Autopsy Description

During the course of an element autopsy, many evaluations and examinations are performed to identify:

1. Manufacturing defects
2. Active and inactive membrane area
3. Damage to the membrane and structural components
4. Fouling & scaling
5. Flow restrictions

To help you understand an autopsy procedure, the following photos and descriptions are provided:

1.	To determine the quality of membrane element manufacture and identify any manufacturing defects, we examine and evaluate the:	
	A. Fiberglass outer wrap (Shell)	Photo 1
	B. Anti-Telescoping Device (ATD) on each end	Photo 1
	C. Brine seal	Photo 1
	D. Glue lines	Figure 1 & Photo 2
2.	We calculate the Total Active Membrane Area.	Photo 2
3.	We document any damage to the element incurred during operation and/or shipping.	Photo 3
4.	Fouling	Photo 4
5.	Scaling	Photo 5
6.	Membrane Damage	Photo 6
7.	Flow pattern through the element.	Photo 7

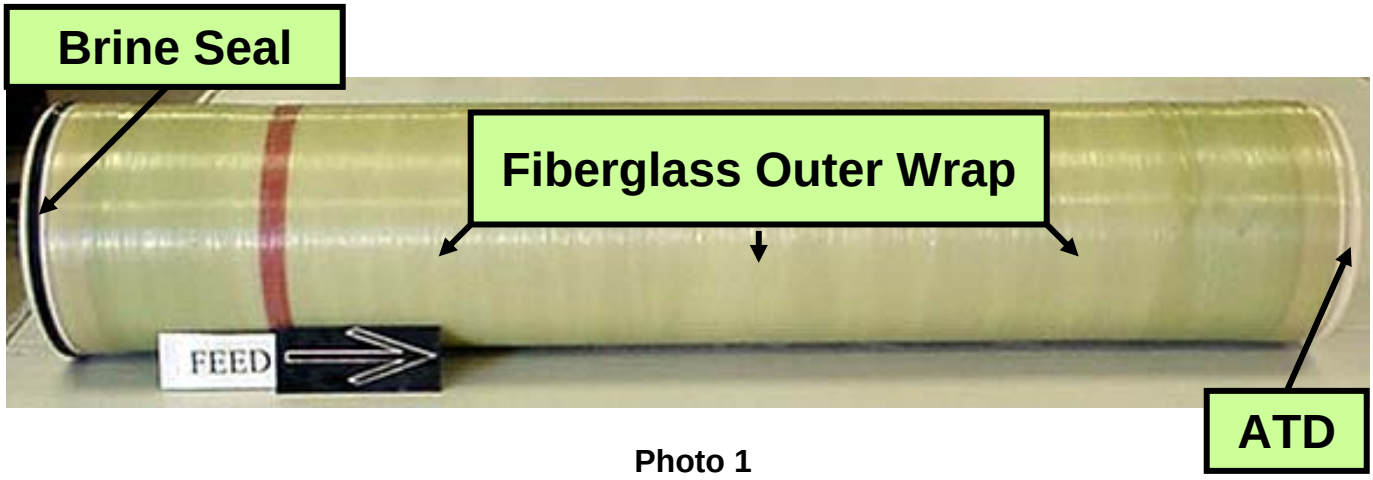

Photo 1

Autopsy Description

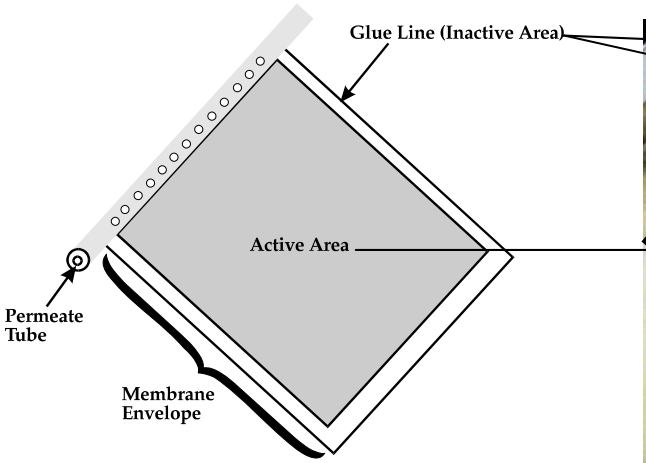

Figure 1

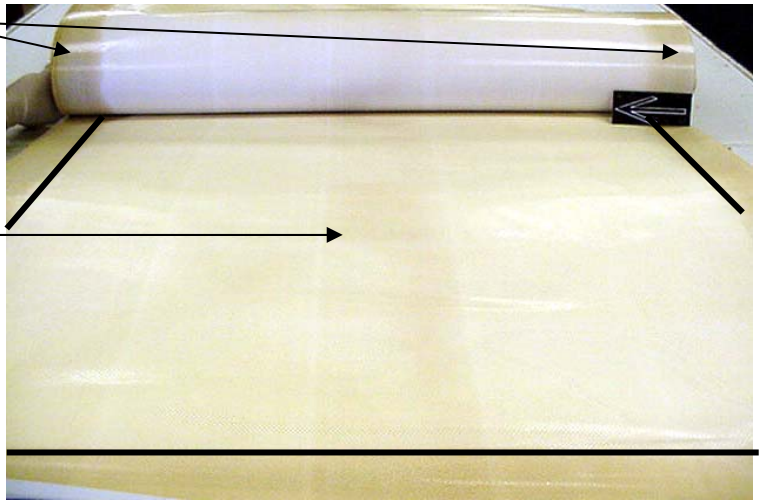

Photo 2

