INTENSIFIED FILTRATION BY DIRECT MEMBRANE CLEANING (DMC)

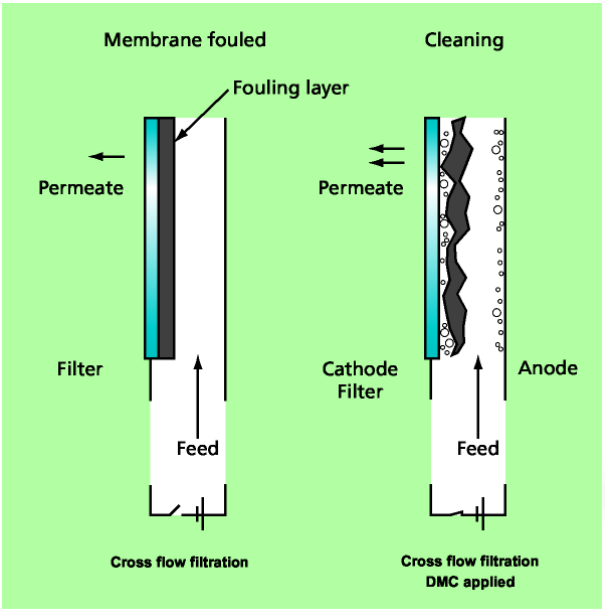
The challenge

Dead-end filter cartridges tend to have a reduced throughput with increasing dirt loading and will ultimately block - particularly with fine suspensions. Cross-flow filtration (with velocities of 2-5m/s across the surface of the filter) improves this situation by reducing the rate of fouling deposition on the membrane. Although the membrane can be cleaned regularly by back-flushing, not only can this have the effect of degrading the mechanical integrity of the membrane through back-pressurisation but progressive fouling will also occur due to ineffective unblocking of the finer pores. Periodically, therefore, chemical cleaning is also required - with the disadvantages of plant down time and secondary waste generation.

DMC is an enhacement to cross-flow filtration where the fouling layer can be removed *in-situ* - thus restoring filtration performance to that of a clean membrane without the need for back-pressurisation or the use of cleaning chemicals.

How it works

DMC is a i*n-situ* method of filtration membrane defouling by the periodic electrolytic generation of microscopic bubbles which effectively break off platelets of fouling materials from a composite membrane, thus restoring the filtration rate. The unit comprises a filtration membrane with a pore size matched to the particulates requiring separation of a material naturally resistant to the fouling species, sandwiched between a conductive backing electrode and a coarse mesh counter electrode.



Selection of membranes with pore sizes matched to the particulates being separated is critical to the maintenence of separation factors of >99.9% by ensuring that any fouling is restricted to the surface of the membrane where it can easily be removed by DMC rather allowing a build up of solids in the depth of the membrane layer.

DMC can be applied to ultrafilters (with only a 1 second pulse duration of 5A/dm^2) and microfilters (with upto a 5 second pulse of 20A/dm^2). Typically, for low solids content feeds (0-1%), only 2-4 pulses/hour are required, while for up to 50%, this increases to 12 pulses/hour.

- Membrane supports can include stainless steel, carbon, conductive ceramics
- Conductive, polymeric or ceramic filtration control layers
- Select pore size for surface filtration
- Tubular or flat sheet filter geometry
- Modular units
- Cleaning pulse duration 1-5 s
- Repetition rate 2-12/h
- Multiplexed power supply unit
- Product slurry 10-50%
- Cross-flow velocity 0.3-1 m/s

Benefits of DMC

The benefits that this technology brings are:-

1. Enhanced flux by upto 10 times through the minimization of membrane fouling.
2. This can allow a reduction in membrane area and/or transmembrane pressure (down to 0.5 Barg) required for a given volumetric throughput, leading to significant cost savings.
3. It is applicable to a wide range of membrane types.
4. Cross-flow velocities can be reduced by 5-10 fold (to 0.3-1m/s),
   a) this reduces pump size and operating costs.
   b) particle degradation is minimised – with consequent benefits in enhanced permeability.
   c) membrane and pump wear is reduced
5. The rapidity of the cleaning process gives high plant availability
6. The units are of modular construction.

Tubular DMC filtration module

DMC is applicable to a wide range of applications including:-

- Effluent treatment
  - pre-treatment by precipitation with chemical conditioning
  - absorption onto a finely divided engineered sorbants added as a suspension at typically 10-50ppm to achieve a volume reductiuon factor of up to 10,000 (eg ferric hydroxide)
- Materials recovery
  - Volume reduction
  - Rinsing from soluble process chemicals
- Sludge dewatering
- Potable water treatment
- Oil-water separations
- Bioseparations

Patents available

US 5916431 Filed 1991	**Electrochemical membrane cleaning electrode**. A low cost anode material comprising 6-12% Cr content offers the advantages of electrical membrane cleaning without the need for expensive DSA e.g. Platinized Titanium. There is a low enough Cr content to prevent contamination of the stream with Cr(VI) corrosion products during the application of the electrical cleaning pulse, but high enough to minimise open circuit corrosion.
US 5342514 Filed 1993	**Filtration: flat sheet DMC system**. This patent describes the application of DMC to a prismatic flat-sheet cross-flow filter design. Particular design features are the back-to-back filter membranes that balance any force from the transmembrane pressure – thus minimising any distortion, and hence the need for re-enforcement structures. Thyristor switches connect both membrane and counter electrodes to a power supply, such that a single small unit may be used to clean discrete membrane areas in sequence.
US 5958242 Filed 1996	**DMC with mesh separator**. This comprises a compact sandwich of a non-conductive membrane between the electrically conductive membrane support and counter electrode. Due to the proximity of the electrical conductors, the resistance to current flow during the cleaning pulse is minimised – thus reducing electrical power consumption. In addition, the filtration properties of the wide array of polymeric membrane materials normally used in cross-flow filtration can be enhanced by DMC. It should be noted that this excludes tubular filter designs.