A new trend in the membrane technology: Rotation filtration with ceramic filters

A Report by Kerafol GmbH*

In the past years, there was a clear development away from classic crossflow filtration towards rotation filtration. The advantages of rotation filtration lie in the substantially improved cleaning off effect on the filter surface with at the same time reduced energy consumption. Due to the availability of ceramic filter elements with a new geometry, this trend towards rotation filtration will become even stronger in plant engineering.

Prerequisite for a continuous filtration method is avoiding membrane blocking respectively preventing a covering layer on the membrane surface (filter cake). This requires permanent cleaning of the filter surface during the process. This is achieved with so-called cross flow technologies, meaning the filter surface is permanently streamed tangentially. The shear forces that occur here prevent the formation of a filter cake (see Fig. 1a). This way, high filtrate outputs can be sustained over very long periods of time.

In order to achieve this crossflow effect, it used to be necessary to move high liquid volumes with the aid of powerful pumps. The excellent filtration capacities were offset by high energy costs. For a few years now, there are new developments towards so-called dynamic crossflow methods that work with much less energy consumption Here, relative motion between the medium to be filtered and the filter is not generated by pumps but instead by the rotation of the filter (see Fig. 1b) or a rotation of flow disrupters.

'Rotation filtration' is the key word, which summarizes these new techniques. Apart from the reduced energy consumption, higher cross flow velocities can be generated by the rotation filtration compared to the conventional Cross-flow-filtration, which leads to improved filtration results (Fig. 2).

There are ceramic filter elements available on the market with a new geometry for the implementation of rotation filtration methods through plant engineering (Fig. 3). These are filter discs made of highly resistant Al_2O_3 ceramic with an outer diameter of 312 mm. These filter disks are combined to filter stacks with a membrane surface of 4 to 10 m^2(see Fig. 4), which can be aligned modularly in plants with several hundred square meters.

There are different rotation filtration methods for permanently cleaning the membrane surface. Some examples are described in the following:

a) Rotation of the filter disk without flow disrupters

The filter stacks described above are set in rotation. The arising centrifugal forces continuously carry off deposits on the membrane surface and filtrate output remains constantly high. A commercially available small plant is portrayed in ill. 5 (membrane surface 3 to 6 m^2).

b) Rotation of the filter disk with static flow disrupters

For supporting the effect of the filter disk rotation, the filtration output can be increased even more by installing flow disrupters. Flow disrupters at the container wall lead to increased turbulence in the filtration module. In addition, a suction effect can be generated on the membrane surface with disrupter elements aligned between the filter disks that prevents the blocking of pores.

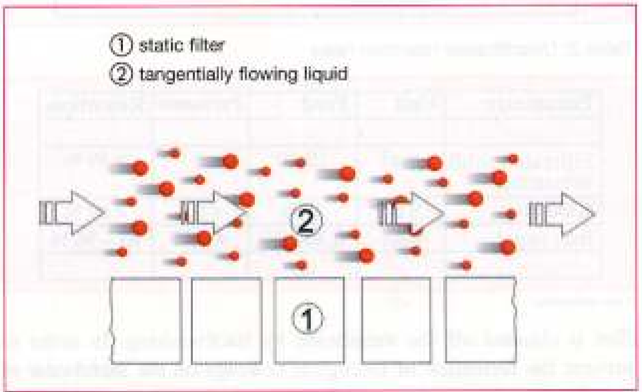

Fig. 1a: Conventional Cross-Flow-Filtration

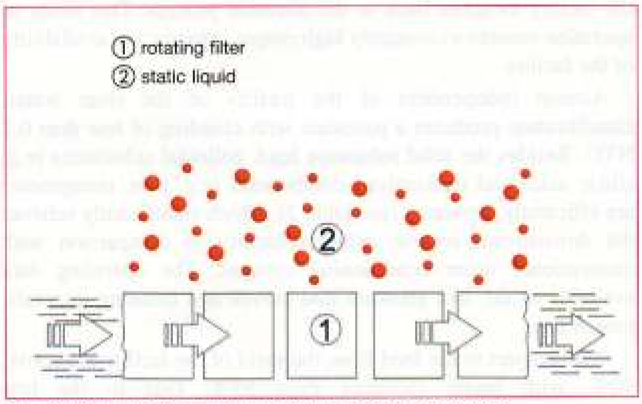

Fig. 1b: Dynamic Cross-Flow-Filtration Rotation filtration

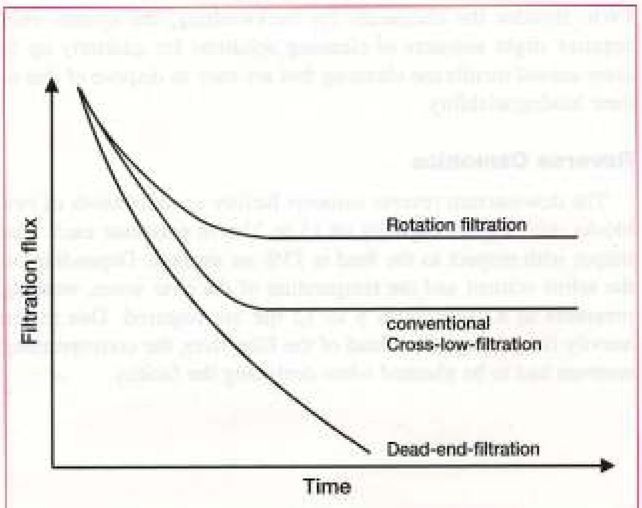

Fig. 2: Increased filtration flux of the Rotation filtration in comparison to the conventional Cross-flow- filtration and Dead-End-filtration.

