ICET EROSION TESTS
AT THE UNIVERSITY OF CAPE TOWN

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Editorial note: *This contribution comprises a major part of the report submitted by the Author to the ICET Co-ordinator in 1988. Only tables comprising the mass loss are omitted as such data are available from the ICET database attached to the ICET Preliminary Report. The installation files of this database can be also easily downloaded from our website. High quality of the photographs submitted has been the main argument when taking the decision to reproduce them again irrespective of the Preliminary Report.*

1. TESTS COMPLETED AND NUMBER OF SPECIMENS USED

Tests	No. of specimens
Cavitation volume loss	3
Photographs of cavitated surface	1
Mean depth of erosion	3
Maximum depth of erosion	2 (cross-section)
Microhardness	2 (cross-section)
Measurements of eroded area	3 (cross-section)
Microstructure and photography of cavitated edge	1 (cross-section)

2. OBSERVATIONS

The Polyamide 6 specimens were kept in distilled water for at least one week prior to the cavitation tests. A control specimen was treated in the same way and its weight change subtracted from the cavitation specimens at each interval. Microhardness measurements along the cavitated edge of the Polyamide 6 specimens could not be performed.

The aluminium PA2 specimens showed a very high volume loss and depth of erosion. The curve in the graph is possibly due to the higher distance of the drill from the curved eroded specimen surface. Due to this curved surface some of the eroded particles would not be washed away immediately by the water and acted as a slurry between drill and specimen. Only the materials M63 and 1H18N9T showed significant differences in microhardness between the bulk and the cavitated surface, i.e. work-hardening of the material. The cavitation damage is generally very shallow. The specimens M63 and 1H18N9T showed evidence of plastic deformation as shear bands at the cavitated edge compared to the centre of the specimens. These were photographed at higher magnification. No scaling effect could be seen.

The mean depth of erosion values were calculated while the maximum depth of erosion measured under the microscope on the cross-sections through the centres of the specimens. The discrepancy of the values for Polyamide 6 might be due to the volume change of the specimen during the preparation of the samples.

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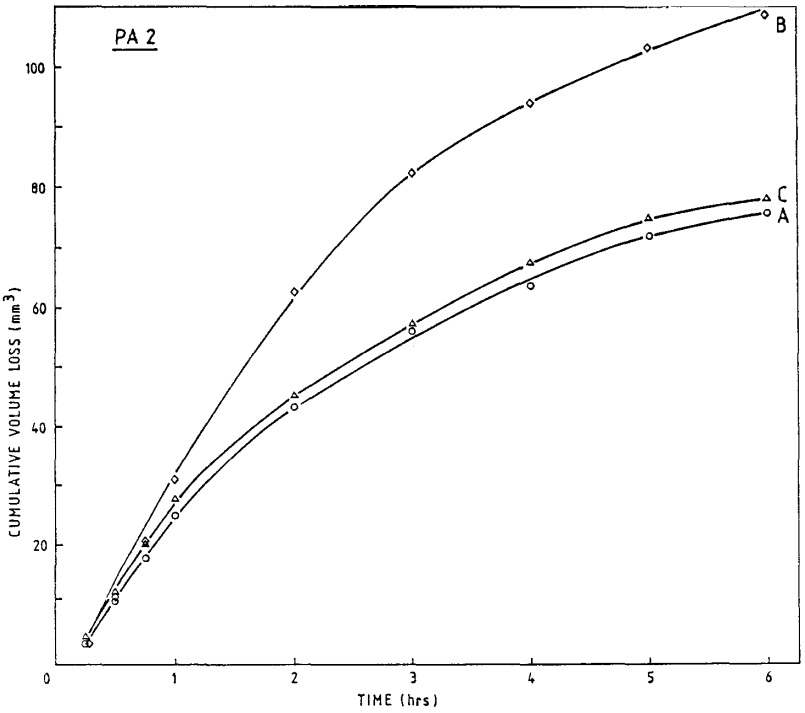
MATERIAL	DESCRIPTION	HEAT TREATMENT	COMPOSITION												
			C	Mn	Si	P	S	Cr	Ni	Fe	Cu	Al	Ti	Zn	Mg
E04	armco iron	normalised	.035	.10	.01	.026	.035	-	-	rest	-	-	-	-	-
45	carbon steel of high quality	hardened and tempered	.43	.63	.26	.030	.033	-	-	rest	-	-	-	-	-
1H18N9T	acid resistant steel	solution treated	.4	1.37	.55	.030	.010	17.6	9.40	rest	-	-	.60	-	-
M63	two-component brass	recrystallised	-	-	-	-	-	-	-	-	rest	-	-	36.26	-
PA2	aluminium alloy	recrystallised	-	-	-	-	-	-	-	-	-	rest	-	-	2.73
45?	possibly E04	unknown													
M63?	two-component brass	unknown													
Polyamide 6	Nylon 6														

Material: PA2

1. Graph showing cumulative volume loss against time for 3 specimens



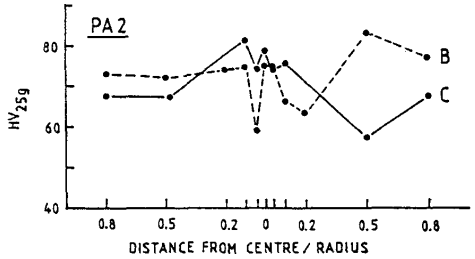
2. Hardness measurements

Macro hardness HV 30
Poland 69.5
Cape Town 69

Micro hardness of cross-sections HV_{25}

	B	C
Range, below the cavitated area	59-83	57-81
Average, below the cavitated surface	72	71
Bulk material	71	73