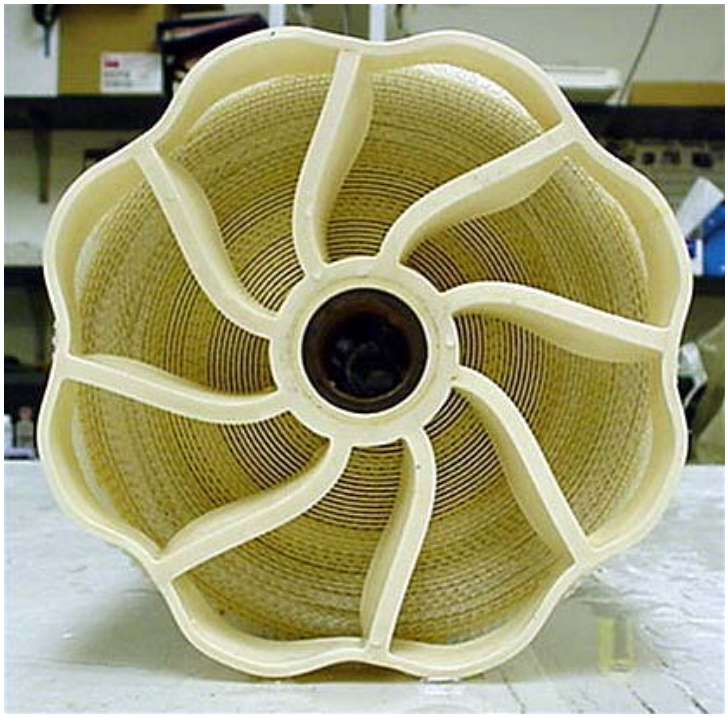

Photo 3

Autopsy Description

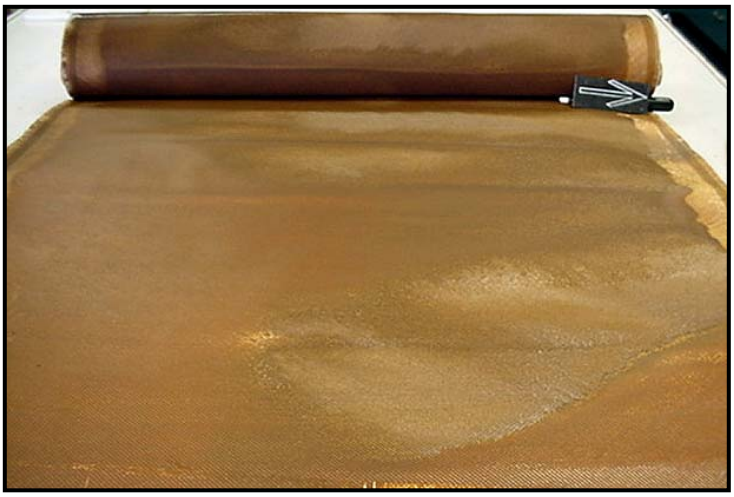

Photo 4

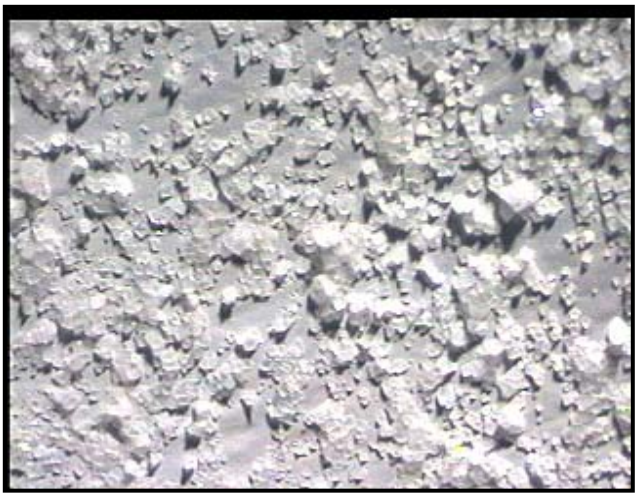

Photo 5

Photo 6

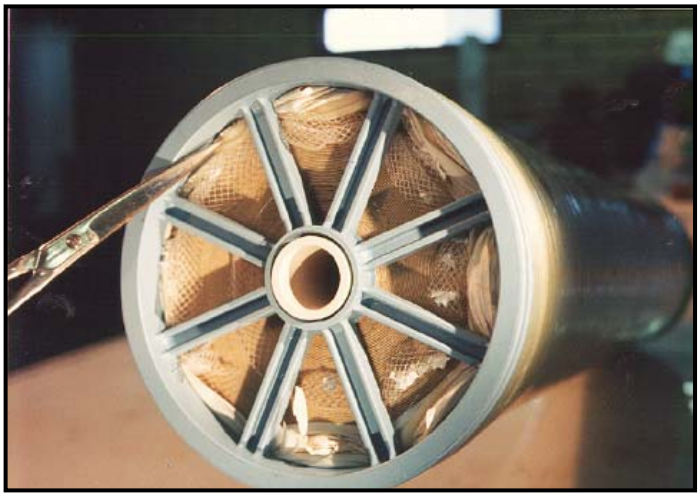

Photo 7

Autopsy Description

A DHP autopsy of a membrane element consists of the following steps:

A. Obtain background information on the conditions under which the element was operated.

B. Examination of the shipping container for damage incurred during shipment.

C. Examination of the external construction of the element for damage incurred during operation and/or shipping, including the fiberglass shell, ATDs, and brine seal.

D. Examination of the feed and concentrate ends of the element before and after removal of the ATDs.

E. Removal of the fiberglass shell.

F. Preservation of samples for further testing if necessary.

G. Examination of each individual membrane sheet for evidence of channeling, fouling, and/or manufacturing defects.

H. Examination of glue lines.

I. Measurements of active membrane area, for comparison against the manufacturer's specifications.

J. Testing of three membrane samples, representing the feed, middle, and concentrate portions of the element, for determination of membrane damage.

K. Examination of the foulant and/or the scalant found on the membrane surface, including but not limited to, Gram Stain testing and subjecting a sample of the membrane to EDS and FTIR analysis.

L. Performance of additional, approved (by Client), tests as required to determine the cause of the problem. Additional tests such as Fugiwara (for chlorine damage), Scanning Electron Microscope (SEM) photos, foulant extraction studies, and other test as necessary. Any test or tests that are not listed in the proposal will incur an additional cost.

M. Preparation and submittal of around a 40-60 page autopsy "Final Report", which documents step-by-step the findings of the autopsy. This report includes one to two dozen photos of all external, internal and typical microscopic findings. A final "Statement of Results" summarizes the findings.

N. The autopsy report is written to act as a training document as well as a technical report.