*Kerafol GmbH
Industriegebiet Stegnthumbach, D-92676 Eschenbach
Tel./Fax : 0049 (0) 9645-88-721/390
www.kerafol.com

c) Static filter disks with rotating flow disrupters

A relative motion with comparable filtration results can also be generated by a rotation of flow disrupters in combination with static filter disks. The flow disrupters set the liquid to be filtered in motion, which results in the desired cross-flow effect.

d) Rotation of interlocked filter discs

The filter stacks can be aligned in such a way that the filter disks have an overlapping section (Fig. 6). If the filter stacks are now subjected to rotary movement in the same direction, this causes a movement in the opposite direction in this overlapping zone. A zone of maximum turbulence results in which the membrane surface is permanently cleaned off. This cleaning effect is homogenous across the entire disk radius, as the track velocities of the counterrotating disks add up to a constant value.

The described rotation filtration methods differ in their mode of action and energy consumption. Depending on the different requirements of the respective application, one can select the respective optimum method. While for example with application in the wastewater sector the focus is on very low energy consumption, many industrial application cases require high streaming velocities.

New chances and markets are opening up for plant engineering due to the known material properties of ceramic in combination with the new rotation filtration methods. The described ceramic filter disks are available in different separation limits for micro and ultrafiltration. The filter disks are commercially available both as individual parts as well as ready-mounted units (units from 1 to 6m²). In addition, there are facilities with membrane surfaces in a range from 1 to 6 m² that can be applied directly and used as test plants for projecting membrane plants with several 100 m² of membrane surface.

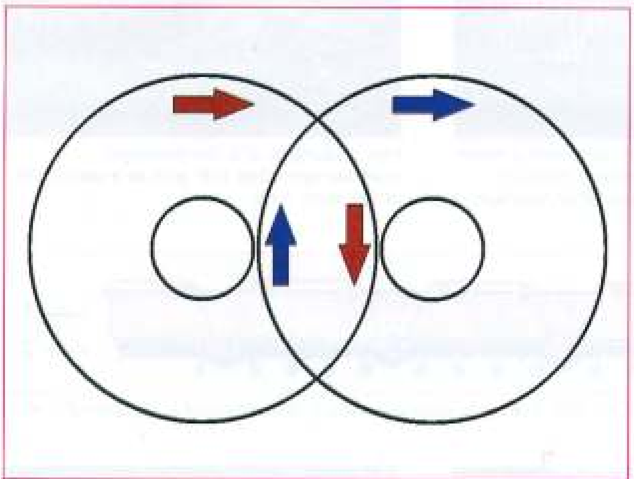

Fig. 6: Scheme: interlocked filter stacks, counterrotating movement and thus maximum cleaning effect on the filter surface

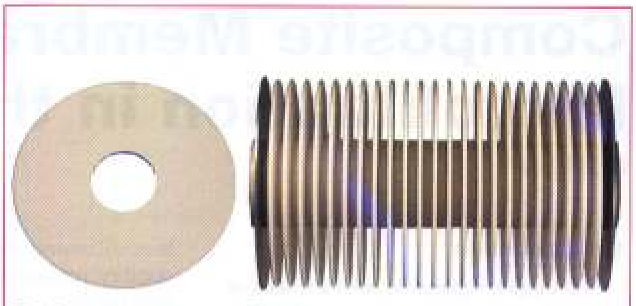

Fig. 3 Fig. 4

Fig. 3: Filter disk made of highly stable Al_2O_3 ceramic with a new geometry (external diameter 312 mm)
Figure 4: Filter stacks with a membrane surface of 4 to 10 m² as base unit

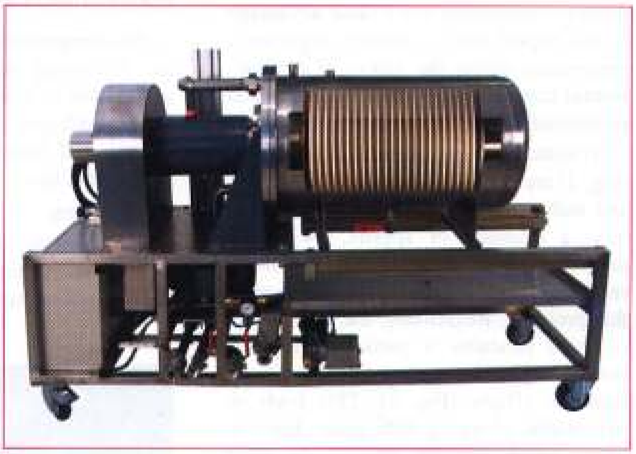

Fig. 5: Rotation filtration facility with a membrane surface of 4 to 6 m² (flow disrupter optional, automatic backwash facility)

Tabelle 1: Rotation filtration with ceramic filters

Applications
• Filtration of emulsions, cooling lubricants
• Filtration of industrial process media, electroplating
• Preparation of corrosive media in combination with increased temperature
Branches:
• Environmental technology and waste water treatment
• Food industry, biotechnology, pharmaceutics
• Process engineering and chemistry
Rotation filtration with ceramic filters
System advantages:
• extremely high cross flow velocities - no filter blocking
• reduced energy costs (compared with conventional cross flow concepts)
• compact plant facilities with large filter surfaces
• chemical and thermal stability
• regeneration of the membranes (back flushing, hot steam sterilisation)
• material-caused high service life