3. Graph of micro hardness measurements below the cavitated surface



Scanning electron microscopy of the cavitated surface

Material: PA2

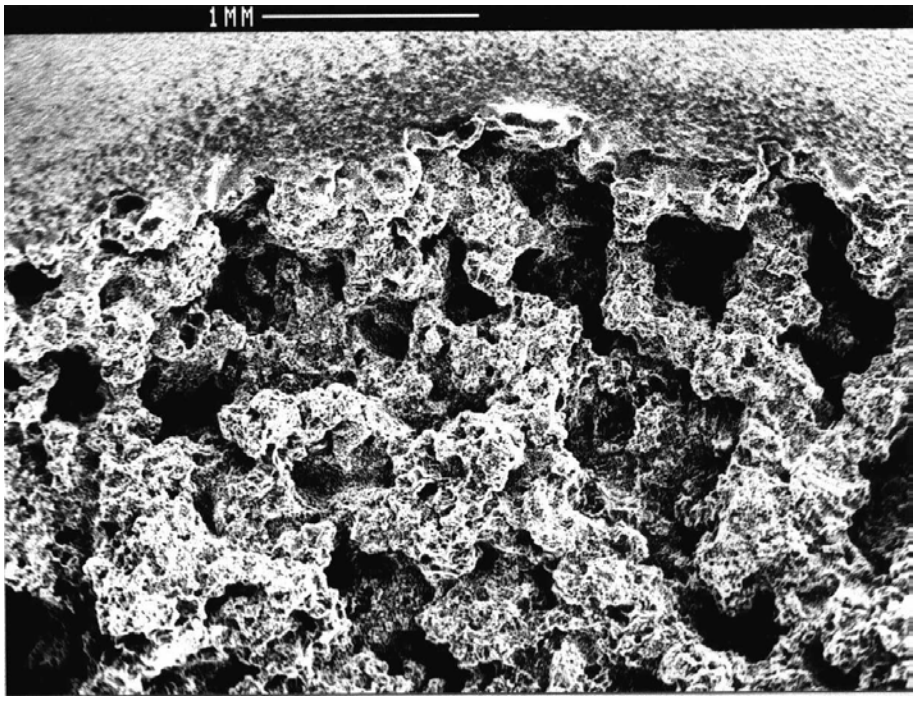


FIGURE 1 General view of the cavitated area

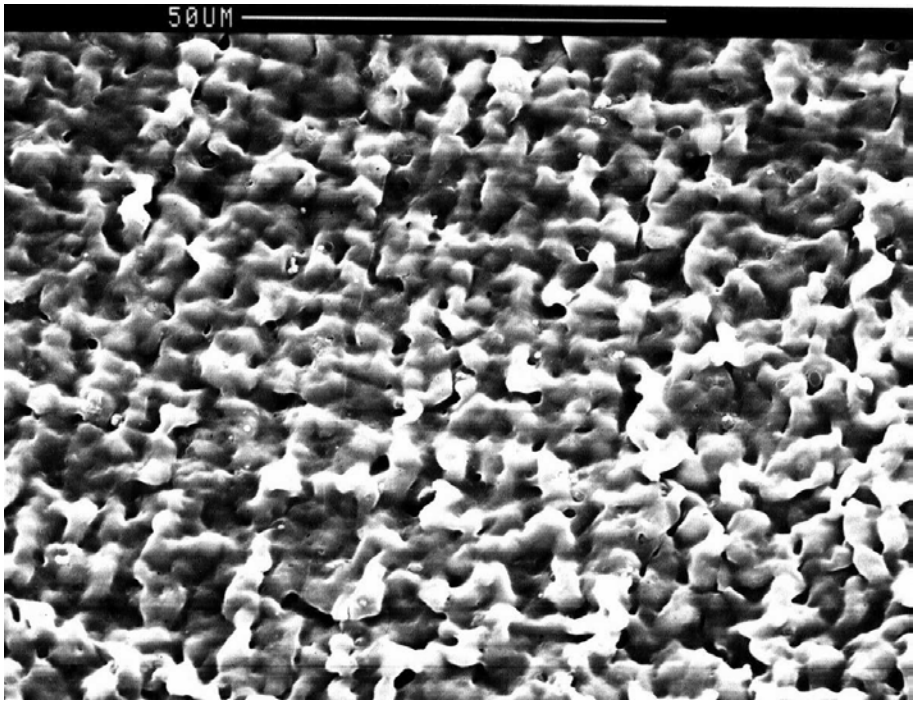


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

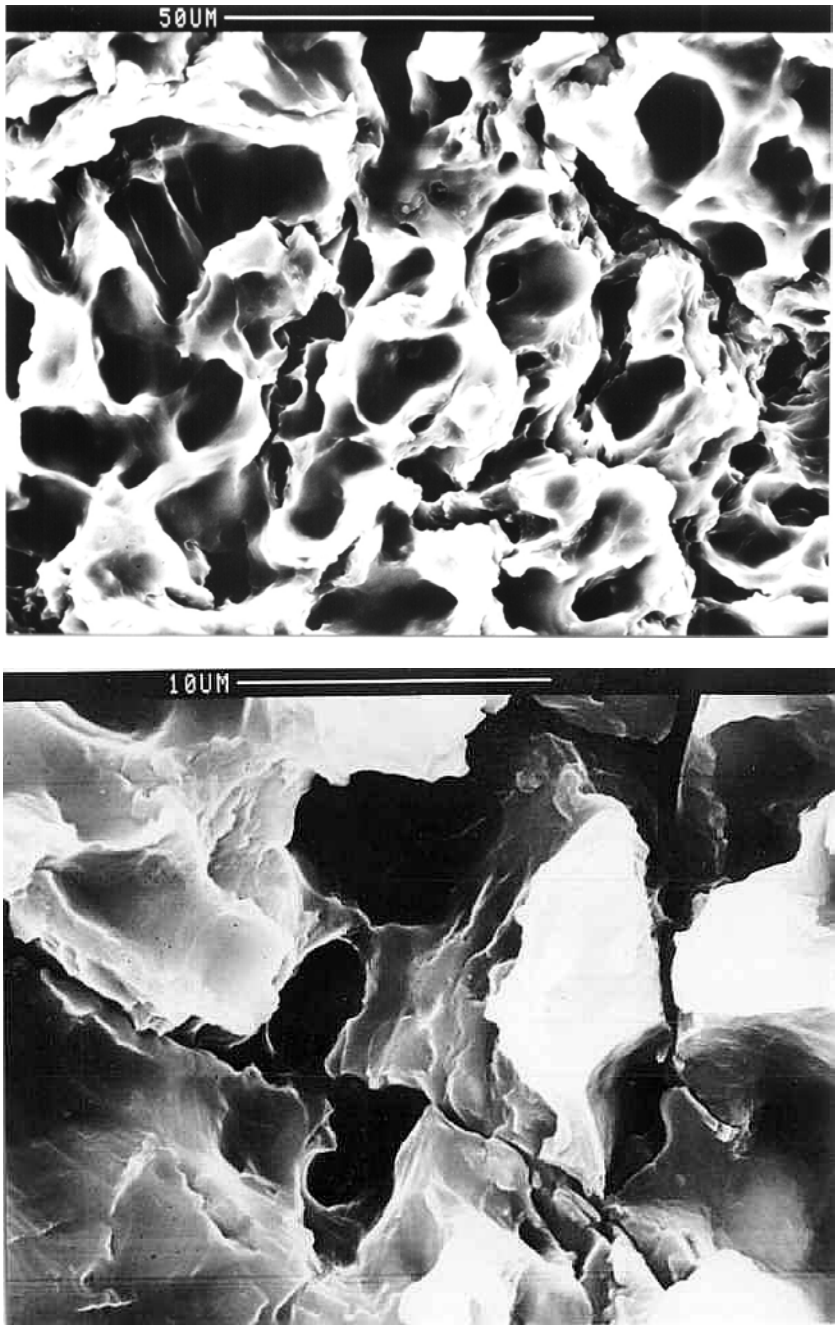


FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Optical microscopy of a cross-section

