CLEANING OF MICRO-AND ULTRAFILTRATION MEMBRANES WITH INFRASONIC BACKPULSING

by

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of

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Supervised by

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STELLENBOSCH

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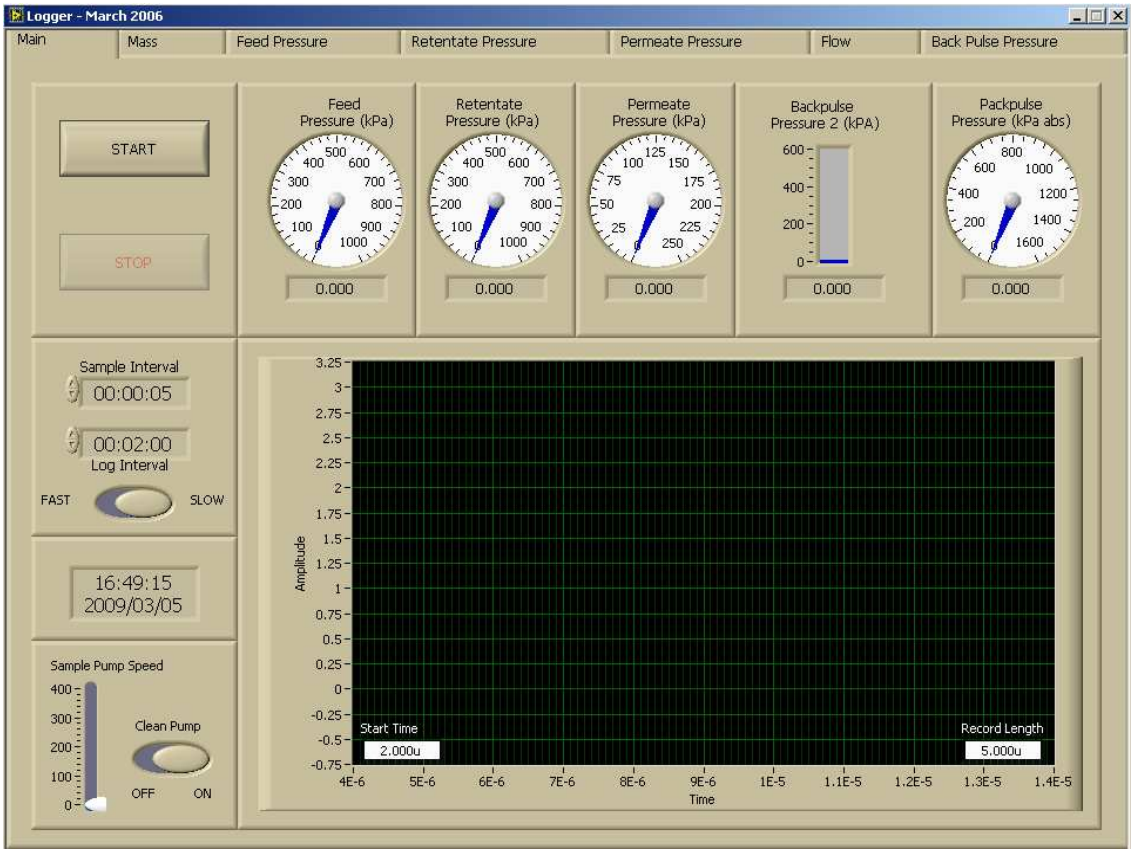
APPENDIX 1

SOFTWARE/PROGRAM

The LabView program can be opened using the Measurement Application shortcut icon in the windows desktop.

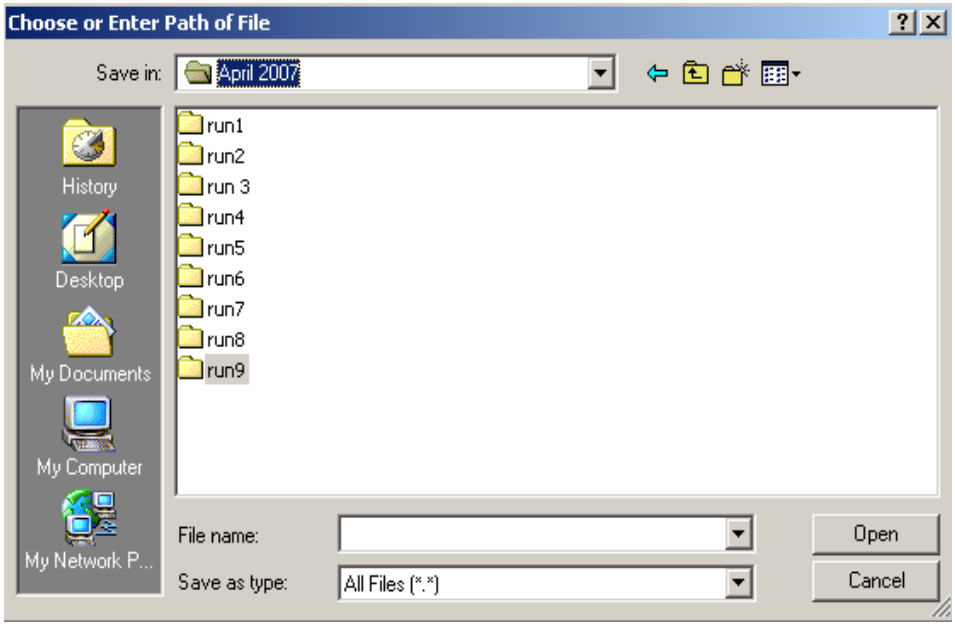
Measurement Application - August 2007.llb

The program will load and appear as illustrated below.

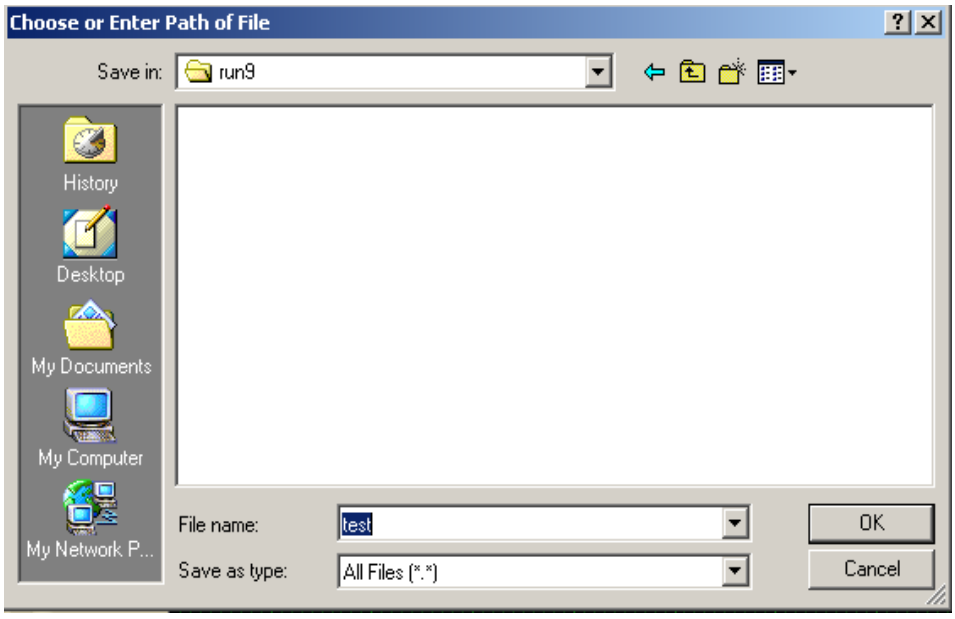


All measurements do not commence until the START button has been pressed and the file for data logging has been selected.

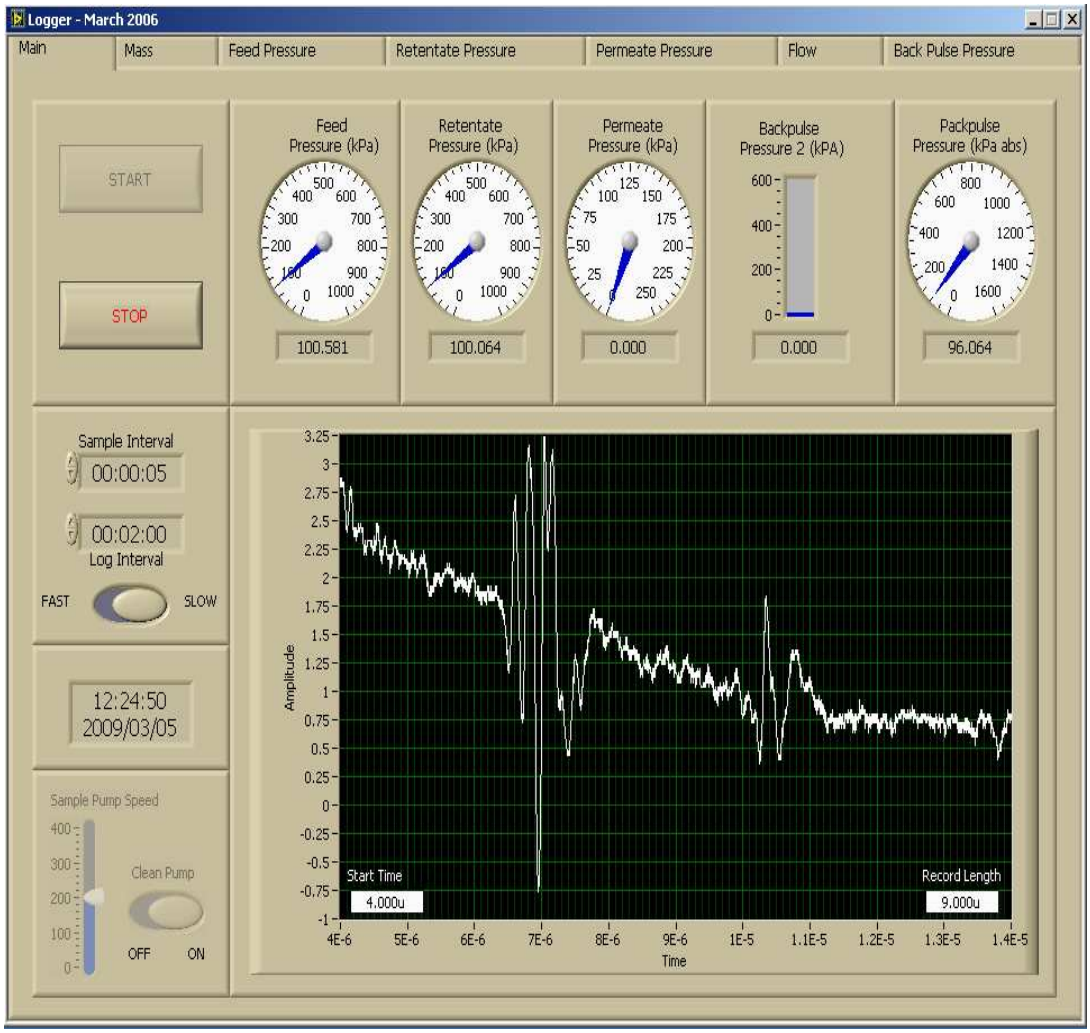
Press START button to begin with data logging. Choose or Enter Path of File dialog box will appear as shown below.



Create a folder and select the folder name for example, run9. Double click the created folder and the new dialog box will appear as shown below.

