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Novel ceramic filter disks and further development of tubular nanofiltration elements, their characterization and first use in the treatment of textile wastewater

C. Pflieger [a,*], M. Weyd [a], P. Puhlfürß [a], V. Prehn [b], C. Günther [b], D. Kaulbars [c], F. Krause [d], V. Voigt [a]
[a] Fraunhofer IKTS, Michael-Faraday-Straße 1, 07629 Hermsdorf, Germany
[b] Rauschert Kloster Veilsdorf GmbH, Industriestraße 1, 98669 Veilsdorf, Germany
[c] E.S.C.H. GmbH, Maxhüttenstraße 19, 07333 Unterwellenborn, Germany
[d] CHMS GmbH & Co.KG, Coburger Straße 19, 96472 Rödental, Germany
[*] christian.pflieger@ikts.fraunhofer.de

Introduction

Inorganic membranes based on oxide and non-oxide materials have undergone constant development in recent years. Especially in the field of oxide materials, the availability, also with regard to the selection of different tubular geometries, and the pore size spectrum have expanded enormously. Even in the field of nanofiltration membranes (TiO_2/ZrO_2), ceramic-based tubular elements have been successfully developed with and for industrial partners.
These ceramic based membranes, which are in general stable in the pH range from 0-14 and show a high temperature stability, have proven their performance in many industrial (water treatment) applications. Typical applications focus on the separation of organic molecules, the retention of multivalent ions, the decolorization of waters, the retention of micropollutants or a combination thereof.

New developments

Whereas the membrane development started on small tubular single channel elements the ceramic nanofiltration membranes (NF) are available on an industrial scale with specific membrane areas of up to 1.2 m² per element. The project team is currently working on elements with up to 311 channels or 2.93 m^2 of membrane area. These elements are already available as prototypes membranes in the entire pore size range (1200 nm to < 1 nm).
In addition, newest developments focus also on rotating disc filters. This new type of rotating disc (RD) brings enormous mechanical stability. In current projects, attempts are being made to synthesize them in different diameters (up to 374 mm) but also with different pore sizes (800 nm to < 1 nm). NF membrane layers on RD are a worldwide novelty. Membrane systems with RD certainly form an application niche. However, they have some advantages. They are considered to be operated more efficiently in terms of energy, since the energy required to rotate the disc filters is less than the pump energy required to operate the crossflow filtration systems. In some applications, they also allow the use of membrane processes for the first time.
All new elements were compared with established geometries in terms of the membrane quality achieved. Corresponding results are presented.

Exemplary applications - treatment of textile wastewater

Large amounts of wastewater are generated in the laundry and textile cleaning industry, which requires the appropriate use of fresh water. The aim is to reduce the need for fresh water by allowing wastewater to be specifically treated. Depending on the items being washed, different levels of contaminated wastewater are produced and different requirements are placed on the water output qualities for carrying out the cleaning.
The focus of the present work is on foot mat and towel wastewater. A special feature is the requirement to treat heavily colored towel wastewater so that it can also be used to wash non-colored towels. There is also a massive reduction in chemical oxygen demand as a central treatment goal.
Based on the target criteria, a pilot plant (NF, for tubular elements + RD) was planned and built. It is currently being tested on site in a laundry. Results and economic considerations are presented.

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