Material: PA2

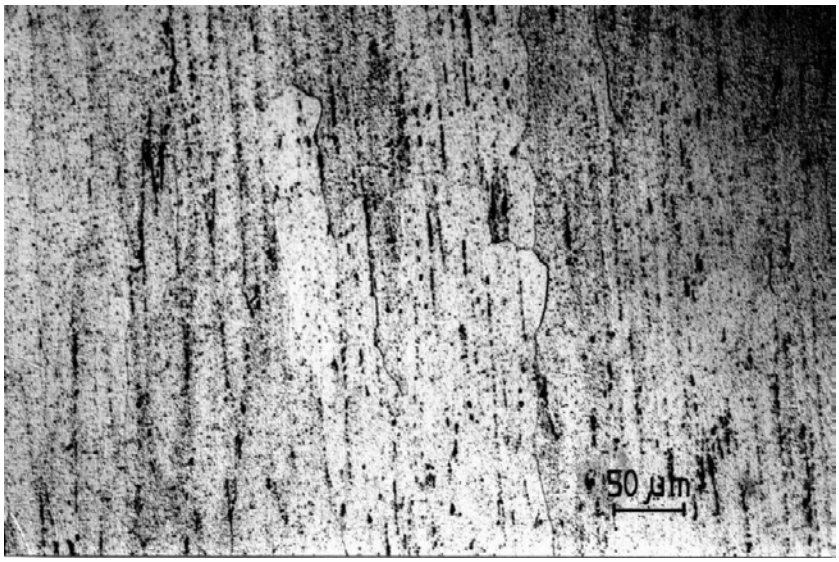


FIGURE 4 Microstructure in the centre of the specimen

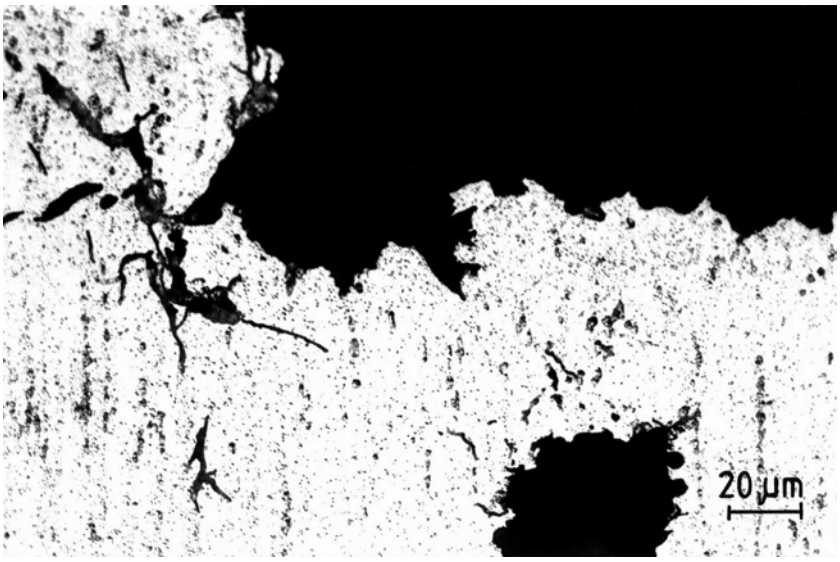


FIGURE 5 General view of the cavitated edge

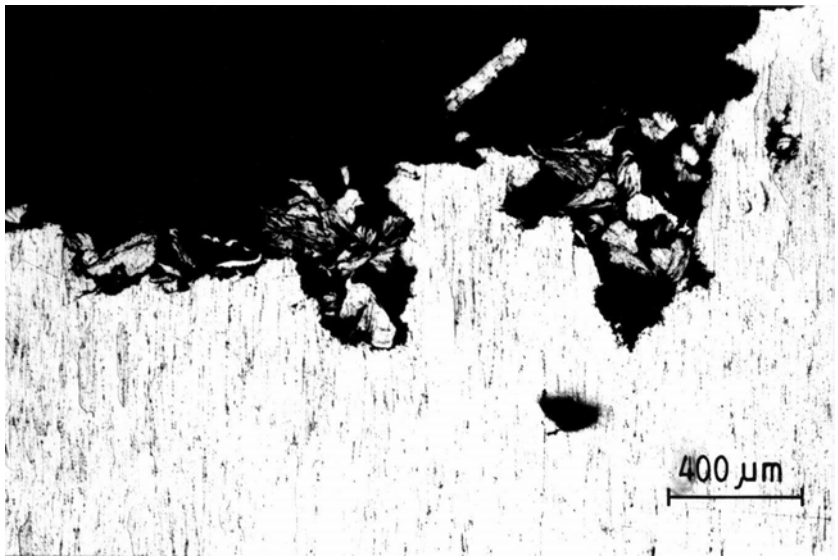
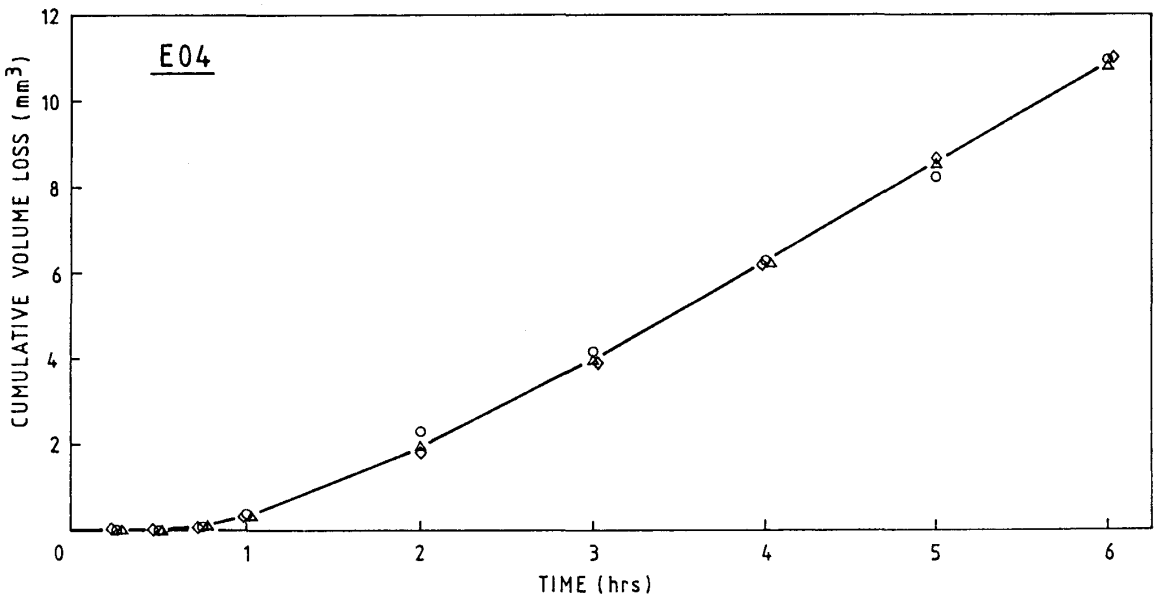


FIGURE 6
The cavitated edge at higher magnification

Material: E04

1. Graph showing cumulative volume loss against time for 3 specimens



2. Hardness measurements

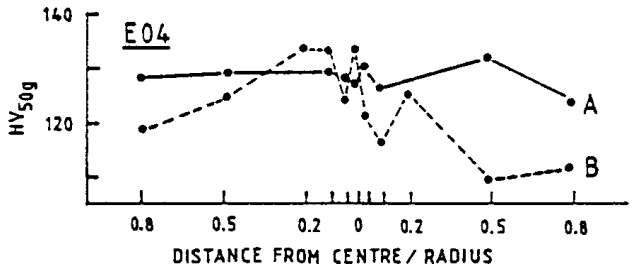
Macro hardness HV 30

Poland	102
Cape Town	105

Micro hardness of cross-sections HV_{50g}

	A	B
Range, below the cavitated area	102-133	111-134
Average, below the cavitated surface	129	124
Bulk material	126	122