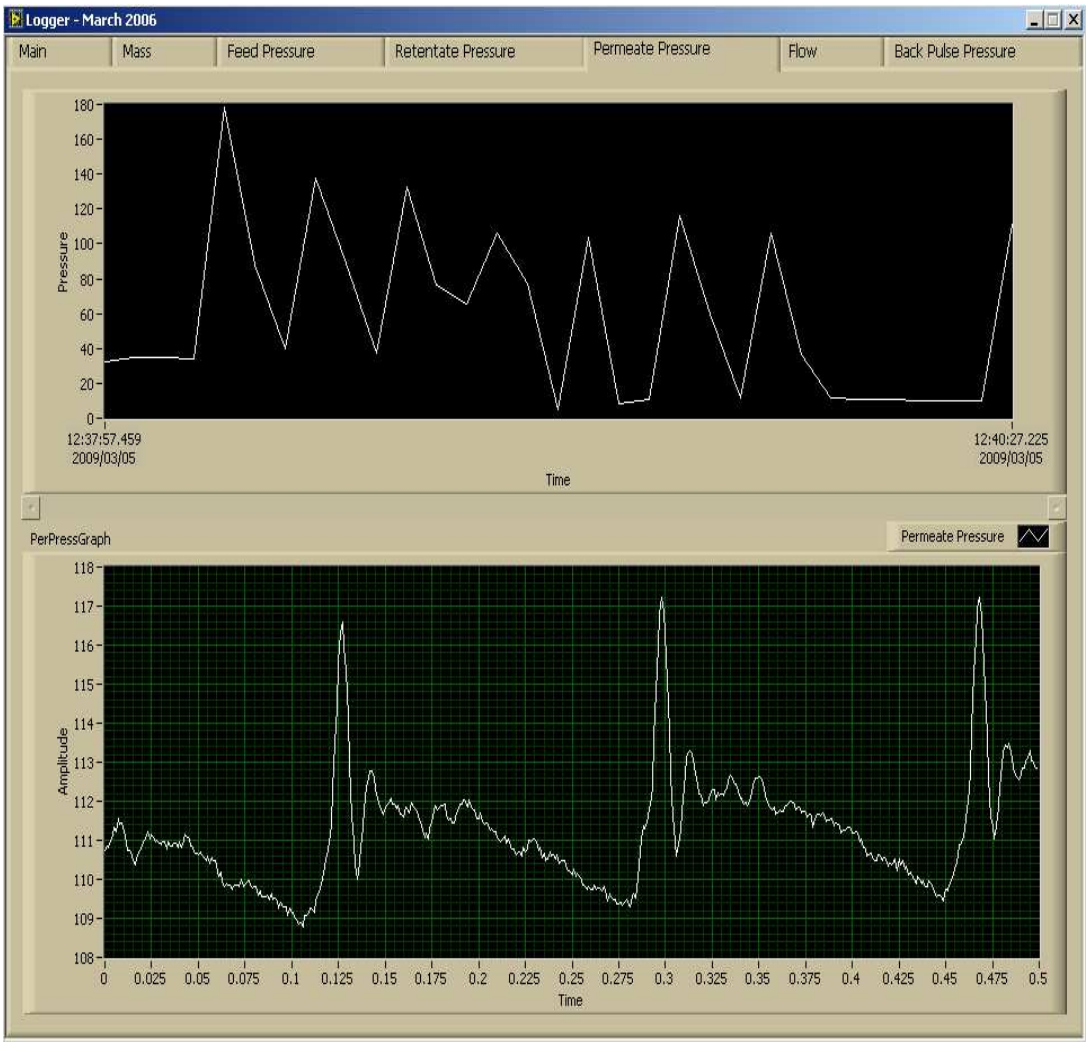


Select a name at file name. Click OK, the front panel will appear with the data displayed as below.



In the front panel display, there are mass flow, 4 pressure gauges (Feed, Retentate, Permeate and Backpulse pressure), 1 flow meter and Ultrasonic signal (Oscilloscope). The Sampling Interval and the data logging interval can be controlled from the time control buttons.

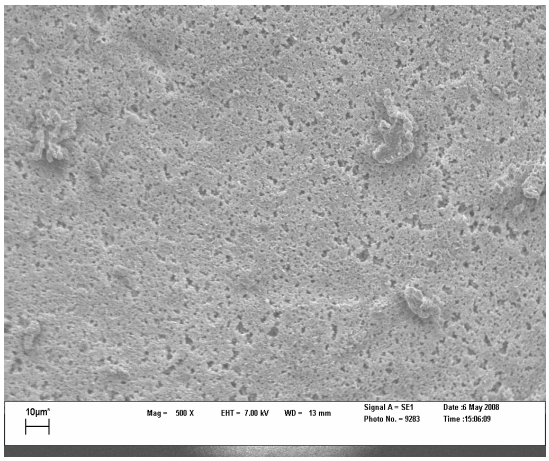
In order to see the Mass flow, Feed Pressure, Retentate Pressure, Permeate Pressure, Flow and Backpulsing Pressure changes and their Amplitude-Time graphs, press the corresponding tap. Example to see the changes. See illustration below.



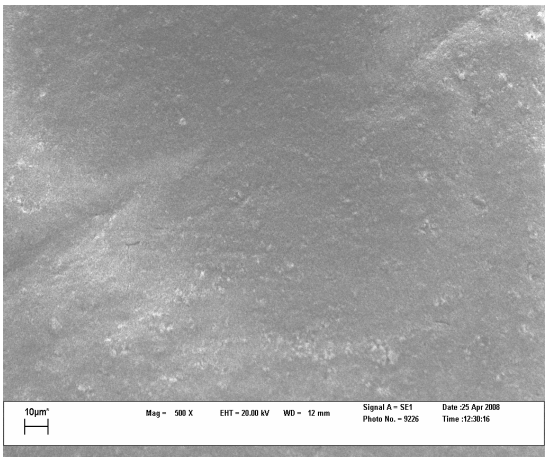
APPENDIX 2

SEM IMAGES (MAGNIFICATION 500X)

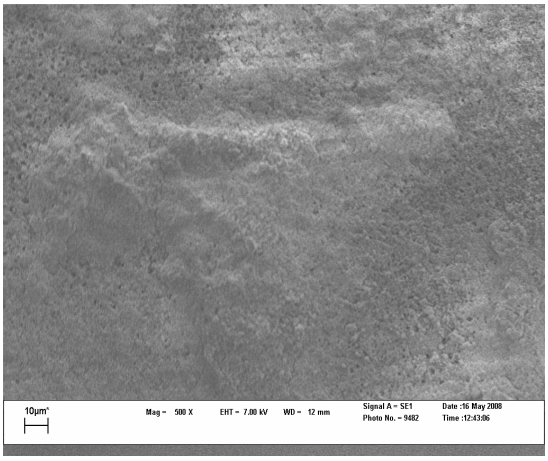
A2.1 SEM IMAGES OF THE BIODYNE A (AMPHOTERIC NYLON 6, 6) MEMBRANE /ALUMINA SYSTEM



(a)



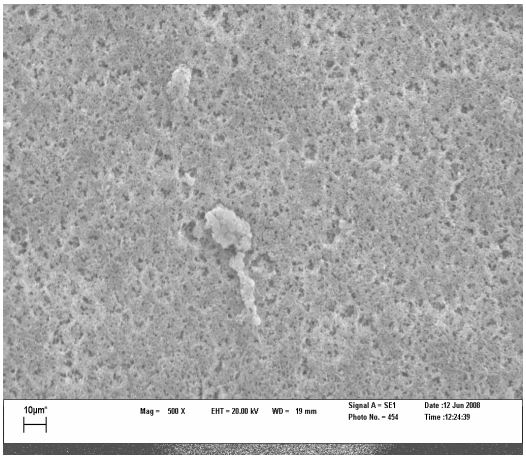
(b)



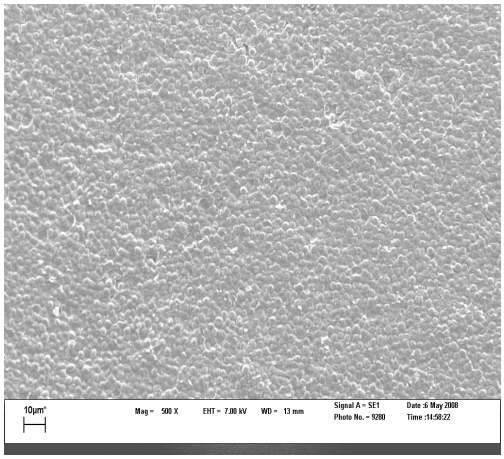
(c)

Figure A2.1 SEM images (magnification 500X) of the Biodyne A (amphoteric nylon 6, 6) 0.2 µm membrane /alumina system. (a) a new membrane surface, (b) a fouled (60 minute) surface, (c) surface cleaned by three successive pure water backpulses.

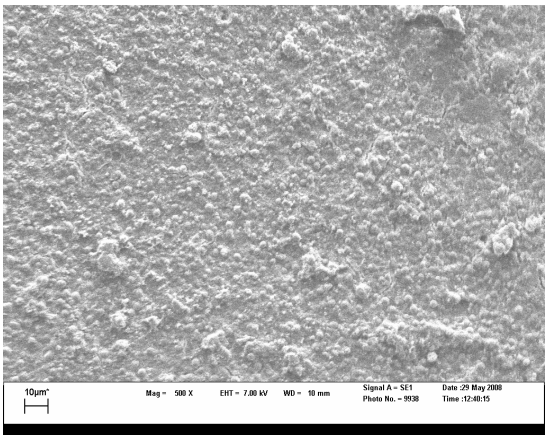
A2.2 SEM IMAGES OF THE BIODYNE A (AMPHOTERIC NYLON 6, 6) MEMBRANE /YEAST SYSTEM



(a)



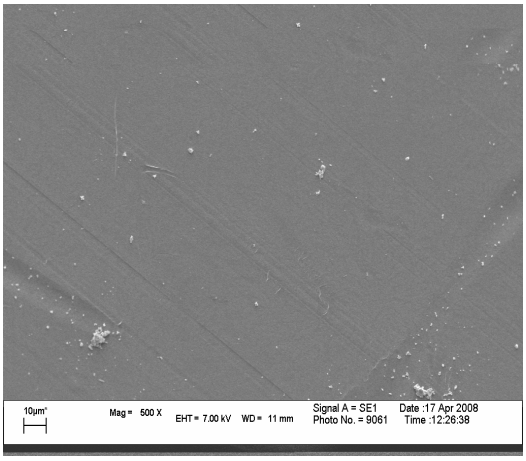
(b)



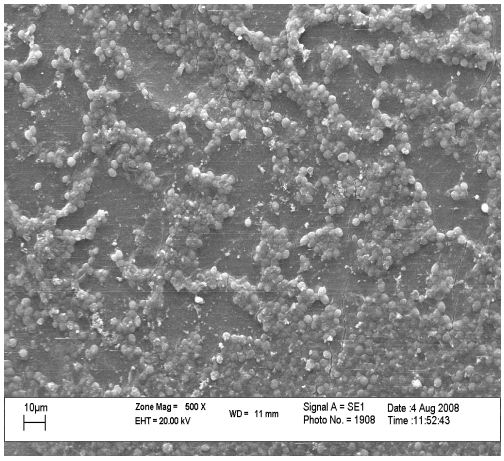
(c)

Figure A2.2 SEM images (magnification 500X) of the Biodyne A (amphoteric nylon 6, 6) 0.45 µm membrane /yeast system. (a) a new membrane surface, (b) a fouled (60 minute) surface, (c) surface cleaned by three successive pure water backpulses.

