High Flux and Low Fouling Membrane Separation Process

Membrane fouling due to particulates is driven by permeate drag is a key issue that reduces the efficiency of membranes in various applications. To overcome this, a flow-field mitigation of membrane fouling (FMMF) technique has been developed that can potentially reduce the fouling. The technique is based on changing the pattern of the flow of fluids from parallel to an inclined one to counter the permeate drag experienced by the foulants.

Researchers have designed two configurations of FMMF channels and also identified corresponding mechanisms to mitigate fouling, along with confirming the efficacy of FMMF through CFD simulations and experiments.

Potential Applications

The research can find extensive applications in design and manufacture of filtration membranes. It can be expected to be applicable to all types of membranes, irrespective of the material used for its manufacture. The resultant membranes can be used in filtration processes in various industries from medical science, food to environmental, and pharmaceutical.

Customer Benefits

- The flow-field mitigation of membrane fouling (FMMF) configuration design can
  - lower the energy requirements of the filtration process
  - reduce tendency of membranes towards fouling
  - consistently give lower deposition factors than the conventional parallel wall channel design.
  - give higher critical fluxes than the conventional parallel wall channel configuration.
- Membrane developers have an option of using 3D (three-dimensional) printing to manufacture components such as wedge-shaped baffles, spacers or mandrels that would simplify the assembly of tapered channels.
- The simulated smaller angles for the membrane walls of 0.39°, 0.57° and 1.15° are also more practical values that can be considered for industrial-scale designs.

Technology Features & Specifications

The developed design is based on the additional transverse fluid vector that is caused by a small inclination of the fluid flow channel walls of the membrane. Both the simulation and experiments conducted confirmed the high efficacy of FMMF in mitigating fouling of a membrane at a reduced energy requirement compared with the conventional channels/membranes characterized parallel walls.

In the simulations conducted over a range of permeate fluxes, it was established that a slight channel inclination angle of 1.15° can give a deposition factor that is lesser than that of conventional channels with parallel walls even at twice the permeate flux.

Direct observation experiments using two varied particulate diameters over a range of power inputs also showed that the critical fluxes were significantly increased in the FMMF module compared to the conventional module.

The design also minimizes the probability of contact of the particulate foulant with the membrane.

Market Trends and Opportunities

Market growth for membranes is being fueled by an increasing demand for cleaner water and safer discharge of wastewater, due to growing health and environmental concerns. Traditional technologies such as microfiltration and ultrafiltration are being replaced by new membranes developed using ZIF, MOF and other upcoming high performance materials with increased durability and greater application diversity, and also by new membrane processes such as Forward Osmosis (FO). The Southeast Asian (SE Asia) membrane technologies market in Water and Wastewater (WWW) treatment alone was worth $351.4 million in 2016 and is expected to grow to $590.5 million by 2021 at a CAGR of 10.9 %.
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