3. Graph of micro hardness measurements below the cavitated surface



Scanning electron microscopy of the cavitated surface

Material: E04

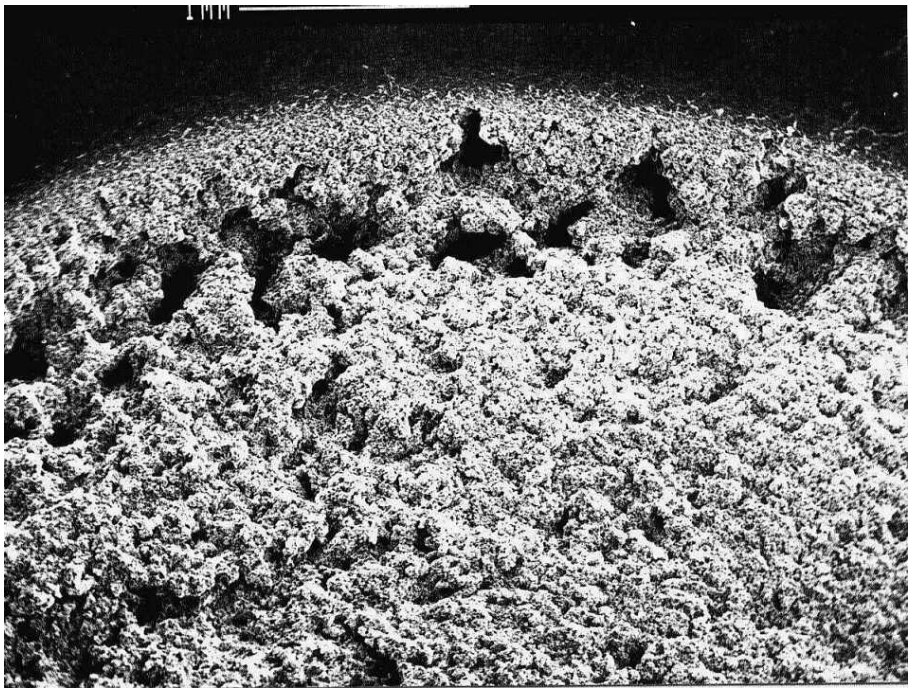


FIGURE 1 General view of the cavitated area

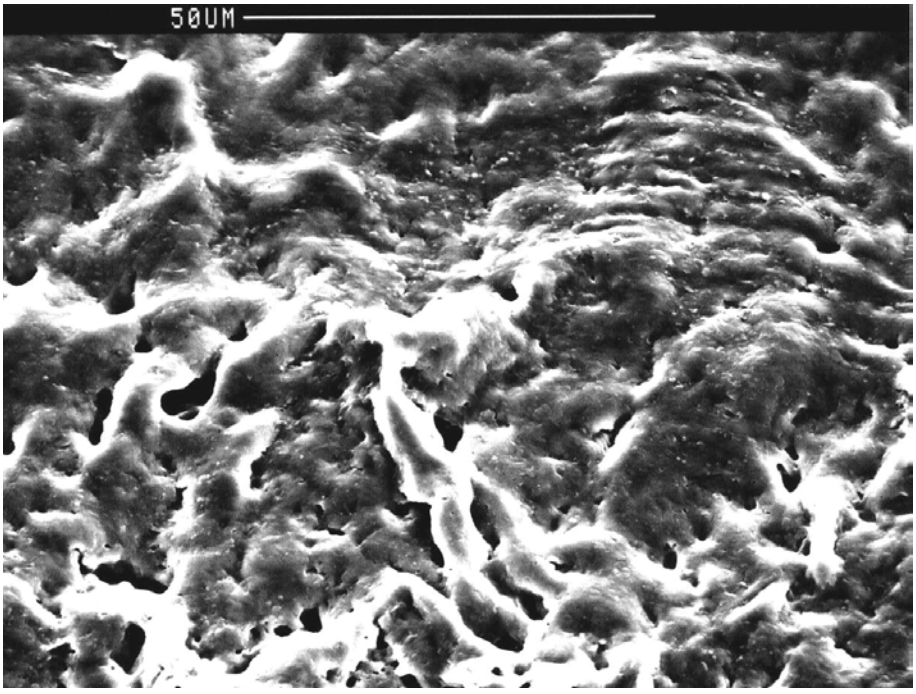


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

Scanning electron microscopy of the cavitated surface

Material: E04

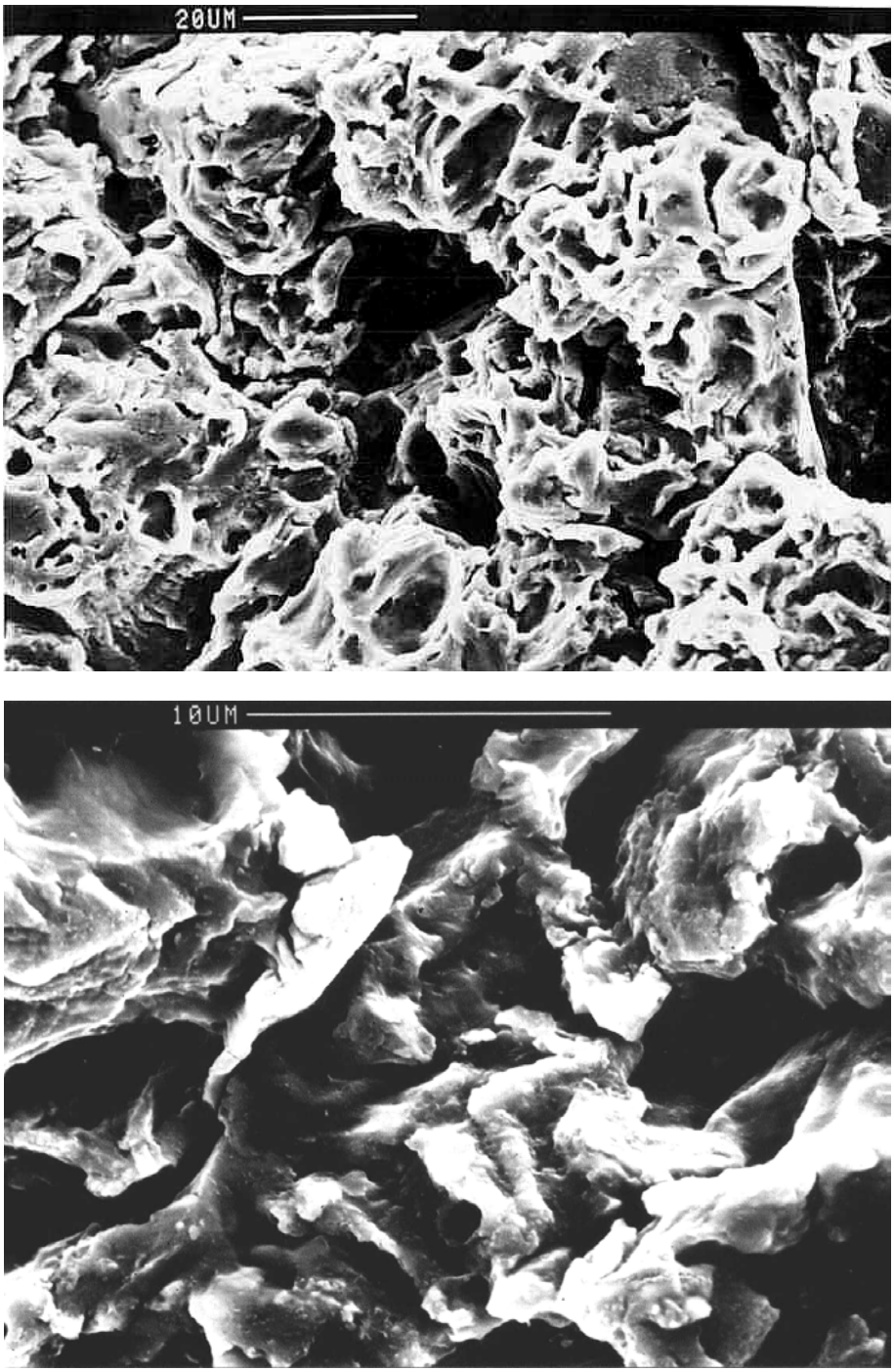


FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Optical microscopy of a cross-section

Material: E04

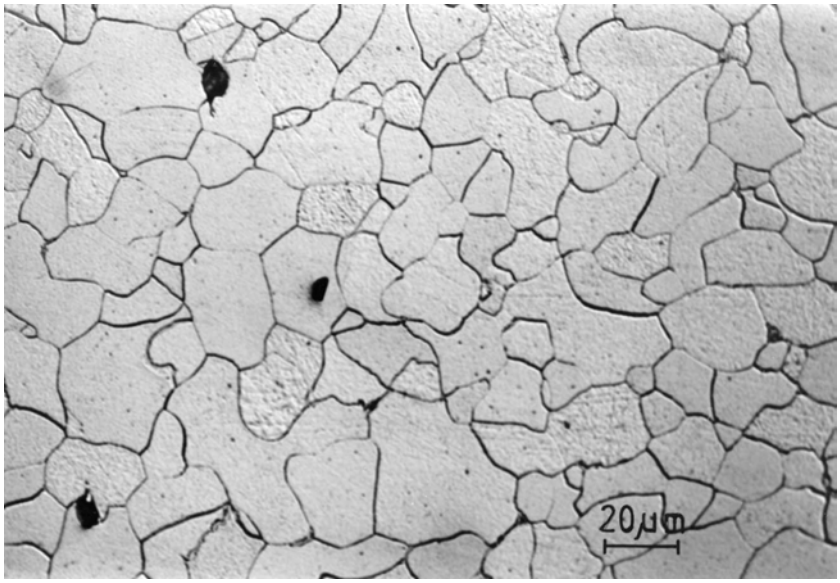


FIGURE 4
Microstructure in the centre of the specimen

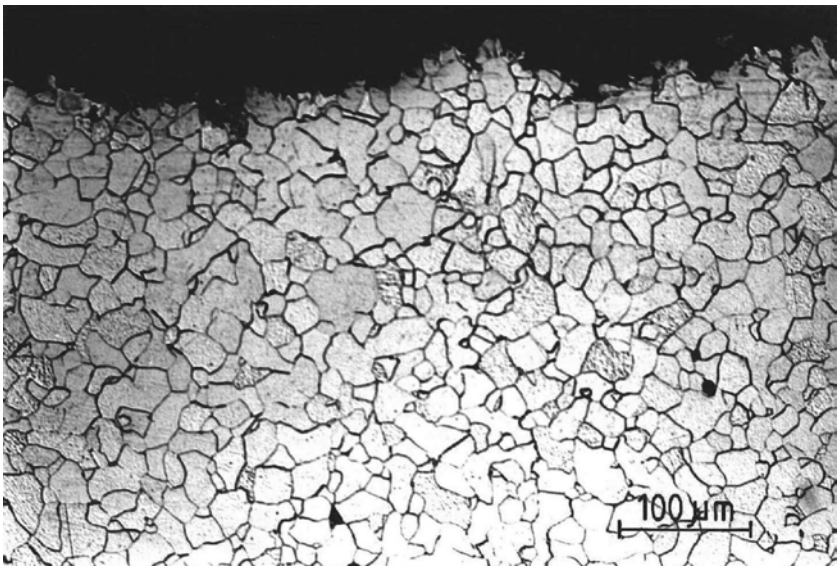


FIGURE 5
General view of the cavitated edge

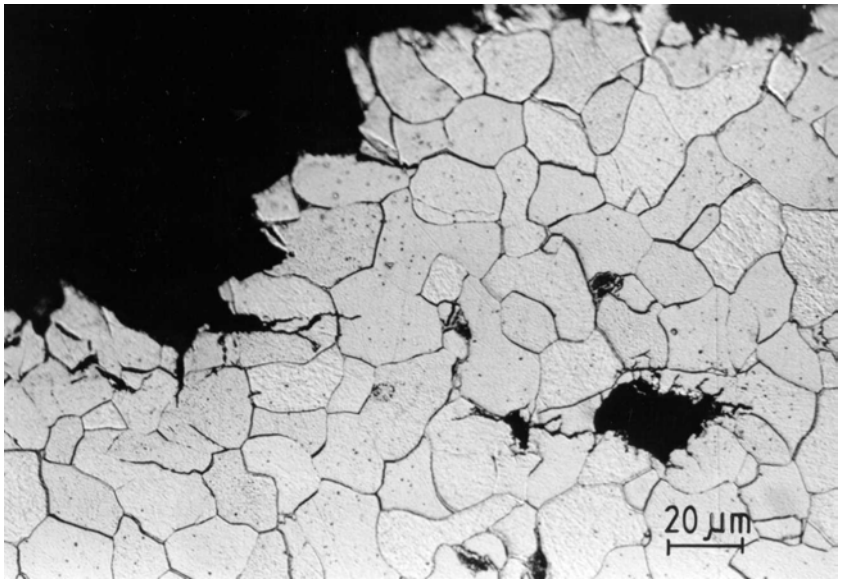
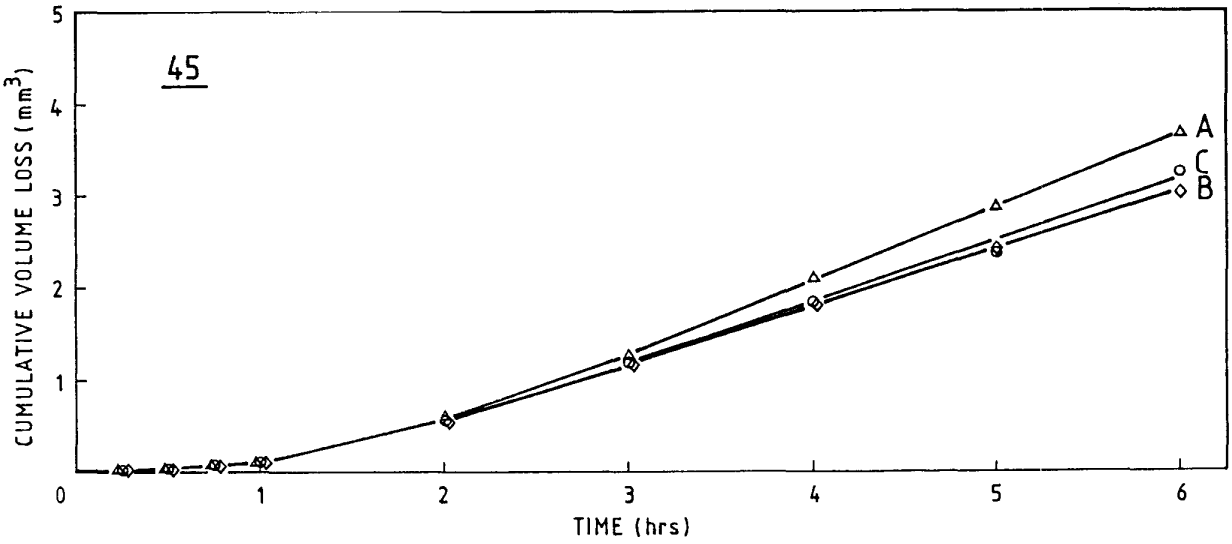