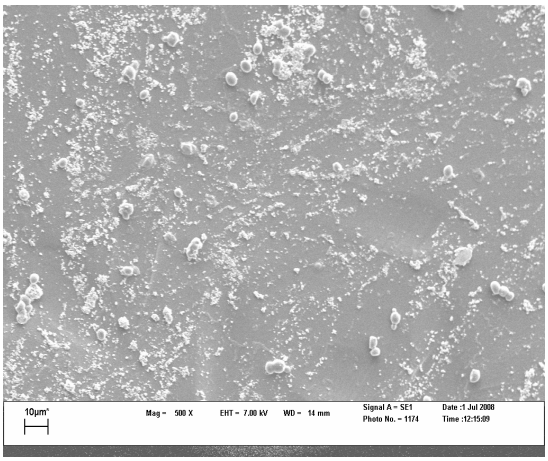
A2.3 SEM IMAGES OF THE PS MEMBRANE /YEAST SYSTEMS



(a)



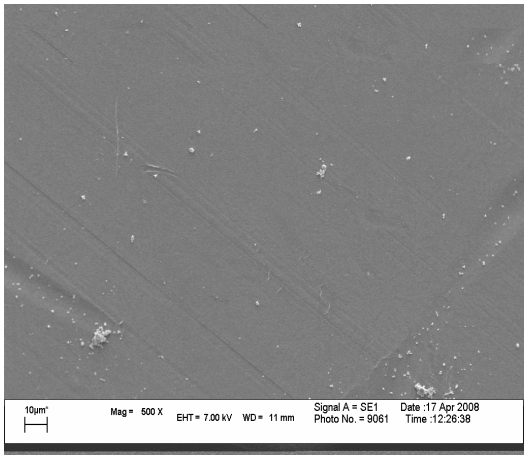
(b)



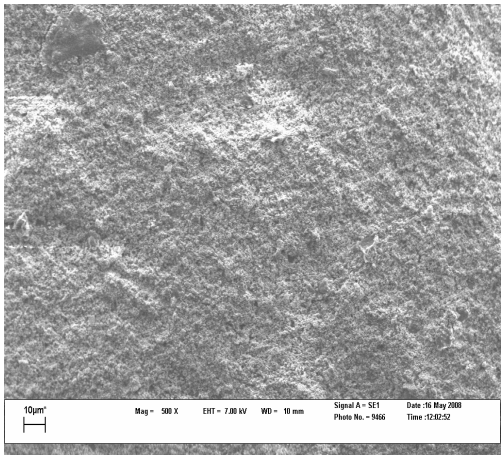
(c)

Figure A2.3 SEM images (magnification 500X) of the PS membrane /yeast systems. (a) a new membrane surface, (b) a fouled (60 minute) surface, (c) surface cleaned by three successive pure water backpulses.

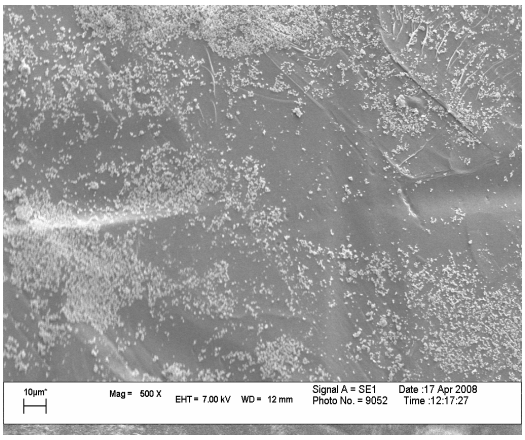
A2.4 SEM IMAGES OF THE PS MEMBRANE /DEXTRIN SYSTEMS



(a)



(b)



(c)

Figure A2.4 SEM images (magnification 500X) of the PS membrane /dextrin systems. (a) a new membrane surface, (b) a fouled (60 minute) surface, (c) surface cleaned by three successive pure water backpulses.

APPENDIX 3

DEFOULING EXPERIMENTS WHEN THE SECOND PULSE INCLUDED USE OF A SOAP SOLUTION

These experiments in this appendix were carried out using F9 soap solution and the results of these experiments are summarized in Table 5.6

A3.1 FOULING WITH AN ALUMINA SUSPENSION IN A MF SYSTEM

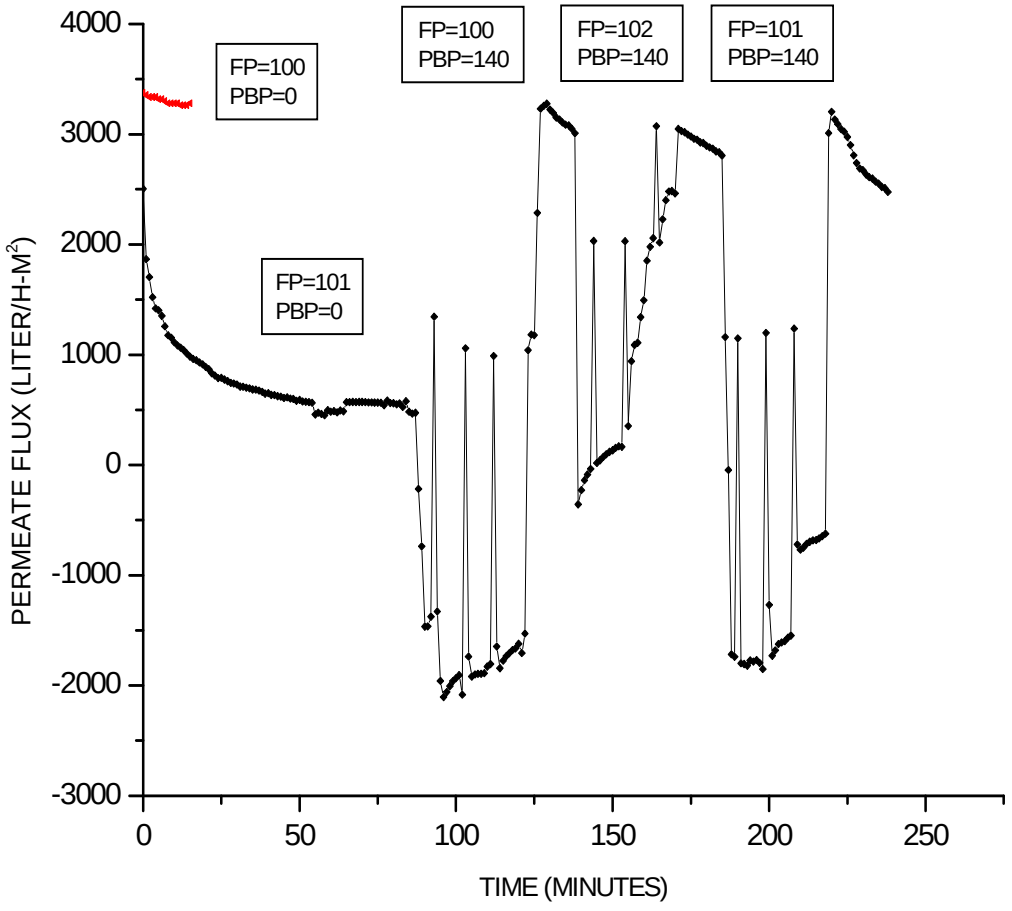


Figure A3.1 Flux against time for the Biodyne A (amphoteric nylon 6, 6) 0.2 μm membrane /alumina system (second backpulsing with F9 soap solution).

A3.2 FOULING WITH A YEAST SUSPENSION IN A MF SYSTEM

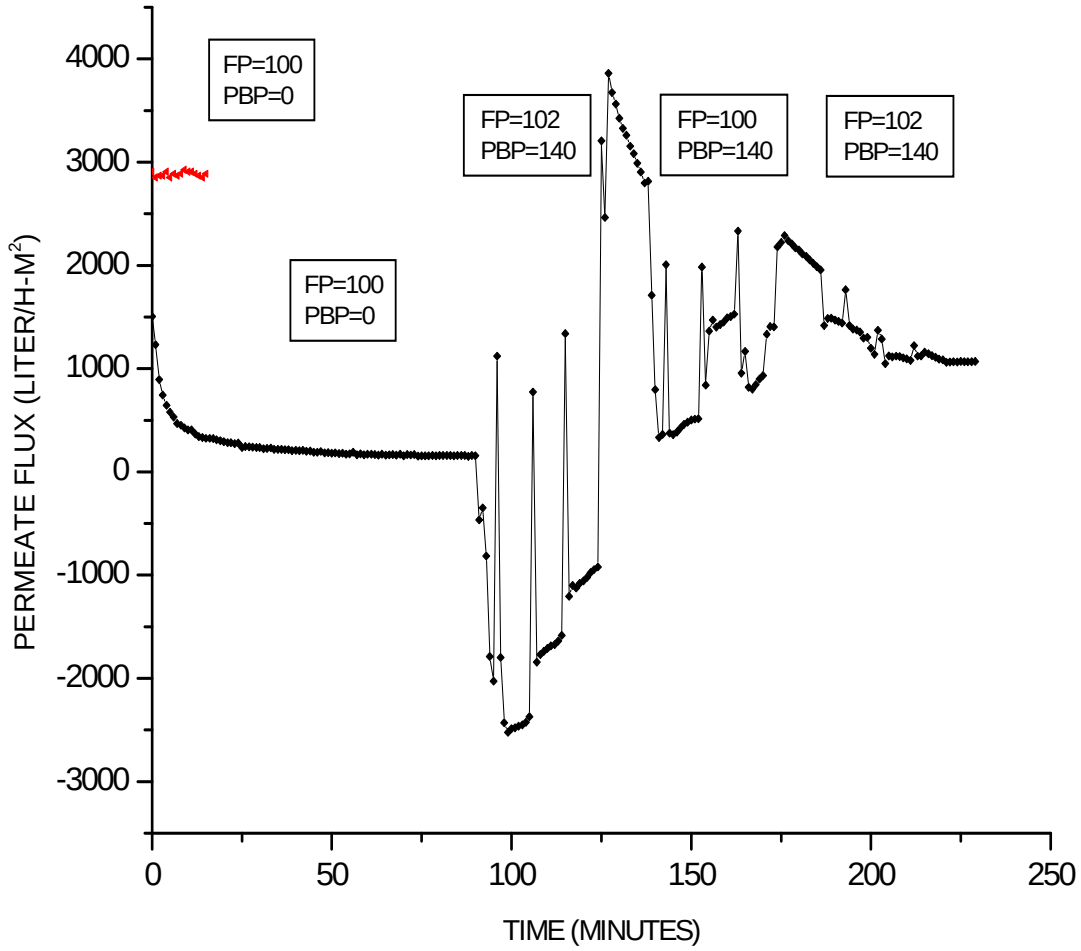


Figure A3.2 Flux against time for the Biodyne A (amphoteric nylon 6, 6) 0.45 μm membrane /yeast system (second backpulsing with F9 soap solution).

