Membrane Autopsy

- The UNESCO Centre for Membrane Science and Technology (CMST) has been providing autopsy services for over 10 years and has autopsies for clients ranging from small industry companies to large water treatment plants.
- Since 2006, the centre has been developing an autopsy database which stores information gathered from previous autopsies to be used as reference material for further work, thereby benefitting clients.

- Water reclamation utilising alternative, renewable and sustainable sources of water often employ membranes to achieve consistent product water quality and quantity. Therefore, a high emphasis is placed on the integrity of the membranes.
- Membrane autopsy is a useful technique for determining causes of fouling events in membrane systems as well as providing a broad overview of the membrane's condition. The type and extent of fouling on the membrane surface can also be evaluated.

- Fouling occurs in all membrane systems and the general operating principle is not how to eliminate fouling but how can it best be managed.
- When conducting an autopsy it is usually on the premise that the fouling management process has failed.
- The aim of the autopsy is to identify the root cause of the fouling event and provide some recommendation on how to correct or manage it.

Is there a problem with your membrane system? When should an autopsy be undertaken?

Problems associated with membrane systems:
- An observed loss in performance resulting in:
    - High permeate conductivity/ low rejection
    - High TMP
    - High ΔP
    - Decrease in product flux
    - Increased frequency of cleaning
- Other reasons:
    - End of trials
    - Long term effects of cleaning methods
    - System incident or mishap

Membrane Failure Tree
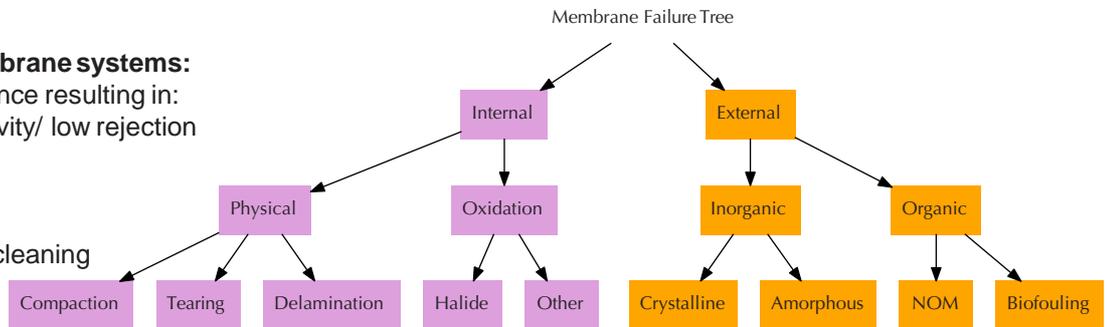
Autopsy Tools and Techniques

Standard membrane autopsy procedures:

1.Visual Inspection – examines the internal and external condition of the membrane

2.Loss-on Ignition (LOI) – determines the ratio of volatile and non-volatile components in the fouling material and provides a guide to the types of fouling present

3.Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES) and Dissolved Organic Carbon (DOC) – determines the soluble inorganic components from the fouling material and also the organic carbon content respectively. Provides further detail as to the identity and nature of the fouling material.

4.Scanning Electron Microscopy – X-ray Dispersive Spectroscopy (SEM-EDX) – examines the membrane surface at high magnification and will assist in identifying whether the fouling material is organic, inorganic or biofouling. It is particularly useful in identifying the types inorganic scale.

5.Fujiwara Analysis – is a colorimetric method to determine if the membrane has been damaged by the presence of halides, in particular chlorine.

Severely fouled MBR MF hollow fibre.

Amorphous Calcium inorganic scales.

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