

Nanofiltration

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Course: STS 201

Water:

- It is IMPORTANT!!!
- 97% of Earth's water is saltwater

Problems that arise:

- Under developed countries and kids
- Groundwater contamination
- Waterborne diseases and related illnesses kill 5+ million people a year

Water's future:

- World's population predicted to double in next 40 years
- Demand for fresh water by industries

Are we doing anything?

- Minimally
- Tim Harper claims “No”
 - “Governments and companies... have not yet made the connection between nanotechnology and water”
 - Will not be a primary focus until a profit margin is realized

Ahead of the pack:

- A few academic institutes and companies have realized the potential and begun research and development

Companies:

- Secretive
- Liquid filtration for industries
 - Berghof
 - Fluxxion
 - Saehan

More:

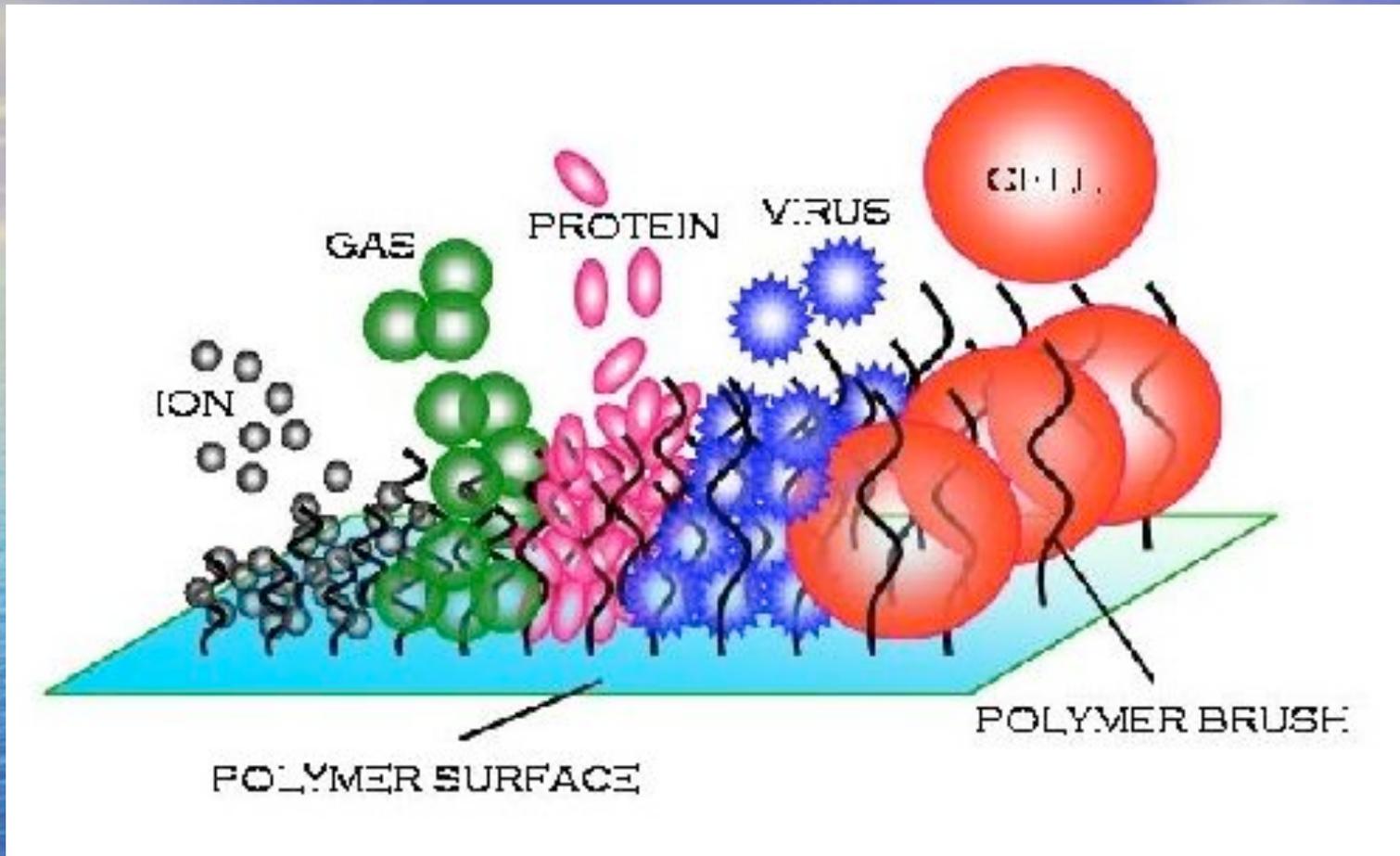
- NanoSight
 - Nanoparticle Tracking Analysis (NTA)
- Seldon Laboratories
 - Nanomesh

Honorable mention:

- Inframat
 - Broad nanomaterial studies
- KX Industries
 - Not sure if nano: use carbon block filter cartridges