A3.3 FOULING WITH A YEAST SUSPENSION IN A UF SYSTEM

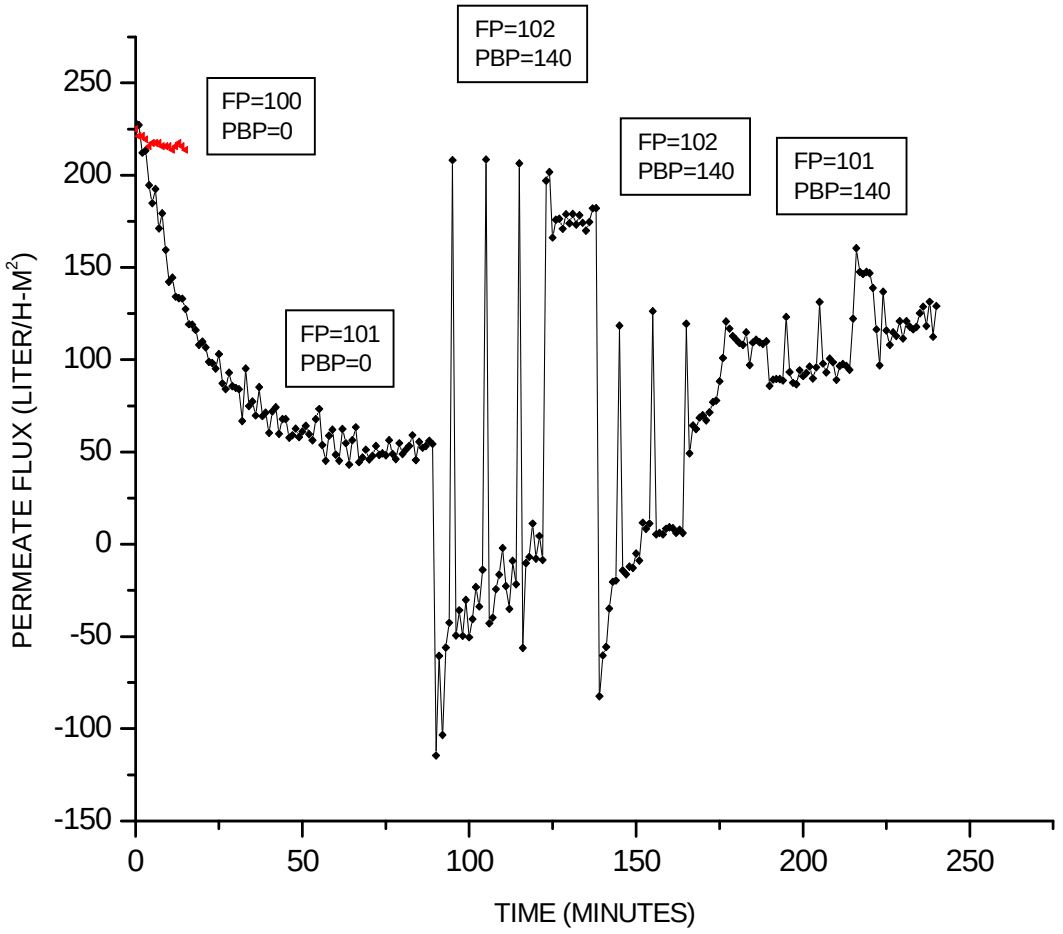


Figure A3.3 Flux against time for the PS membrane /yeast system (second backpulsing with F9 soap solution).

A3.4 FOULING WITH A DEXTRIN SUSPENSION IN A UF SYSTEM

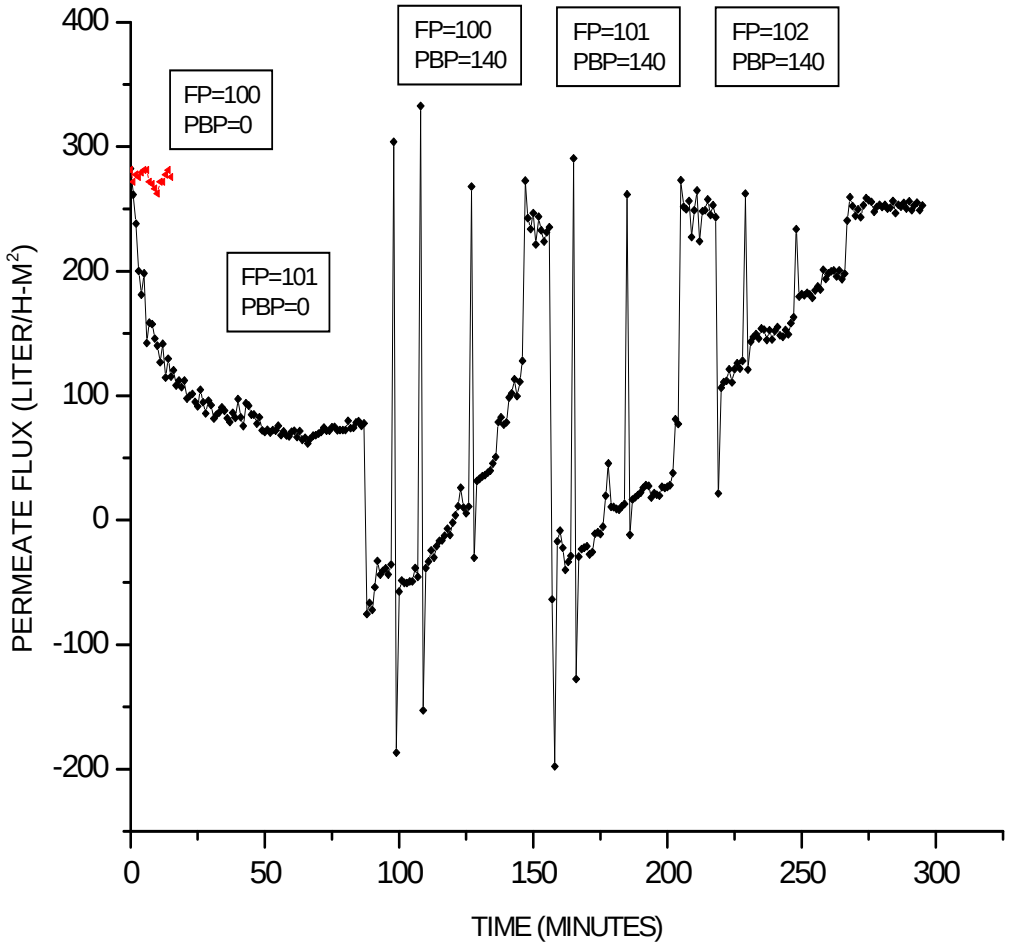


Figure A3.4 Flux against time for the PS membrane /dextrin system (second backpulsing with F9 soap solution).

APPENDIX 4

ULTRASONIC MEASUREMENTS WHEN THE SECOND BACKPULSE WAS A SOAP SOLUTION

A4.1 SES SOLUTION

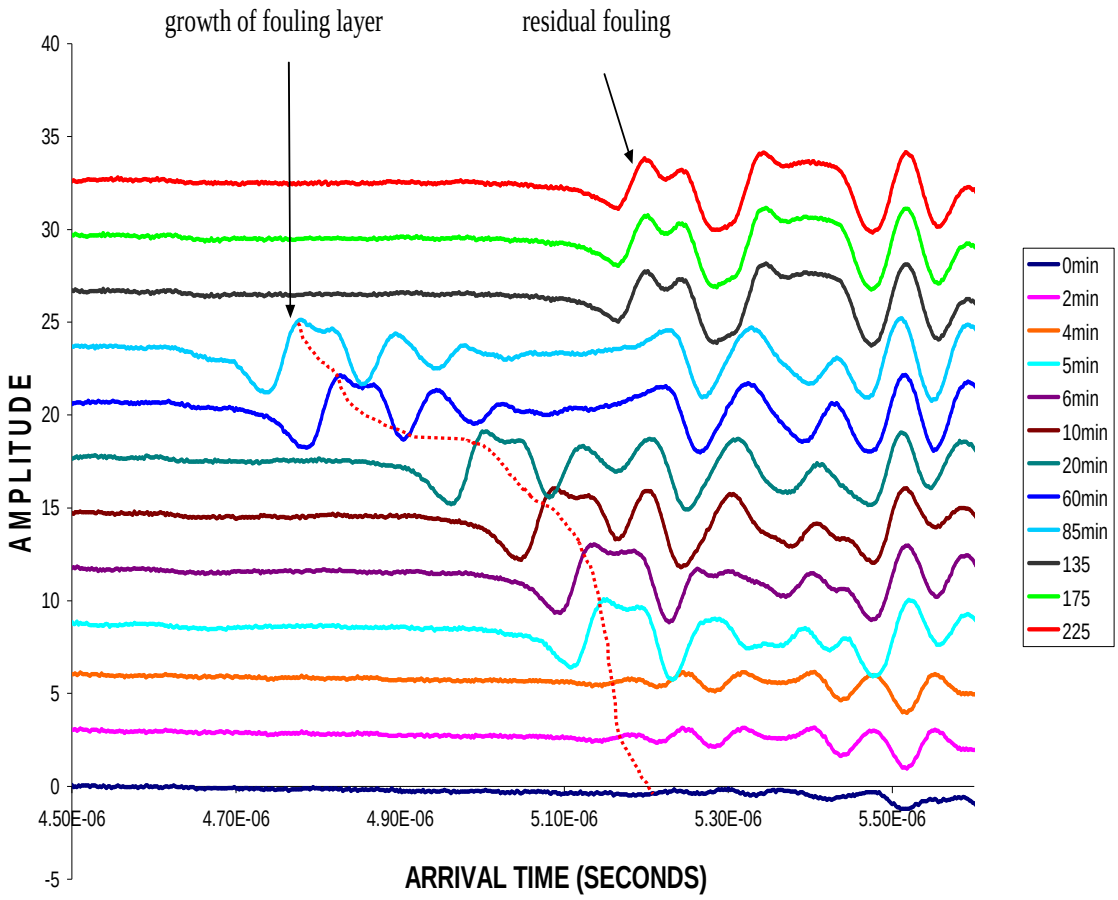


Figure A4.1.1 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.2 μm membrane/alumina system (second backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

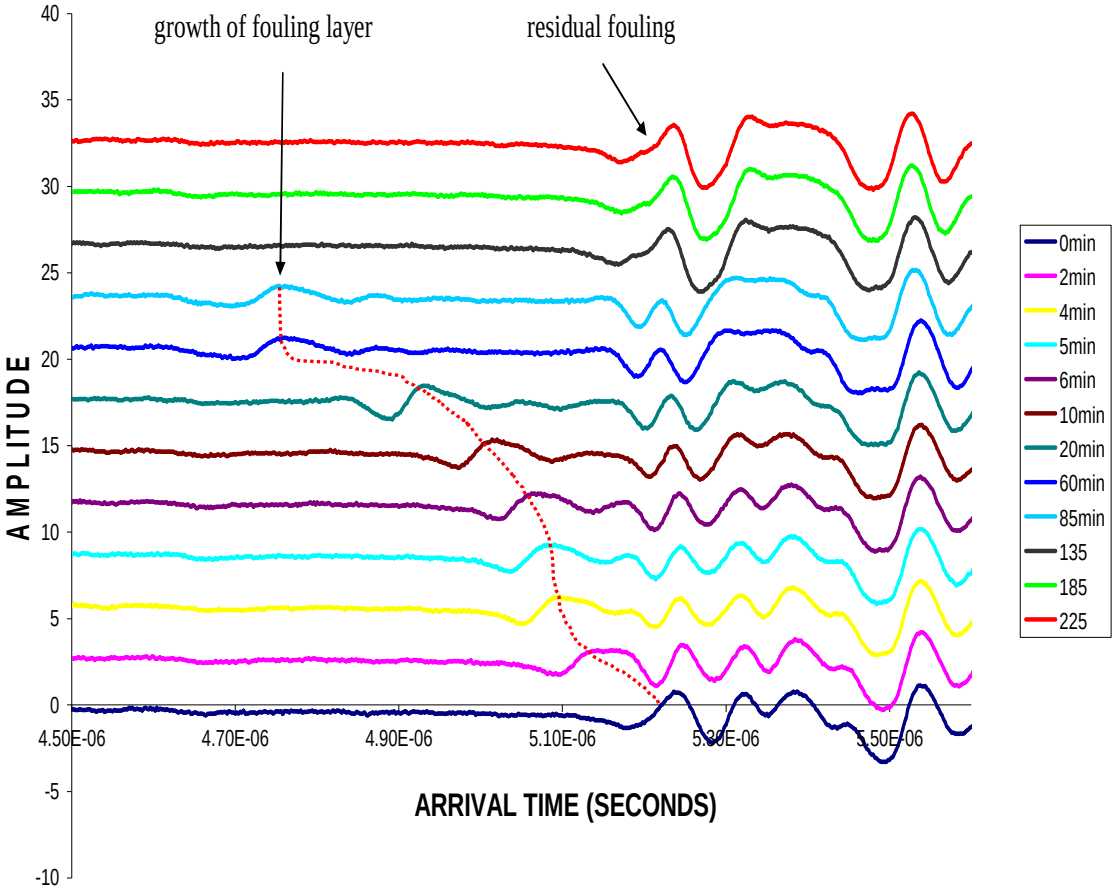


Figure A4.1.2 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.45 μm membrane/yeast system (second backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