FIGURE 6
The cavitated edge at higher magnification

Material: 45

1. Graph showing cumulative vo1ume loss against time for 3 specimens



2. Hardness measurements

Macro hardness HV 30

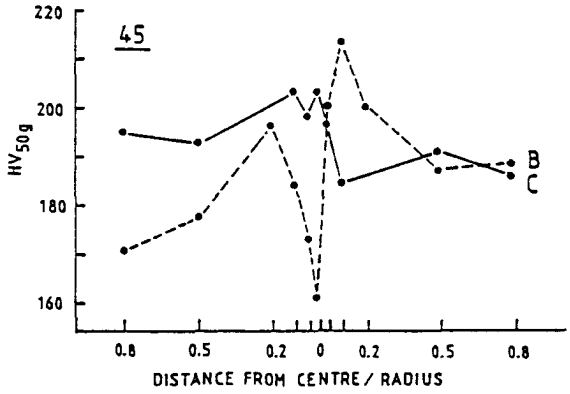
Poland 184.8

Cape Town 196

Micro hardness of cross-sections HV_{50g}

	B	C
Range, below the cavitated area	162-214	185-204
Average, below the cavitated surface	187	195
Bulk material	190	180

3. Graph of micro hardness measurements below the cavitated surface



Scanning electron microscopy of the cavitated surface

Material: 45

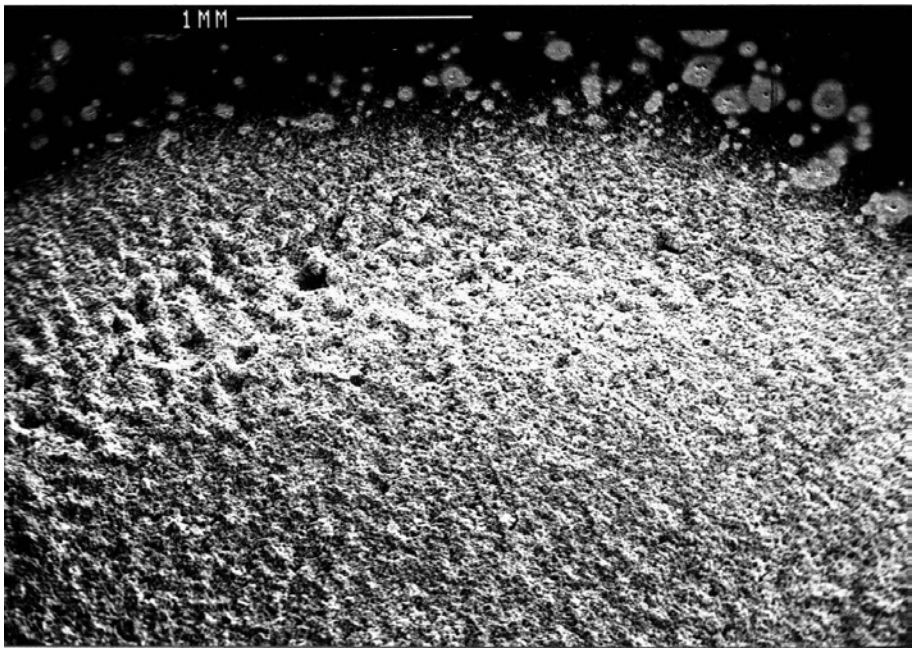


FIGURE 1 General view of the cavitated area

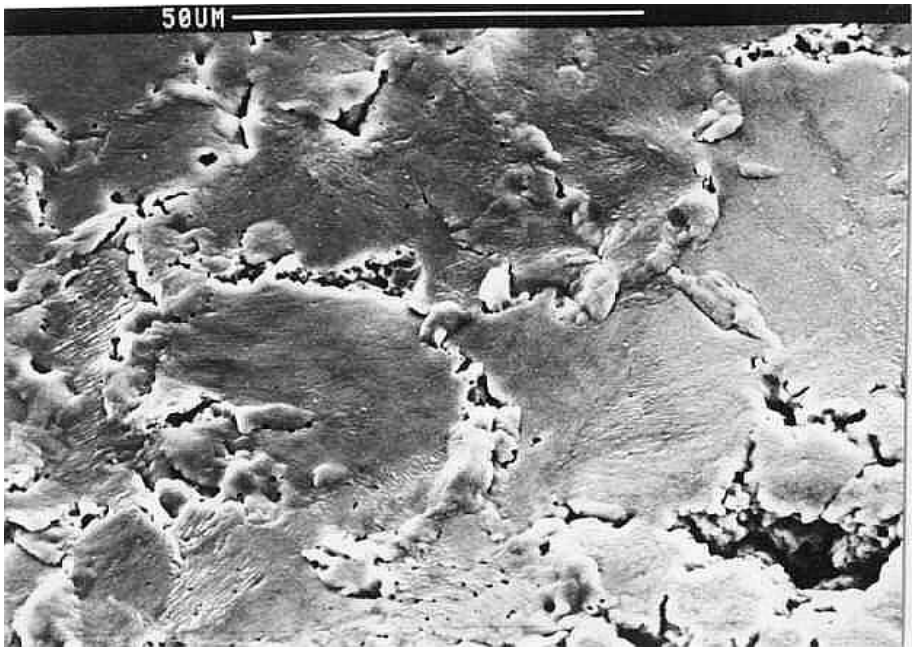
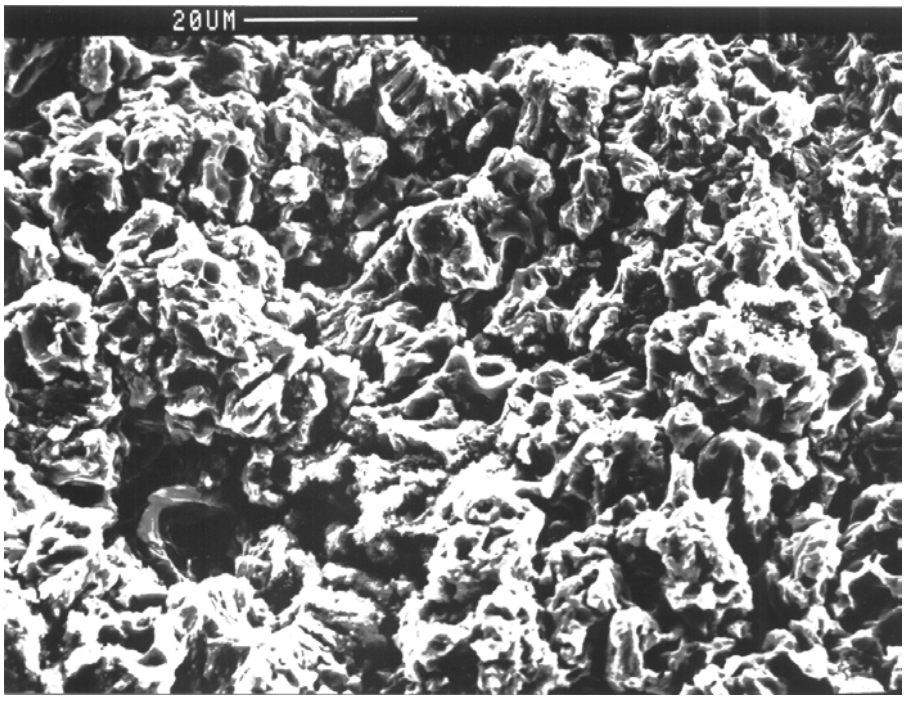