The inside scoop on companies:

- eMembrane
 - Nanoscale brushes
 - Functional groups on brushes can simultaneously capture and remove toxic metal ions, soluble proteins, viruses or cells from the filtrate
 - Density and the length of the polymer brushes can be easily controlled



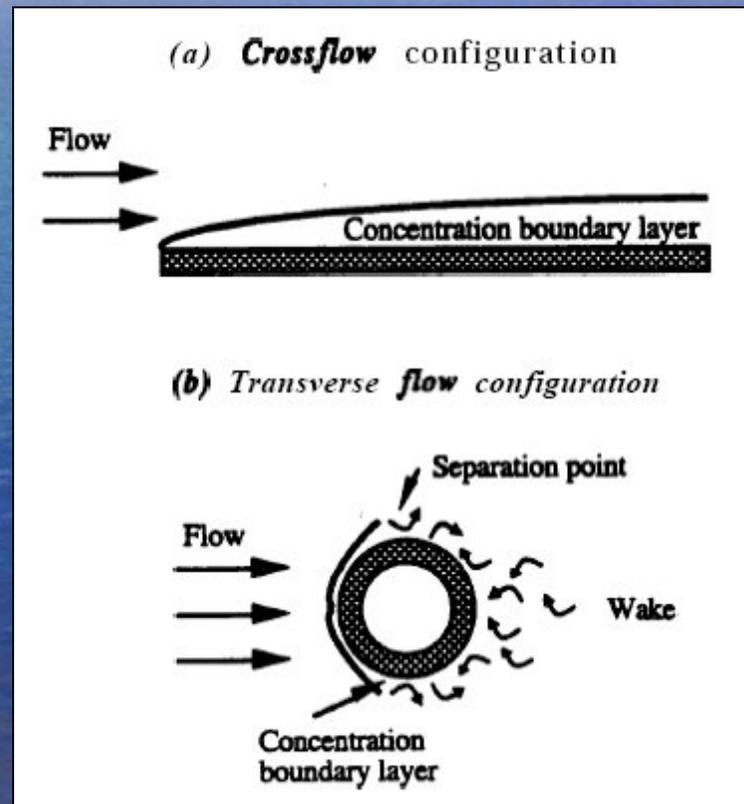
<http://www.emembrane.com/index.html>



continued...

- ZENON Environmental, Inc.
 - Transverse flow hollow fiber nanofiltration module
 - Used for pretreatment to reverse osmosis