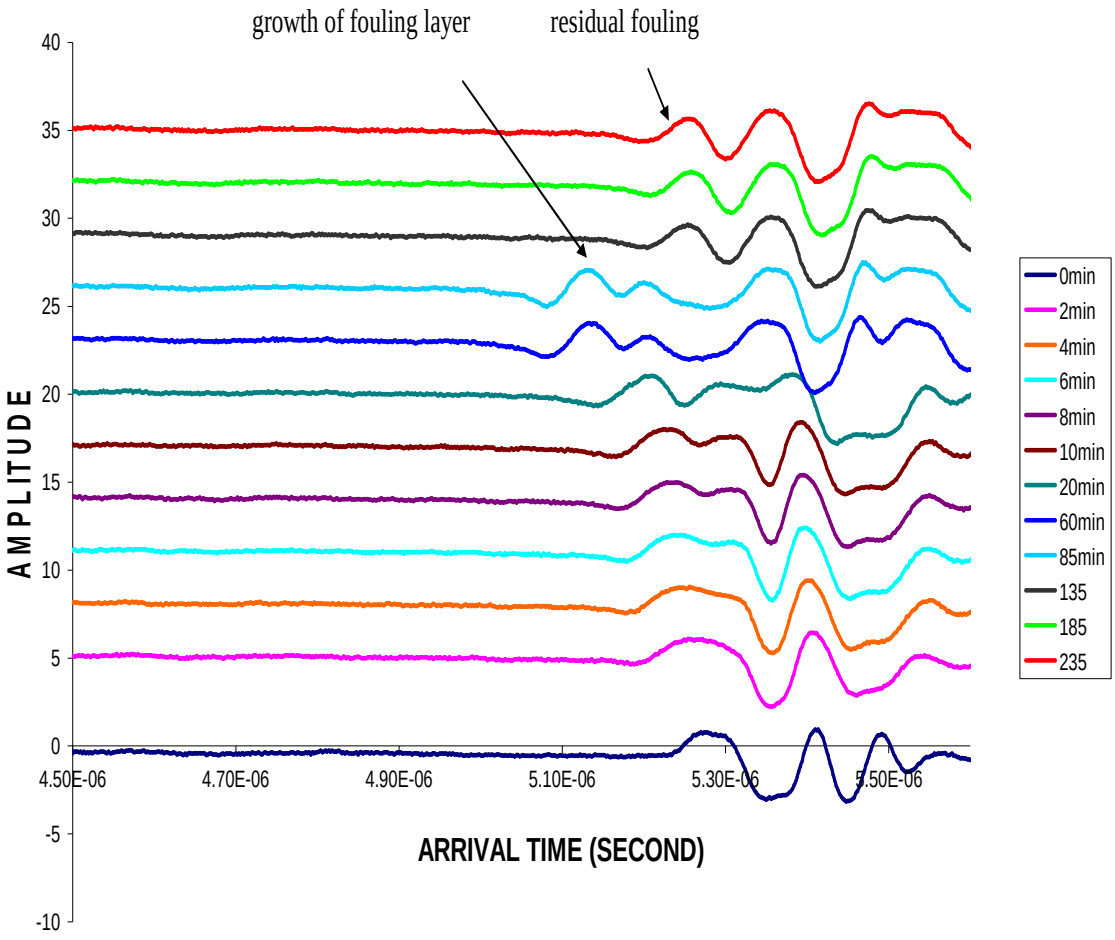


Figure A4.1.3 Amplitude of the reflection received at the detector as a function time, for the PS membrane/yeast system (second backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

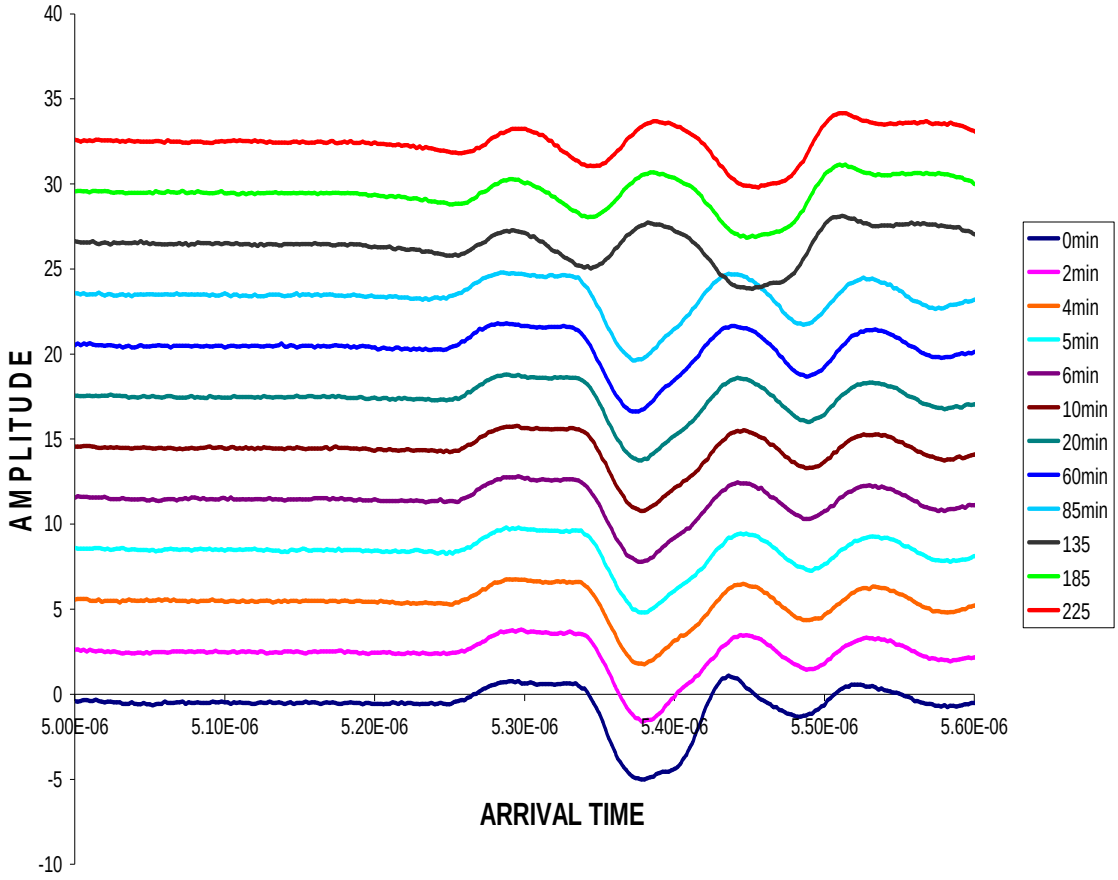


Figure A4.1.4 Amplitude of the reflection received at the detector as a function time, for the PS membrane/dextrin system (second backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

A4.2 F9 SOLUTION

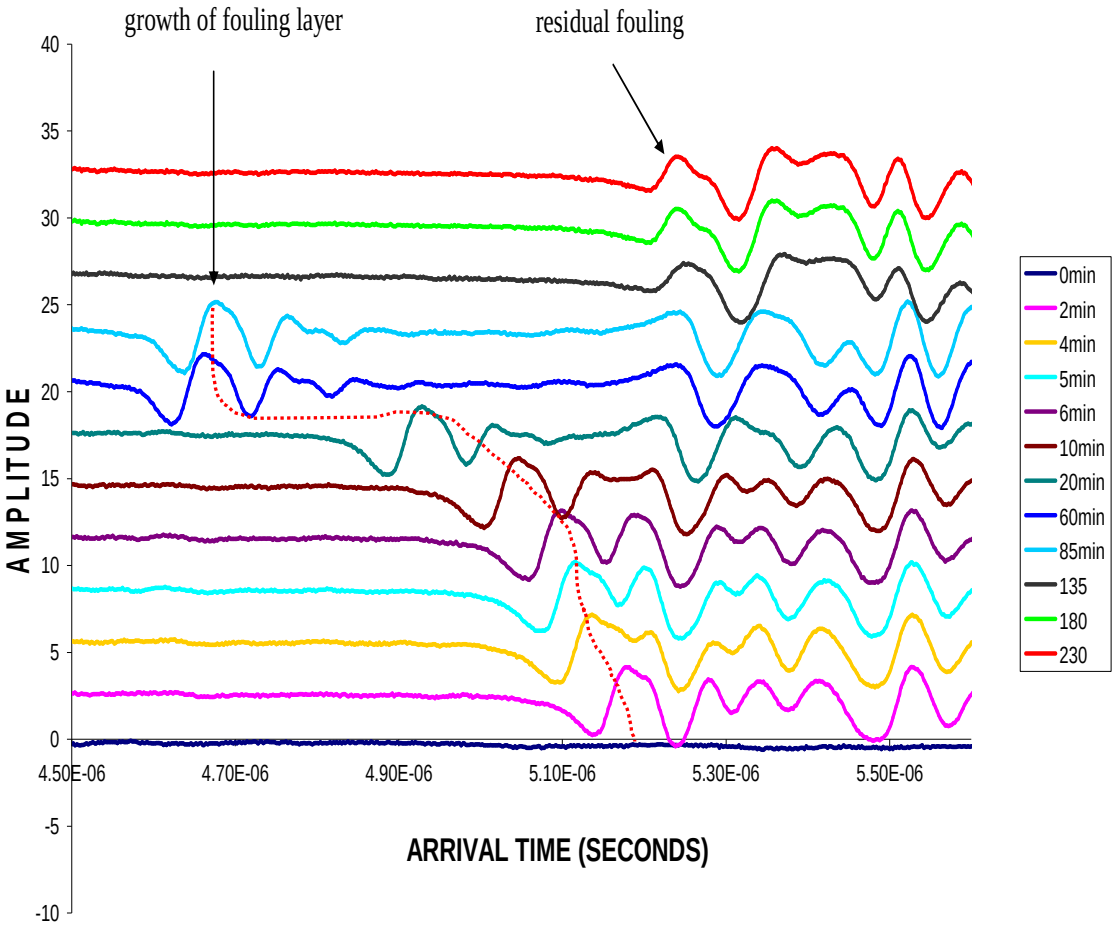


Figure A4.2.1 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.2 μm membrane/alumina system (second backpulsing with F9 solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