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

Scanning electron microscopy of the cavitated surface

Material: 45



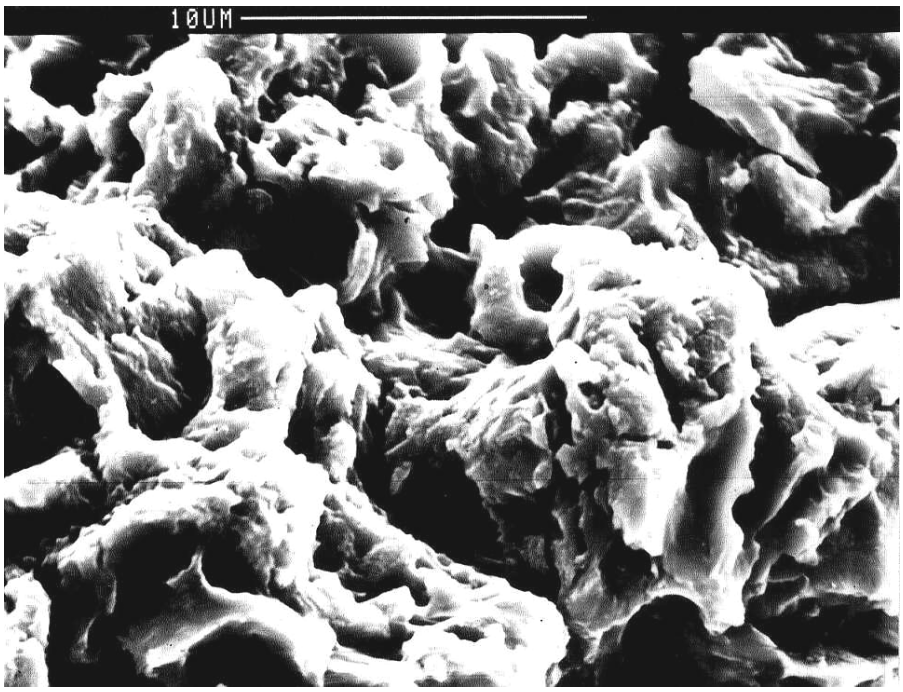


FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Optical microscopy of a cross-section

Material 45

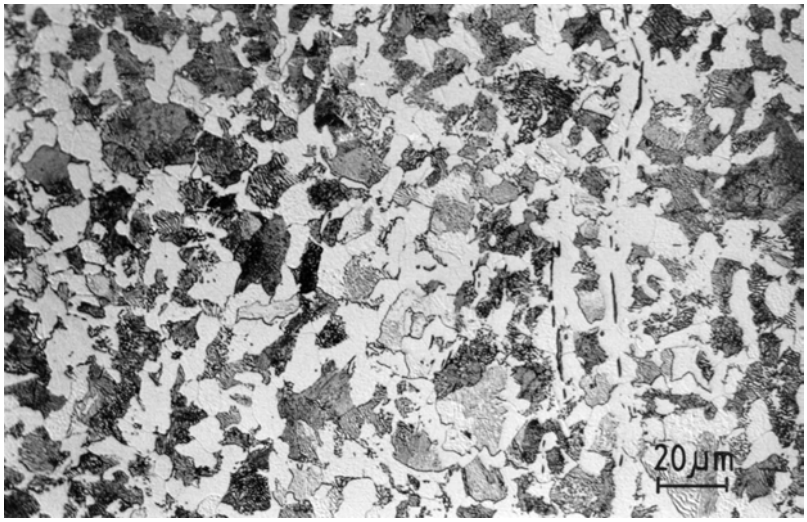


FIGURE 4
Microstructure
in the centre of the specimen

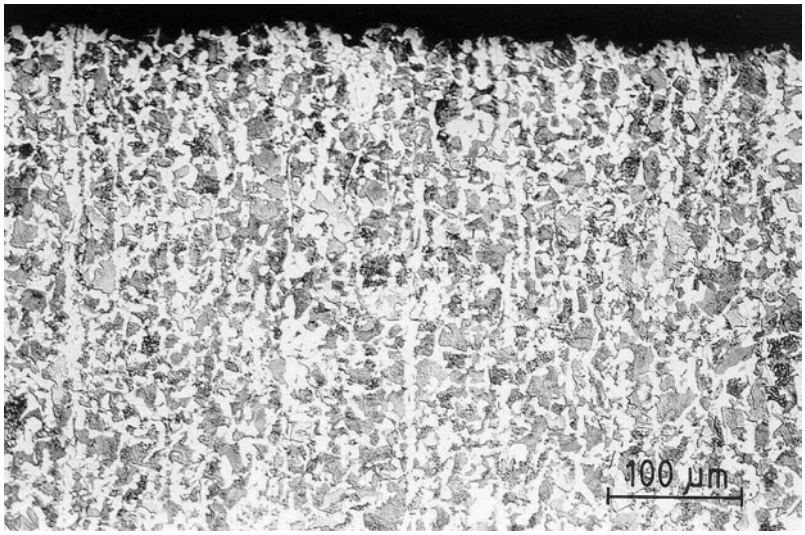


FIGURE 5
General view
of the cavitated edge

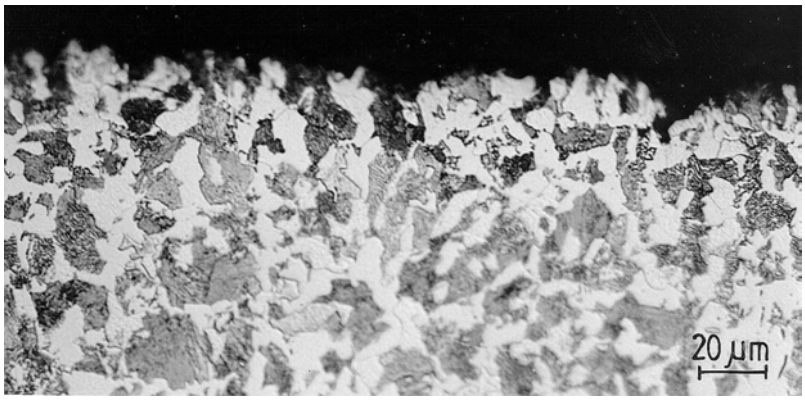
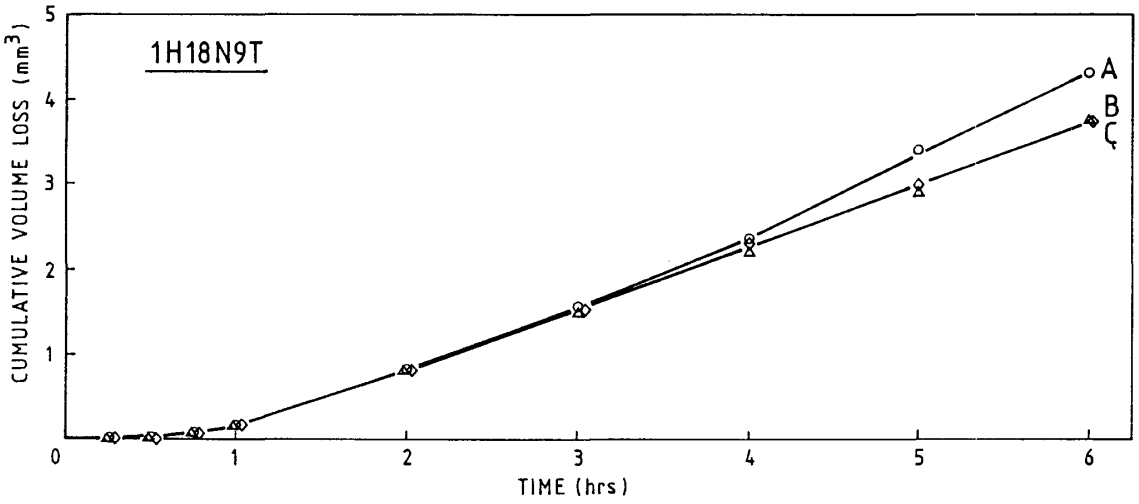


FIGURE 6
The cavitated edge
at higher magnification

Material: 1H18N9T

1. Graph showing cumulative volume loss against time for 3 specimens



2. Hardness measurements

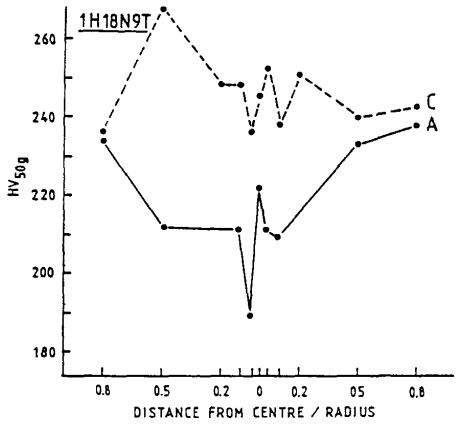
Macro hardness HV 30

Poland	164.2
Cape Town	160

Micro hardnes of cross-section HV_{50g}

	A	C
Range, below the cavitated area	190-239	237-268
Average, below the cavitated surface	218	247
Bulk material	161	164