Transverse flow system

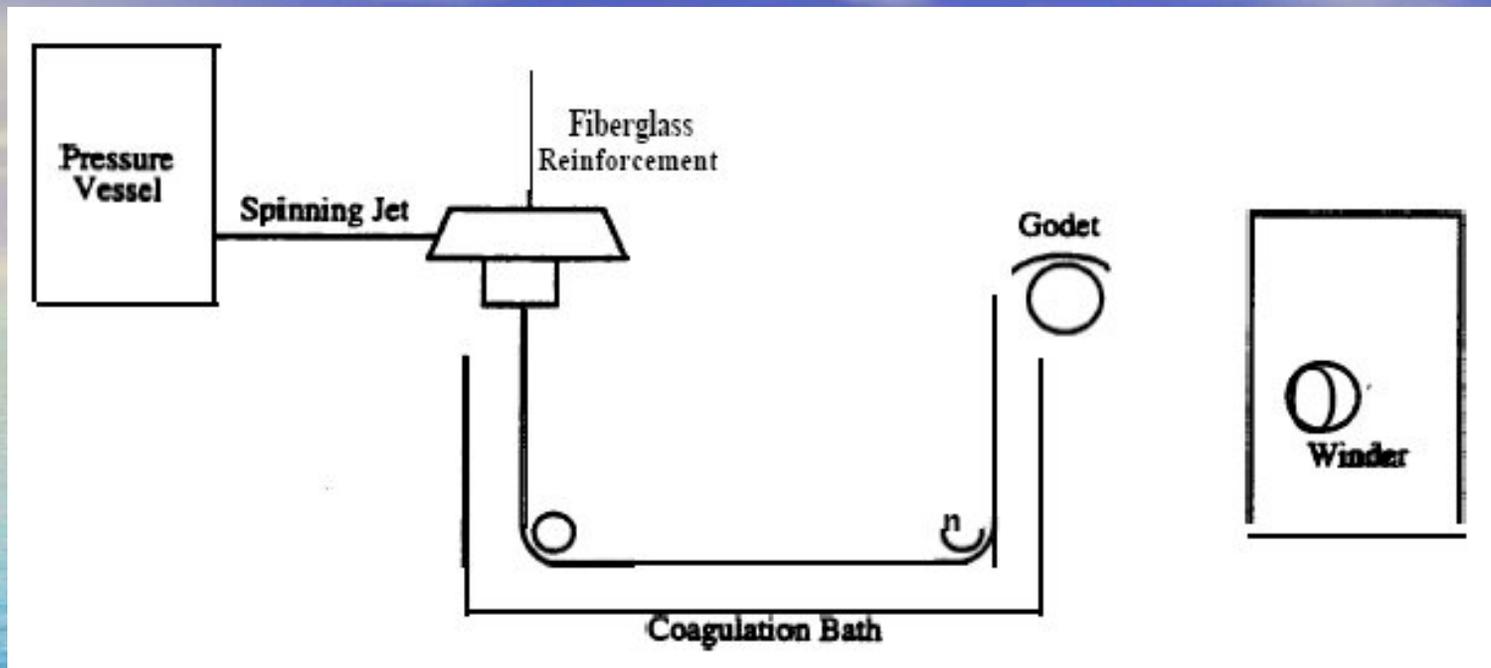


Two layers form a membrane:

- 1st layer
 - Microporous sublayer (base layer)
 - Supports the barrier layer (2nd layer)
 - Composed of hollow fibers reinforced with fiberglass
 - Tested three polymers
 - Most effective fibers were polysulfone fibers

Sublayer formation:

- Wound by:
 - Passing hollow fiberglass through primary jet
 - Passing through secondary jet
 - Passing through conjugation bath
 - Finally, passing through a wash



ZENON Environmental, Inc. June 1995

Barrier layer (2nd layer) formation:

- Most effective method, solvent evaporation, consists of:
 - Dipping base fiber into solution of polymer and additives dissolved in a volatile solvent
 - Allowing solvent to evaporate away to yield a thin film membrane

Crossflow vs. Transverse Flow:

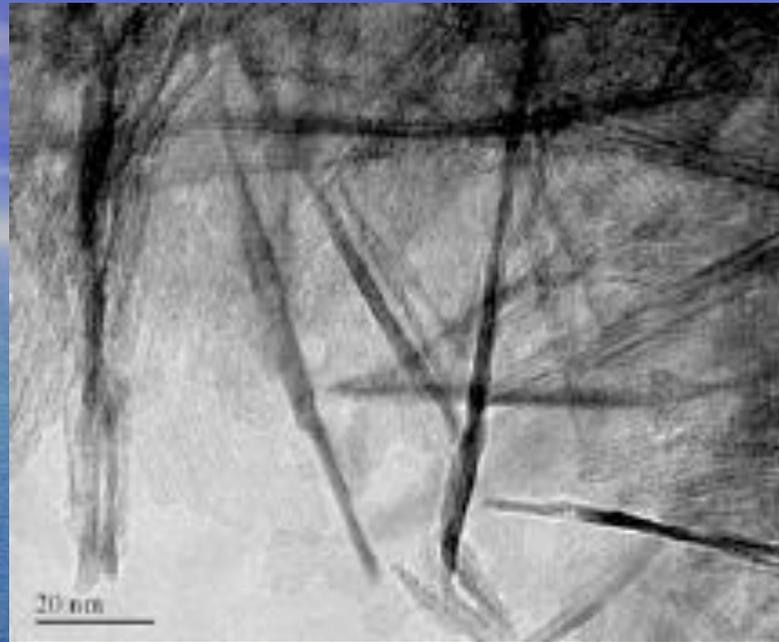
- Using layer formation methods, Zenon tested crossflow systems and transverse flow systems
 - Crossflow provided higher initial flux but was dramatically reduced after 24 hours
 - After 205 hours, transverse flow system decreased only slightly
 - Membrane is very efficient and long lasting
 - Low initial flux observed in trials likely due to air trapped in module flow, which could be eliminated by an automatic coating system
 - Transverse flow allows for minimal pretreatments, reduced spoiling, reduced costs, and is very successful in low pressure applications

Just one more (I promise):

- Argonide
 - NanoCeram[®] is a form of alumina fibers
 - Fibers mainly composed of Boehmite (AlOOH)
 - Surface of the nanofibers is positively charged

Filter formation:

- White, free flowing powder consisting of fibers approximately 2 nanometers in diameter and tens to hundreds of nanometers long, collected in aggregates
- Nanofibers dispersed throughout a microglass fiber matrix resulting in a media with 2 micron average pore size and with water flux typically of that pore size



<http://www.argonide.com/>

Does it work?

- No measurable decay in flow rate/clogging until well past breakthrough
- Capacity of NanoCeram[®] is directly proportional to the ratio of nano alumina fibers in the filter and to the filter thickness (number of layers)
- An important application is in prefiltration of solutions upstream of reverse osmosis membranes

Summary:

- Nanofiltration will play a vital role in providing quality, usable water in the future
- Private companies are leading the research and development of nanofiltration technologies
- When it comes to big technological developments, people do not like to share
- Many different systems of development, all of which have pros and cons
- Nanofiltration best used are pretreatment for reverse osmosis

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