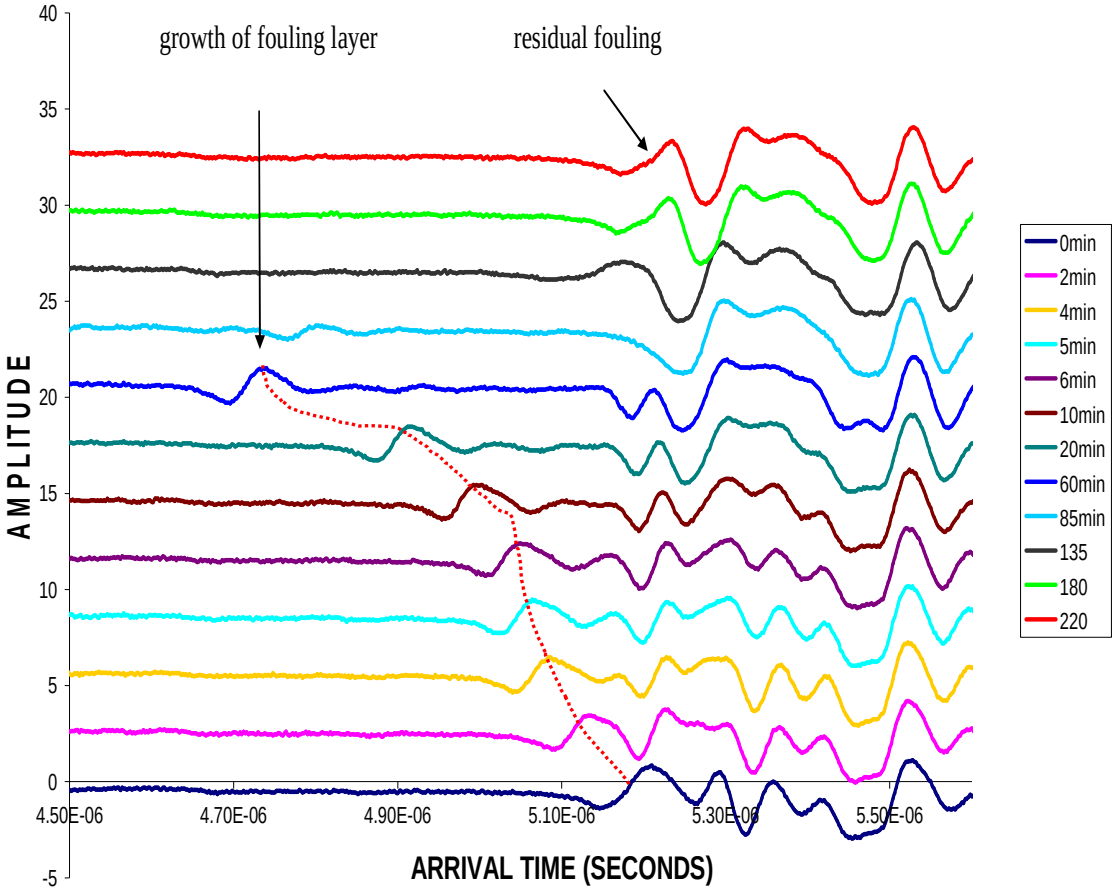


Figure A4.2.2 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.45 μm membrane/yeast system (second backpulsing with F9 solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

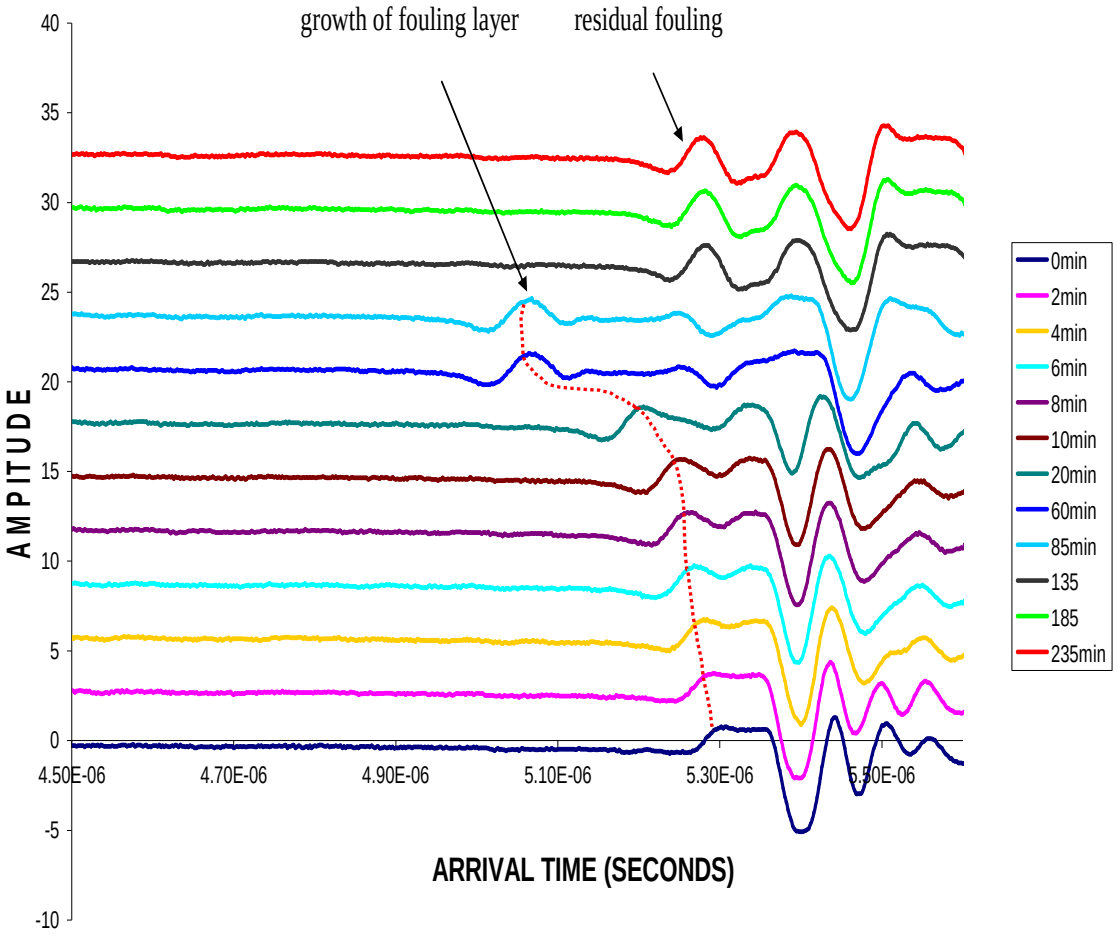


Figure A4.2.3 Amplitude of the reflection received at the detector as a function time, for the PS membrane/yeast system (second backpulsing with F9 solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

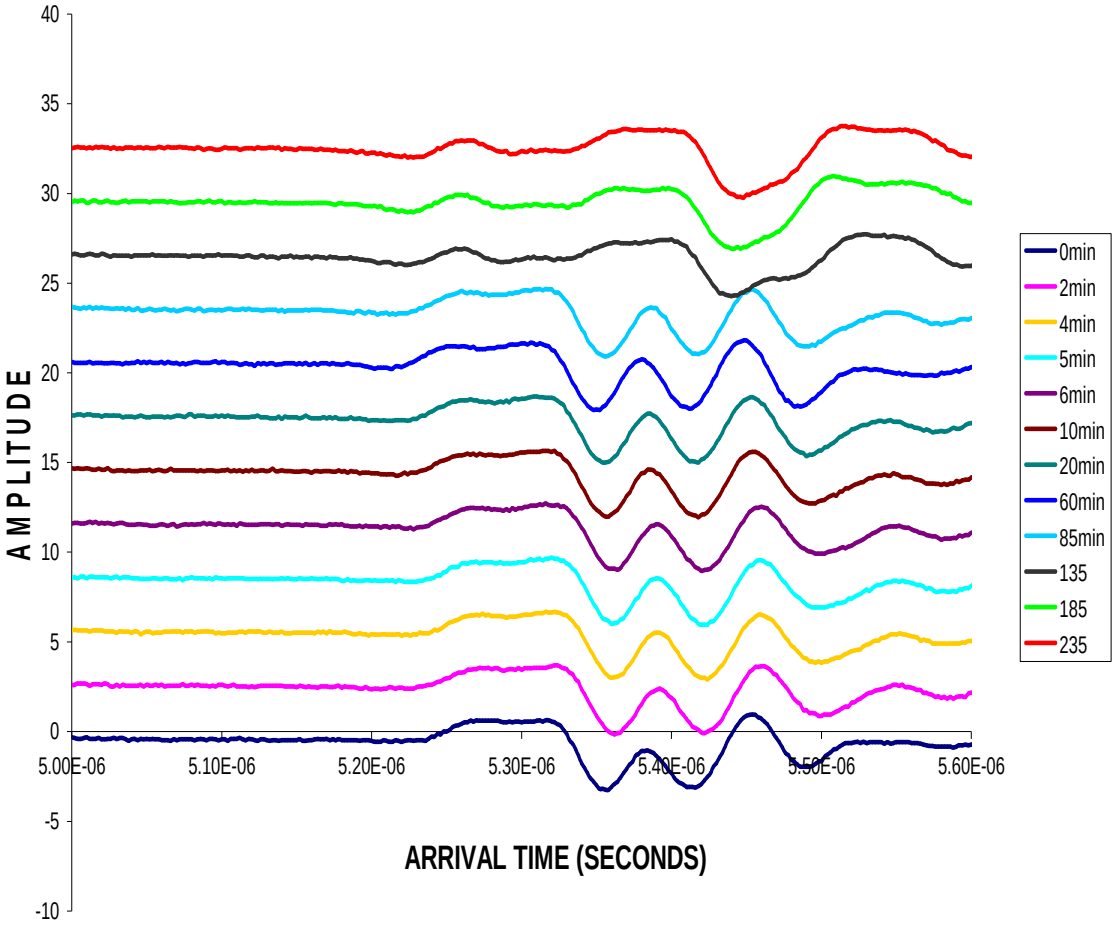


Figure A4.2.4 Amplitude of the reflection received at the detector as a function time, for the PS membrane/dextrin system (second backpulsing with F9 solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

APPENDIX 5

DEFOULING EXPERIMENTS WHEN THE FIRST BACKPULSE WAS A SOAP SOLUTION

Comments on these results are made in Section 5.7.

A5.1 FOULING WITH AN ALUMINA SUSPENSION IN A MF SYSTEM

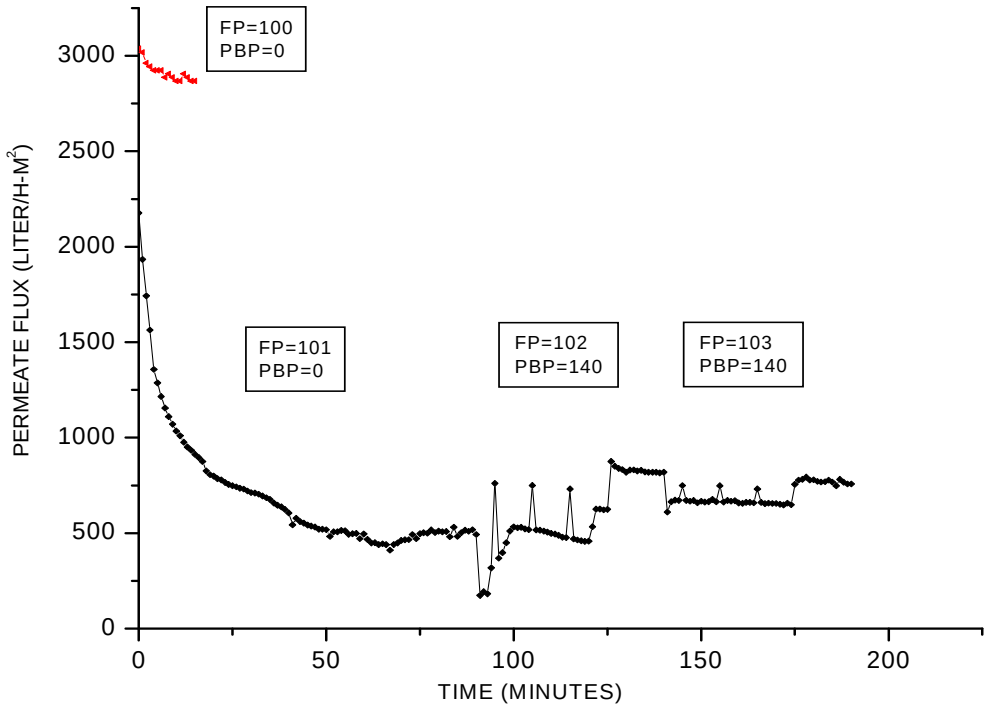


Figure A5.1 Flux against time for the Biodyne A (amphoteric nylon 6, 6) 0.2 μm membrane /alumina system (first backpulsing with SES soap solution).