3. Graph of micro hardness measurements below the cavitated surface



Scanning electron microscopy of the cavitated surface

Material: 1H18N9T

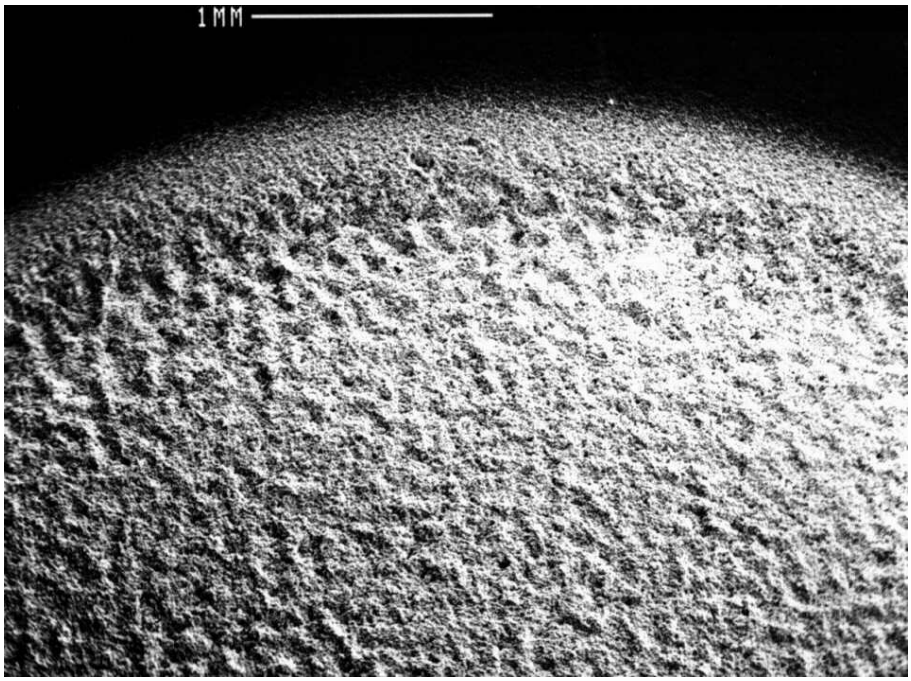


FIGURE 1 General view of the cavitated area

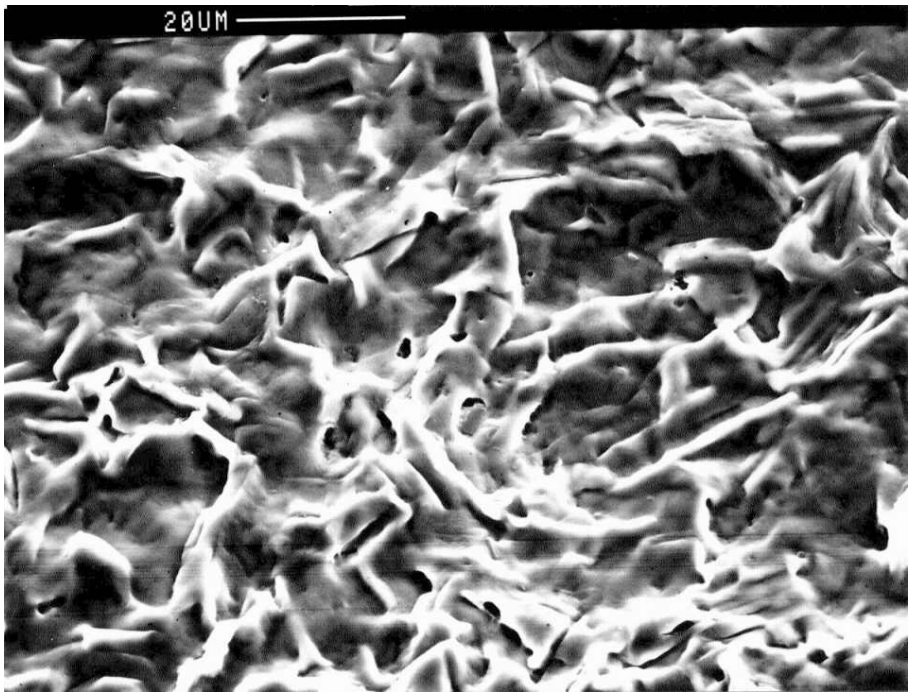


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

Scanning electron microscopy of the cavitated surface

Material: 1H18N9T

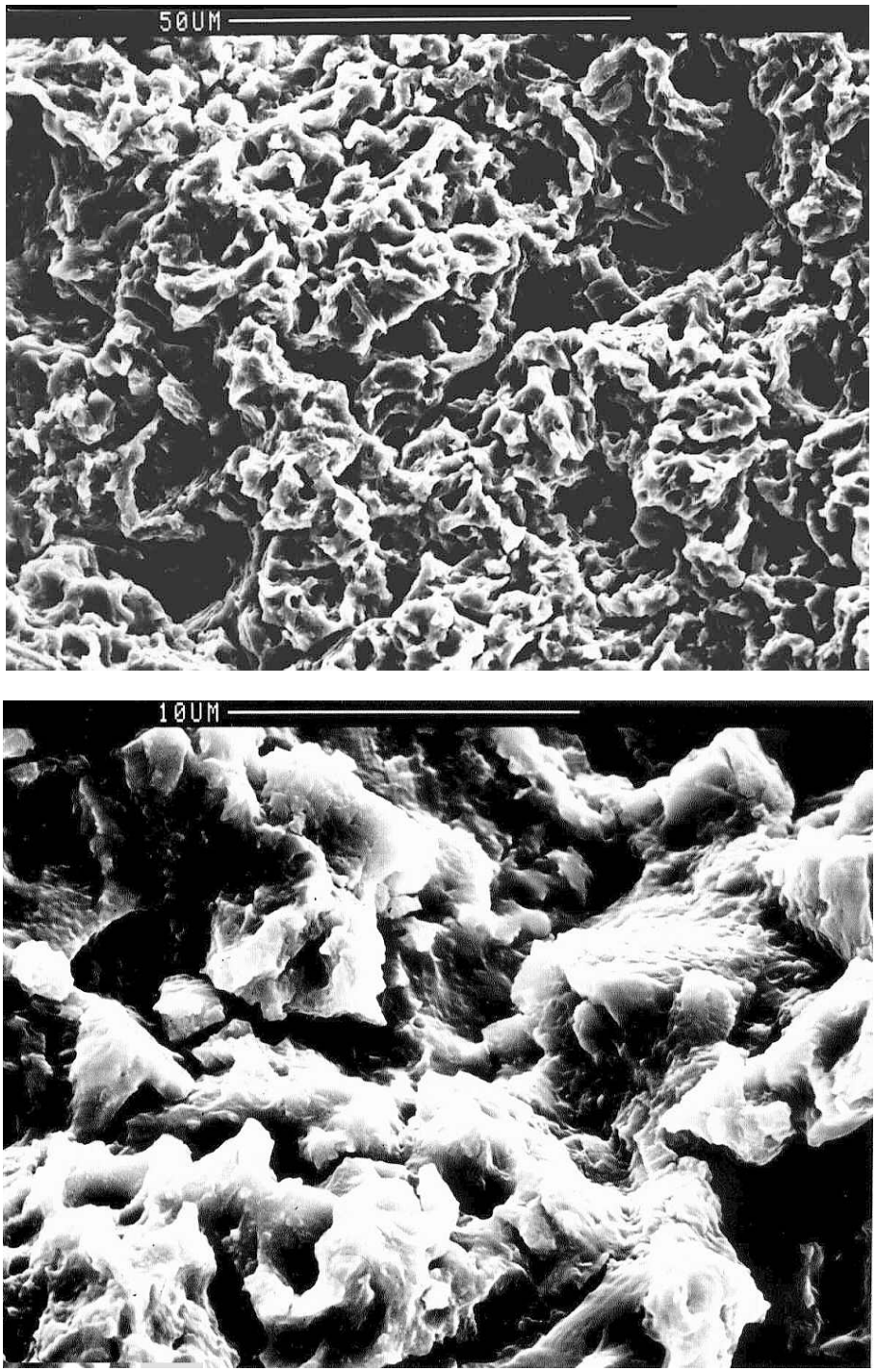


FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Optical microscopy of a cross-section

