2. Description of Related Art

Hollow fiber filtration modules are useful in a variety of filtration processes and generally suitable for immersion in the fluid to be filtered. Standard hollow fiber filtration modules contain bundles of hollow fiber membranes that are secured at each end by a header piece. The hollow fiber membranes generally are secured in place within the header by a potting compound that surrounds the fibers near each end, secures them in place with respect to the other hollow fiber membranes and the header and forms a seal around the membranes. However, both ends of the individual hollow fiber membranes remain open to allow fluid to flow into and/or out of the ends of the membrane through the potting compound.

In another type of hollow fiber filtration module, a single-header filtration module, the hollow fiber membranes are secured by a header at only one end. The other end of the bundle is not secured with a header, and the unsecured ends of the hollow fiber membranes can move freely with respect to each other. In some module designs, movement of the free ends is restricted by a housing, or the unsecured ends are supported by a frame. In other designs the entire fiber bundle may be encased in a housing. In yet other designs the free ends of the membranes are supported only by the fluid in which the filtration module is immersed. In most designs, the free ends of the hollow fiber membranes are sealed to prevent fluid flow into or out of the free ends of the membranes.

Brief Summary ~~of the Invention~~

The present ~~invention~~ disclosure is directed to a method of sealing the free end of a hollow fiber membrane for use in a single-header filtration module by dipping the end of the membrane into a low-viscosity light-curable adhesive and curing the adhesive.

The method of the present ~~invention~~disclosure comprises inserting a first end of the membrane in a low-viscosity light-curable adhesive having a viscosity less than 5000 cps, removing the first end from the adhesive, and exposing the first end to a light source to cure the adhesive. Use of a low-viscosity light-curable adhesive results in a thin coating of adhesive on the exterior of the first end of the hollow fiber membrane. The low viscosity of the adhesive allows the adhesive to flow into the bore of the membrane. Capillary action further causes the low-viscosity adhesive to wick into the inner wall of the membrane. As a result, a plug is formed in the interior bore that further seals the first end of the membrane.

In one aspect, there is provided a method for sealing the free end of a hollow fiber membrane for use in a single-header filtration module, comprising:

inserting a first end of said membrane in a low-viscosity light-curable adhesive having a viscosity less than 5000 cps,

removing said first end from said adhesive,

exposing said first end to a light source to cure said adhesive.

In another aspect, there is provided a hollow fiber membrane for use in a single-header filtration module, comprising:

a hollow fiber membrane having an interior wall defining a hollow internal bore, a first end and a second end,

wherein said first end is coated with a low-viscosity light-curable adhesive,

wherein the thickness of said adhesive coating said first end is less than 0.8 mm; and

wherein said second end is open.

In another aspect, there is provided a hollow fiber filtration module, comprising:

a plurality of hollow fiber membranes, and

one header,

wherein a second end of each of said hollow fiber membranes is secured within said header in a potting compound,

wherein said second end of each hollow fiber membrane is open, and

wherein said first end of each said hollow fiber membrane is sealed with a low-viscosity light-curable adhesive.

The present ~~invention~~ disclosure also encompasses the sealed hollow fiber membrane produced by the process, as well as a hollow fiber filtration module containing fibers sealed by the process of the present ~~invention~~disclosure.

Additional aspects of the ~~invention~~disclosure, together with the advantages and novel features appurtenant thereto, will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned from the practice of the invention. The objects and advantages of the ~~invention~~ discloure may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

Brief Description of the Drawings

Figure 1 is a perspective view of an unsealed hollow fiber membrane.

Figure 2 is a cross-sectional view of a first end of the hollow fiber membrane of Figure 1 after sealing according to the present invention.

Figure 2A is an expanded view of a portion of the hollow fiber membrane of Figure 2 showing penetration of adhesive into the wall of the membrane.

Figure 3 is a cross-sectional view of a first end of the hollow fiber membrane sealed using a high-viscosity adhesive.

Figure 4 is a cross-sectional view of a first end of a hollow fiber membrane being cured after sealing by exposure to a light source.

Figure 5 is a cross-sectional view of a bundle of hollow fiber membranes sealed in accordance with the present invention.

Figure 6 is a cross-sectional view of an exemplary single header filtration module in which the follow fiber membranes have been sealed in accordance with the present invention.