A5.2 FOULING WITH A YEAST SUSPENSION IN A MF SYSTEM

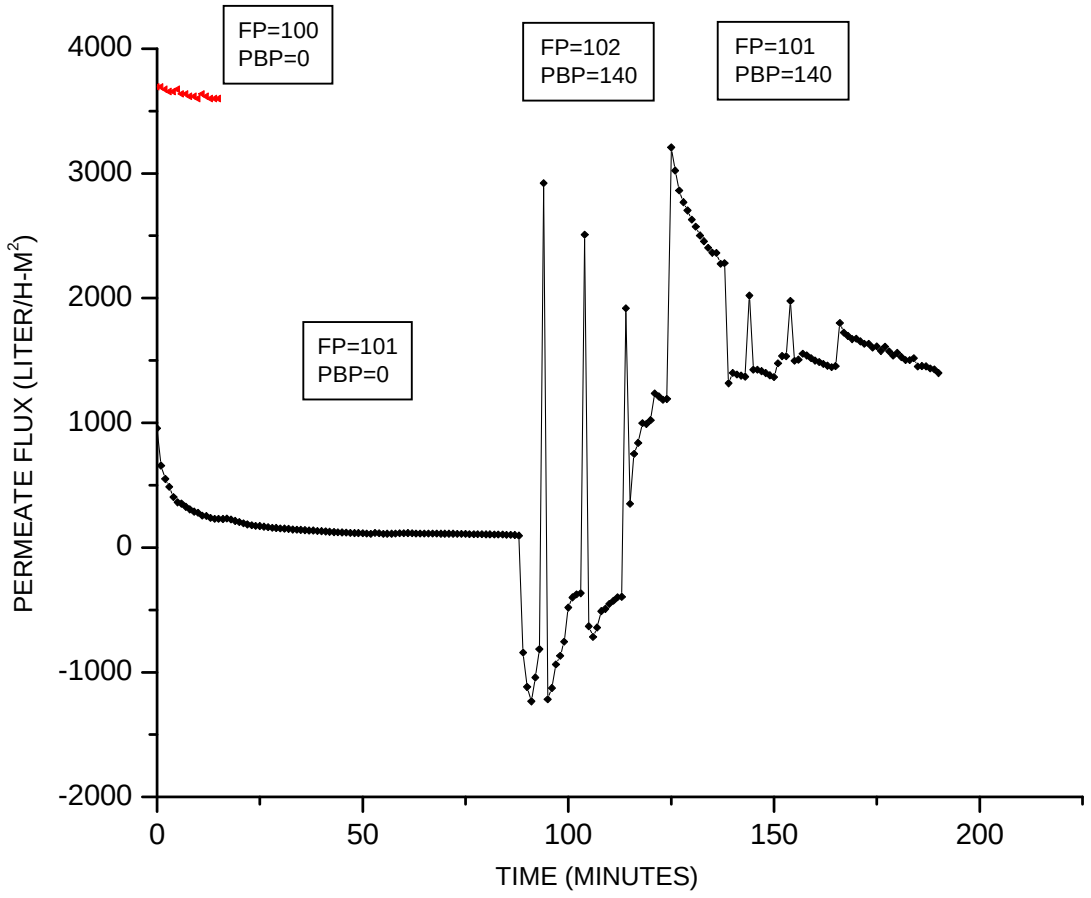


Figure A5.2 Flux against time for the Biodyne A (amphoteric nylon 6, 6) 0.45 μm membrane /yeast system (first backpulsing with SES soap solution).

A5.3 FOULING WITH A YEAST SUSPENSION IN A UF SYSTEM

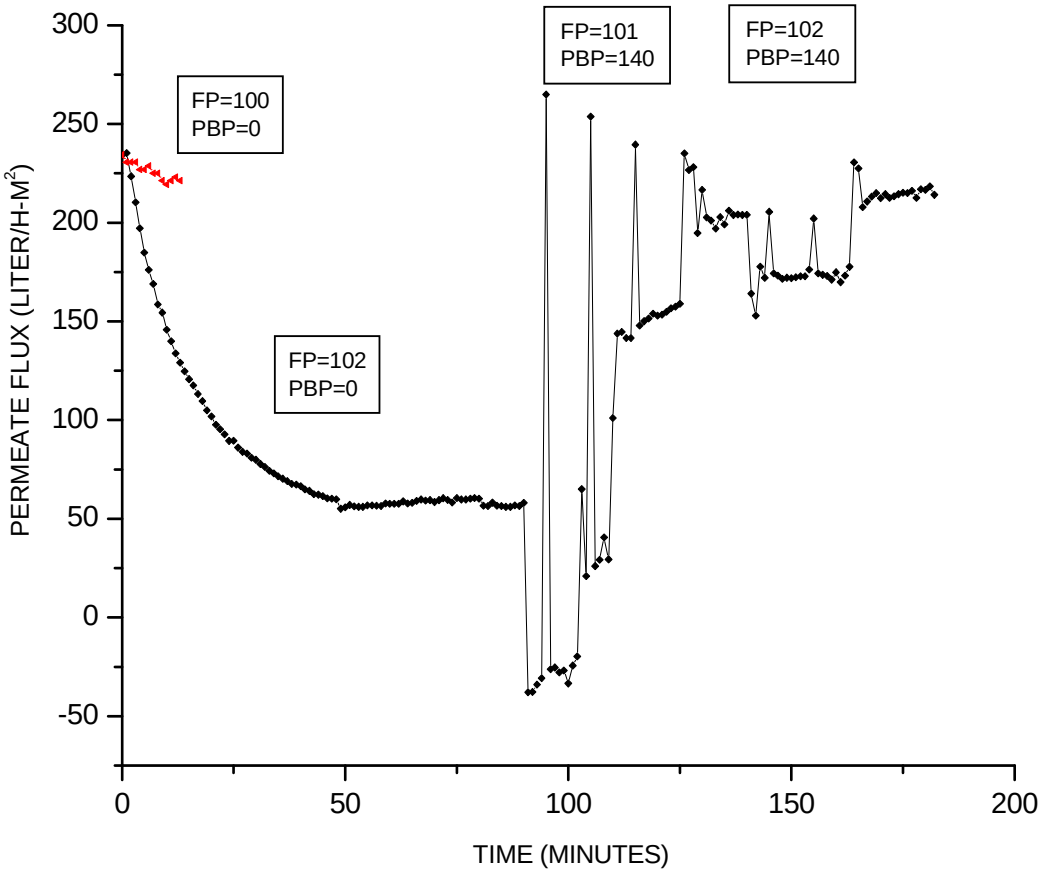


Figure A5.3 Flux against time for the PS membrane /yeast system (first backpulsing with SES soap solution).

A5.4 FOULING WITH A DEXTRIN SUSPENSION IN A UF SYSTEM

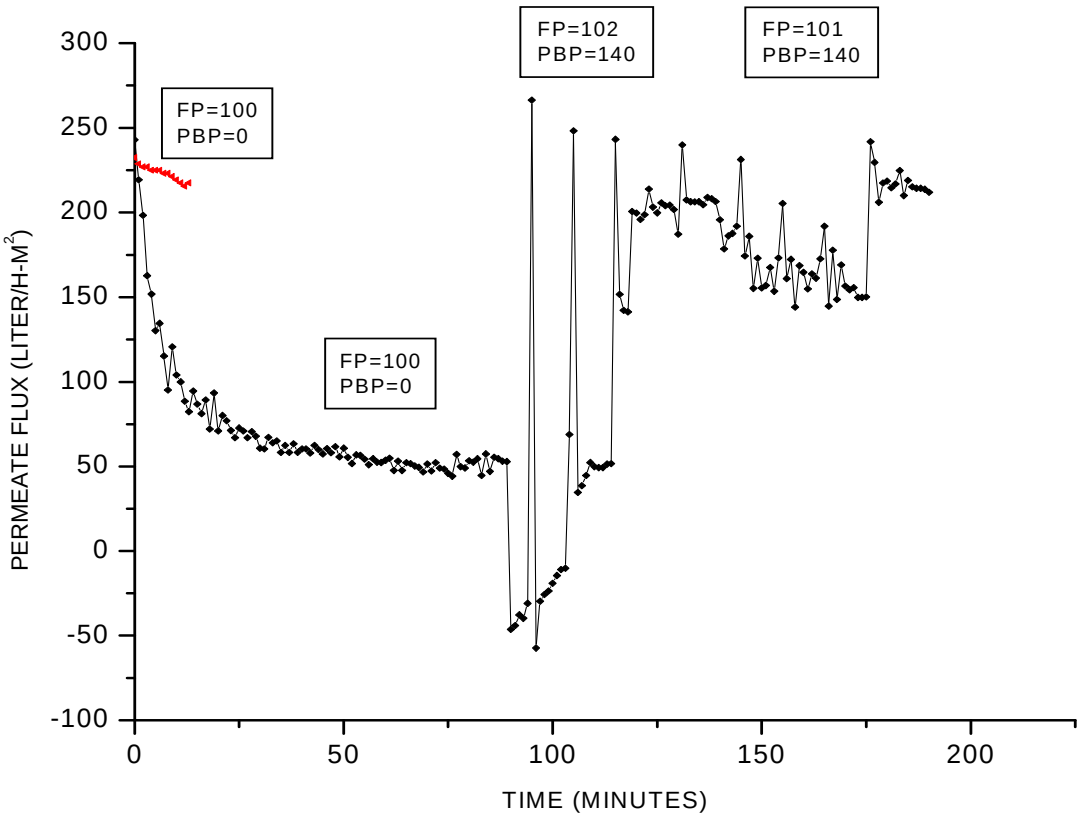


Figure A5.4 Flux against time for the PS membrane /dextrin system (first backpulsing with SES soap solution).

APPENDIX 6

ULTRASONIC MEASUREMENTS WHEN THE FIRST BACKPULSE INCLUDED USE OF A SOAP SOLUTION

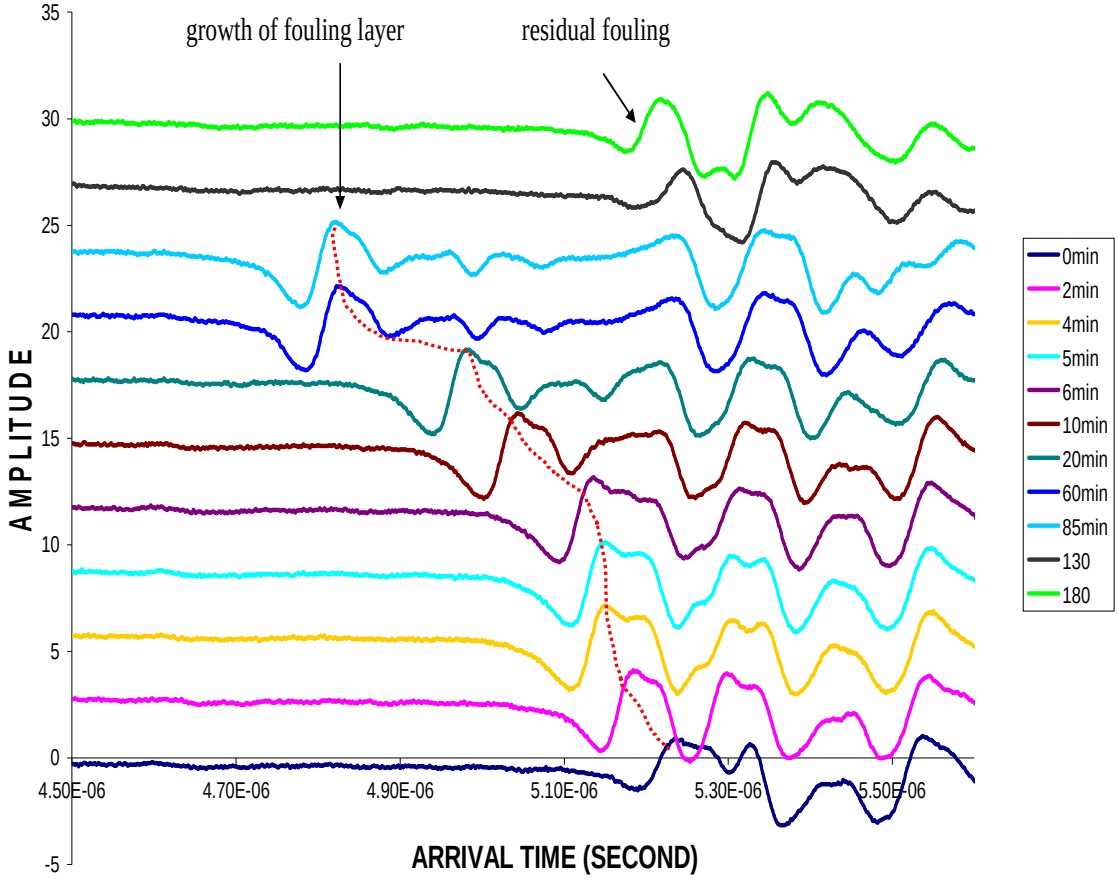


Figure A6.1 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.2 μm membrane/alumina system (backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

