DESCRIPTION

Title of Invention: FILTRATION MODULE AND FILTRATION APPARATUS

Technical Field

[0001]

The present invention relates to a filtration module and a filtration apparatus.

Background Art

[0002]

Filtration apparatuses equipped with filtration modules that include bundles of hollow fiber membranes have been used as solid liquid separation treatment apparatuses in wastewater treatment, processes of producing medicines, and the like. Examples of the filtration modules include external pressure modules in which the pressure on the outer circumferential side of the hollow fiber membranes is increased so that the feed liquid will penetrate into the inner circumferential side of the hollow fiber membranes, immersion type modules in which the feed liquid is caused to permeate into the inner circumferential side by osmotic pressure or by decreasing the pressure at the inner circumferential side, and internal pressure modules in which the pressure at the inner circumferential side of the hollow fiber membranes is increased so that the feed liquid will permeate toward the outer circumferential side of the hollow fiber membranes.

[0003]

Of the filtration modules described above, the external pressure type and immersion type filtration modules become contaminated as substances contained in the feed liquid adhere to the surfaces of the hollow fiber membranes due to operation and their filtration ability will be degraded if left contaminated.

To address this issue, a cleaning method (air scrubbing) has been employed with which air bubbles are supplied from below the filtration modules so that the air bubbles abrade the surfaces of the hollow fiber membranes and vibrate the hollow fiber membranes to remove the adhering substances (refer to Japanese Unexamined Patent Application Publication No. 2010-42329).

Citation List

Patent Literature

[0004]

PTL 1: Japanese Unexamined Patent Application Publication No. 2010-42329

the filtration module, a filtration vessel that houses the filtration module, and an air bubble supply unit that supplies air bubbles to a lower portion of the filtration module.

[0021]

The filtration apparatus is equipped with the filtration module, which has excellent hollow fiber membrane surface cleaning efficiency and excellent filtration ability, and the hollow fiber membranes can be cleaned by air scrubbing using an air bubble supply unit; hence, the filtration ability can be enhanced and the utilization rate can be increased.

[0022]

Here, the "existence region" refers to the smallest in area among imaginary convex polygons (polygons with all inner angles smaller than 180°) that contain all hollow fiber membranes when viewed in the alignment direction of the hollow fiber membranes. The term "rectangular" refers to a quadrilateral with unequal adjacent sides and does not include squares.

The "average effective length" of the hollow fiber membranes refers to an average of the lengths of portions of the hollow fiber membranes exposed between the holding members. The "packing area ratio" refers to the area fraction of the inner side of the outer circumferential surfaces of the hollow fiber membranes and is an occupying ratio including the area of the inner cavities of the hollow fiber membranes.

[0023]

[Details of embodiments of the present invention]

The individual embodiments of the present invention will now be described in detail with reference to the drawings.

[0024]

[Filtration module]

A filtration module 1 illustrated in Fig. 1 includes hollow fiber membranes 2 that are held by being aligned in one direction and a pair of holding members that fix both ends of the hollow fiber membranes 2, namely, an upper holding member 3 and a lower holding member 4.

[0025]

<Hollow fiber membranes>

The hollow fiber membranes 2 are prepared by forming porous films, which allow water to penetrate through but not particles contained in feed liquid, into tubes.