Development of a new ceramic membrane resistant to abrasion

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New ceramic membrane resistant to abrasion
We are pleased to present you a new concept of membrane, specially dedicated to severe applications, where abrasion is a concern.
WHAT FOR?

- In numerous applications, specially in MF and UF, the retentate contains highly abrasive particles. These particles, because of the high velocity of the retentate liquid, damage the membranes, thus reducing the lifetime.

- The abrasion is all the more aggressive as:
  - The concentration of abrasive particles is high
  - The velocity is high
  - The particles are hard and angular

- Their size can be in the range of few microns to millimetre, it can be single particles or aggregates
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Examples of particles and associated applications:

1. **Metallic particles**: include in
   - The recycling of degreasing baths
   - The recycling of metal industry
   - The concentration of micronic particles

2. **Mineral particles**: met in
   - MBR, for water treatment
   - Landfill leachate treatment
   - Reuse water treatment
   - Beverage clarification
   - Catalyst recycling
   - Treatment with filtration agent (like active carbon)
   - Ceramic industry effluent
   - Fermentation broth separation

3. **Organic Particles**: 
   - Sugar juice clarification

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For these applications, and for others, the membranes lifetime can be relatively low, leading to high cost of maintenance, and in the worst case to economical non sense.

The risk is that the membrane technology may be replaced due to abrasion by another technology. It is therefore very important to offer new solutions.
What are the material characteristics affecting the resistance to abrasion?

1. Material composition
2. Material Microstructure
3. Membrane structure
1. Material composition:

TiO$_2$ and ZrO$_2$ are among the stronger and harder materials

⇒ TiO$_2$ and ZrO$_2$ are already very good composition for abrasion

- historical and original TAMI Industries know how
- the best compromise for their chemical stability, mechanical strength, hardness, lack of toxicity
2. **Material microstructure:**

A porous ceramic is made of mineral grains bond together.

=> The way this microstructure is constructed, namely the way the grains are packed and bond is as important as the composition. One can chose the hardest alumina or titania powder as possible as raw material, if the number of contact and the strength of bonding are low, the abrasion resistance will be poor.
3. Membrane structure:

A ceramic membrane is usually made of:

- a porous support,
- a sub-layer
- an active layer

Linked to each other.

⇒ The way this structure is constructed is as important as the composition. A hard alumina or titania layer that do not stick to the support will have a poor lifetime whatever the hardness of the oxyde.

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TAMI Industries INNOVATIONS

TAMI has developed a new membrane, based on

- a proprietary process based on advanced ceramic technology to significantly improve the material microstructure

and

- an original membrane structure enabling the active layer to be very strongly anchored to the support

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**Advantages:**

- Very strong microstructure of the active layer
- A large part of the layer included inside the support microstructure
  
  ⇒ Very strong anchorage

  ⇒ When the top surface of the layer is abraded, the membrane is still perfectly running, and after the membrane is protected by the support ⇒ almost no possible further abrasion

A patent has been filed to protect this innovation

*New ceramic membrane resistant to abrasion*
RESULTS: hardness

CHARACTERIZATION

• Hardness: standard Vickers method, appropriate to minerals

\[ Hv \, (\text{Mpa}) = K \times \frac{F}{d^2} \]

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TAMI LAB RESULTS: hardness value vs commercial membrane from competitor

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CHARACTERIZATION

• Test of abrasion

Pressurized air (1 bar), or water
Containing SiC grains

Evolution of the performances (dextran rejection rate and permeability)

SiC is one of the harder abrasive, closed to diamond

performance

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TAMI LAB RESULTS: resistance to abrasion

Evolution of the rejection rate with time

Example of Ø25-8ch 0,14 µm, tested on 10 samples

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New ceramic membrane resistant to abrasion

TAMI LAB RESULTS: resistance to abrasion

Evolution of the rejection rate with time
example of Ø25-23ch 300 KD, tested on 10 samples

ULTRAFILTRATION

TAMI LAB RESULTS: resistance to abrasion

Evolution of the rejection rate with time
example of Ø25-23ch 300 KD, tested on 10 samples

ULTRAFILTRATION

Major improvement

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Evolution of the rejection rate with time
example of Ø25-23ch 300 KD, tested on 10 samples

Since 1998, TAMI offers « special » membrane with thicker layers

New ceramic membrane resistant to abrasion
RESULTS: resistance to abrasion

To better know the advantages that can afford such membrane, compared to existing filter, we have asked to an independent French laboratory, called LabServices/ALS, to compare the resistance to abrasion with the membranes studied at our Lab in order to be sure our data were good.

Two others membrane marketed by our competitors for their abrasion resistance have been found on the market. One called « Duratech » from the Atech company, and one called « Diamond » from the Novasep company.
INDEPENDENT LAB RESULTS:
resistance to abrasion

New ceramic membrane resistant to abrasion
This study show that one can distinguish 3 families:

- « standard » membrane, that are up to now very suitable for most of current applications

- « special high thickness » membrane, that allow to increase a little the lifetime, but more expensive and with higher transfer resistance

- « new membrane structure », that seems really suitable for abrasive conditions

TAMI Industries has succeeded in the development of a new unique membrane, that can stand severe conditions.

Several of these new membranes are being tested in real application, and it confirms their exceptional resistance.

FOR MORE DETAILS ABOUT THESE NEW MEMBRANES, CONTACT US tami-info@tami-industries.com