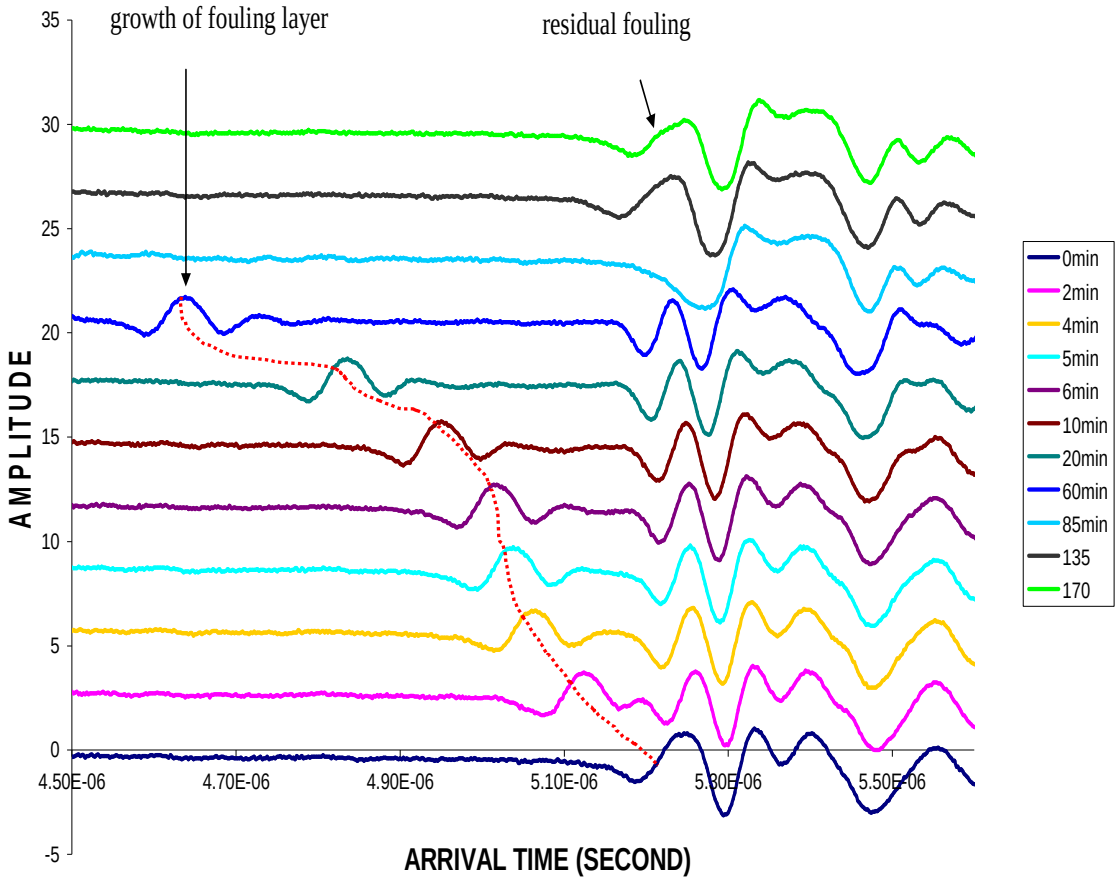


Figure A6.2 Amplitude of the reflection received at the detector as a function time, for the Biodyne A (amphoteric nylon 6, 6) 0.45 μm membrane/yeast system (backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

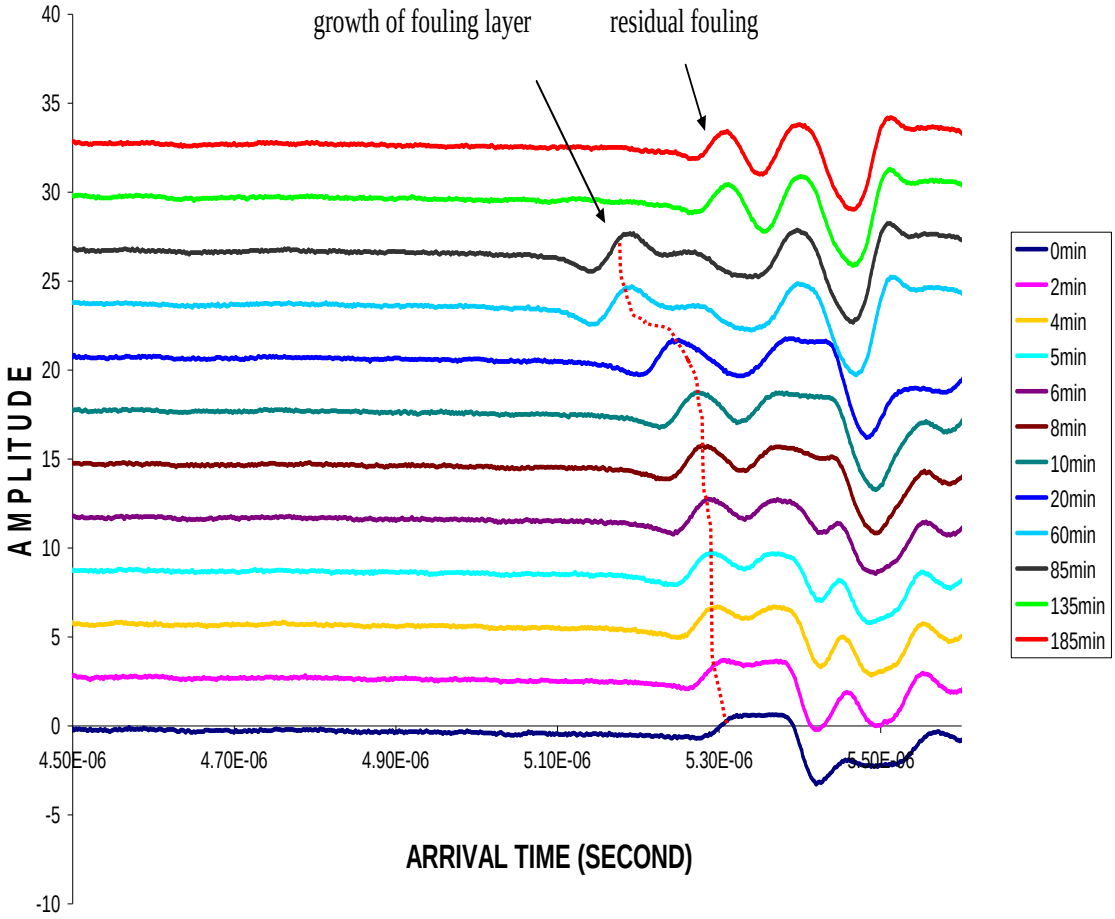


Figure A6.3 Amplitude of the reflection received at the detector as a function time, for the PS membrane/yeast system (backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.

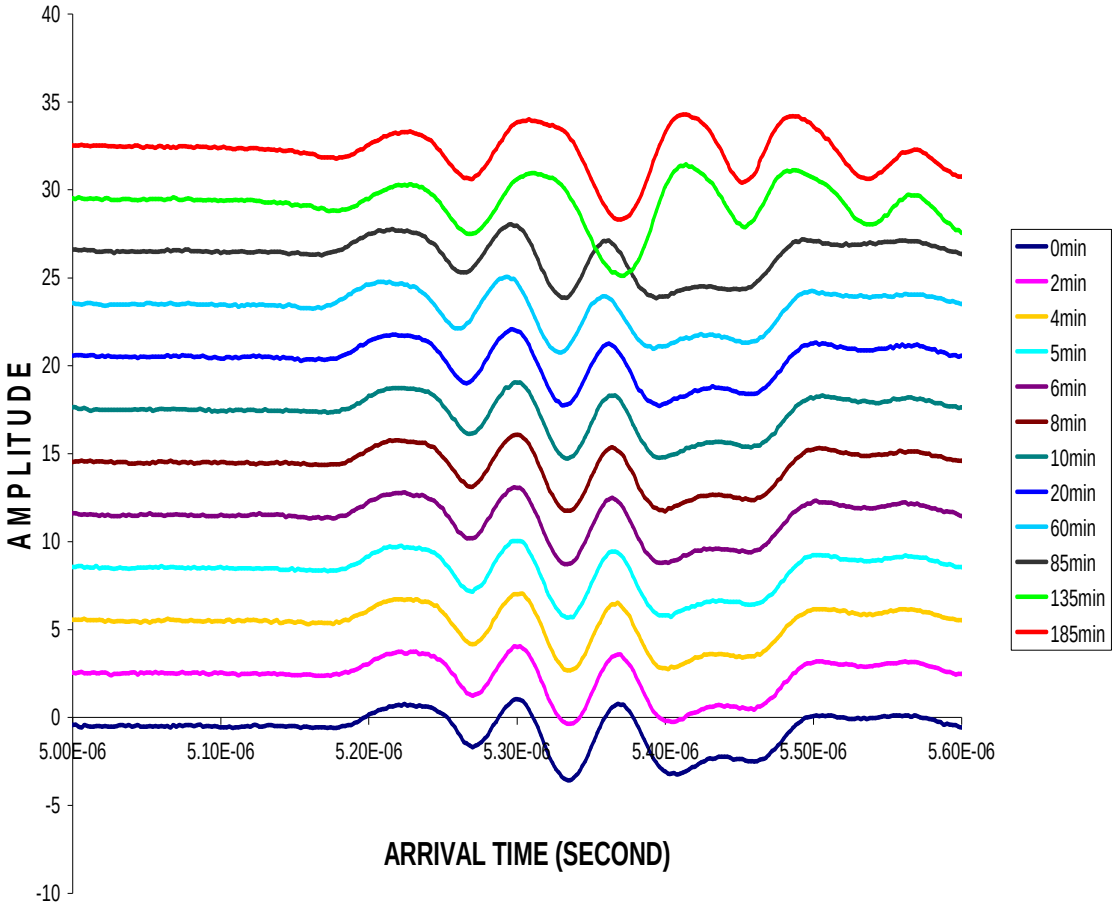


Figure A6.4 Amplitude of the reflection received at the detector as a function time, for the PS membrane/dextrin system (backpulsing with SES solution). The time interval shown encompasses all the reflections received for the water/film, film/membrane and membrane/metal support interfaces.