Material 1H18N9T

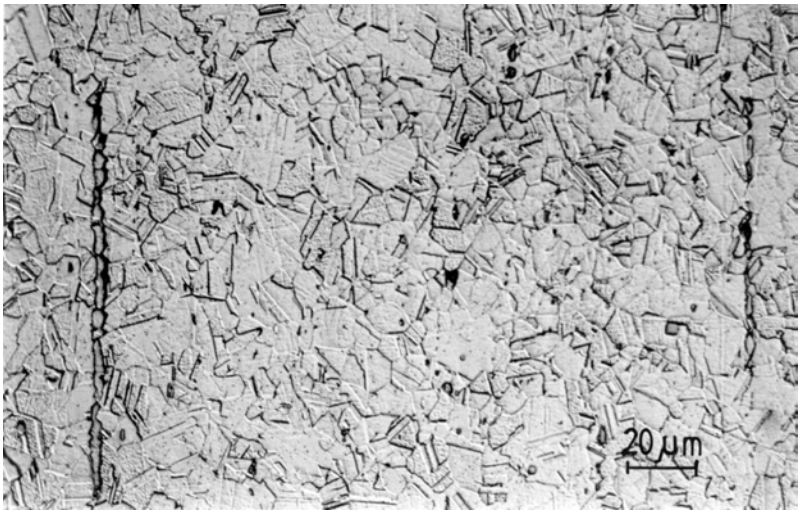


FIGURE 4
Microstructure
in the centre of the specimen

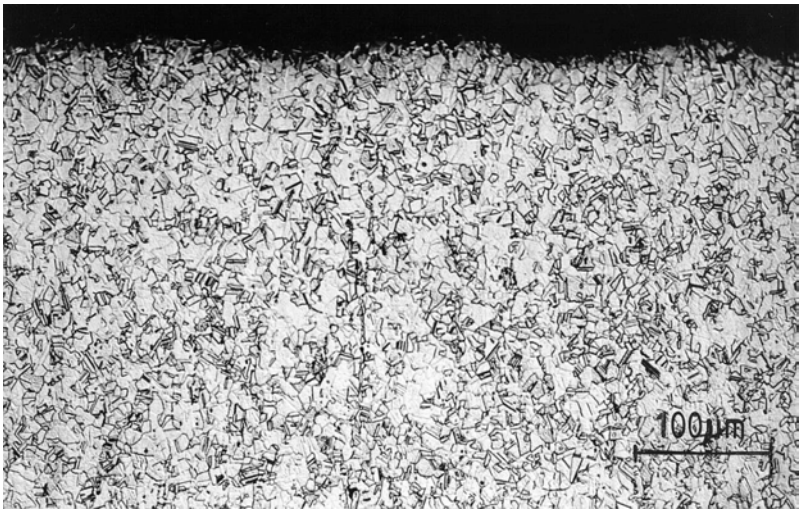


FIGURE 5
General view
of the cavitated edge

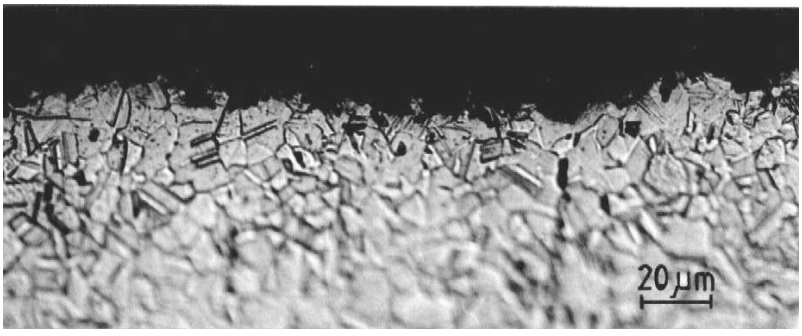


FIGURE 6
The cavitated edge
at higher magnification

Scanning electron microscopy of a cross-section

Material 1H18N9T

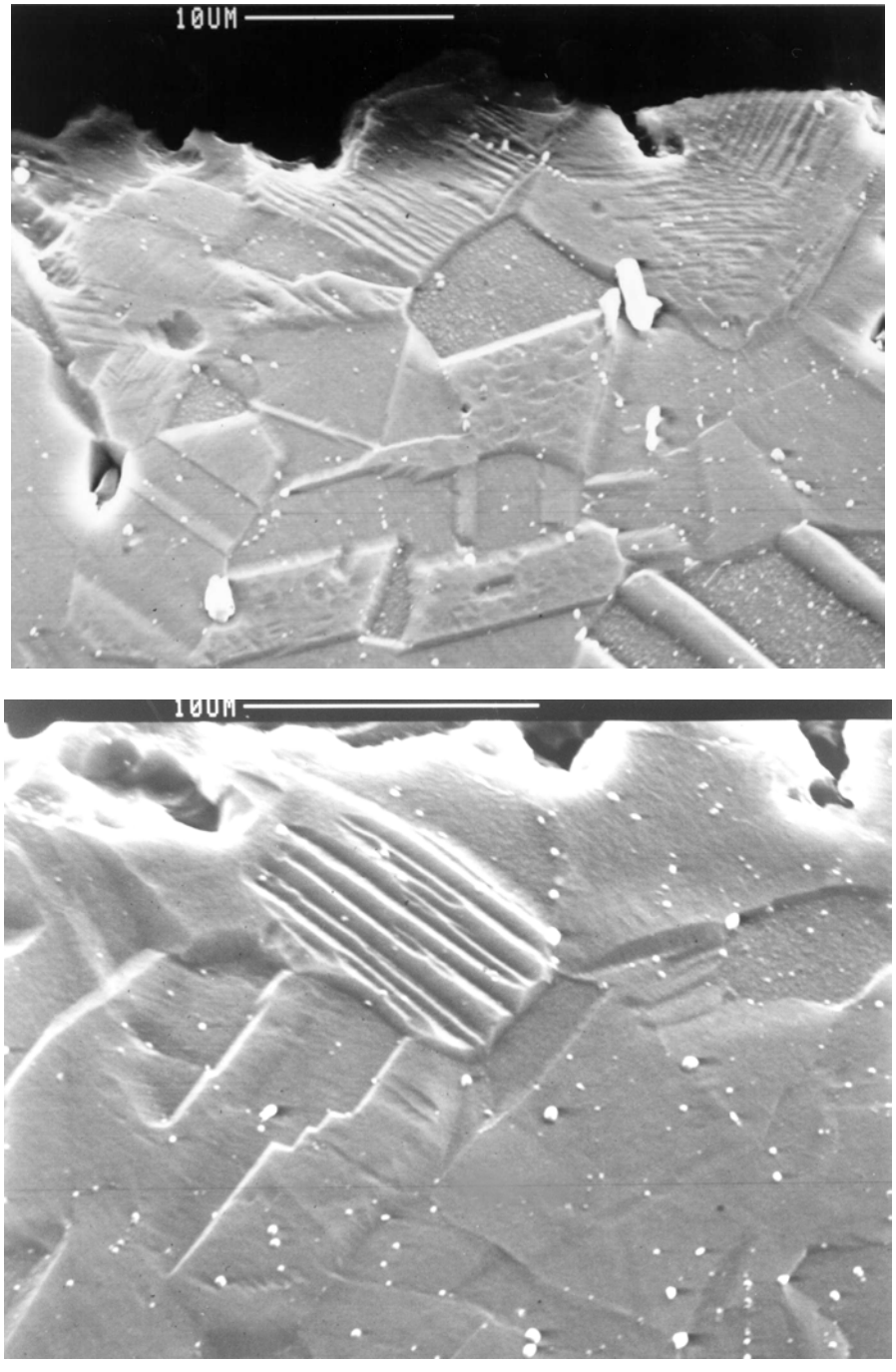
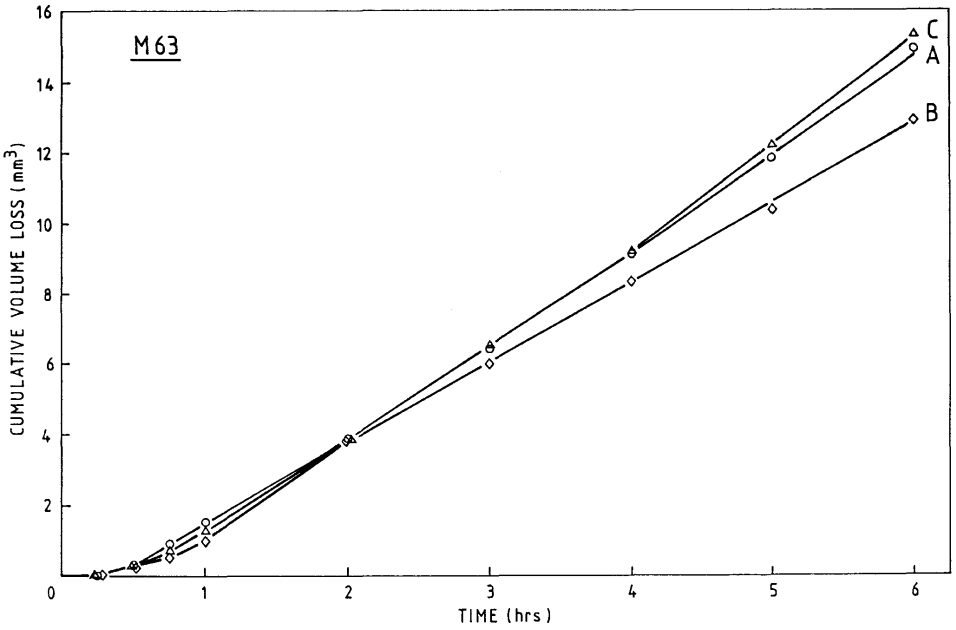


FIGURE 7 The cavitated edge

Material: M63

1. Graph showing cumulative volume loss against time for 3 specimens



2. Hardness measurements

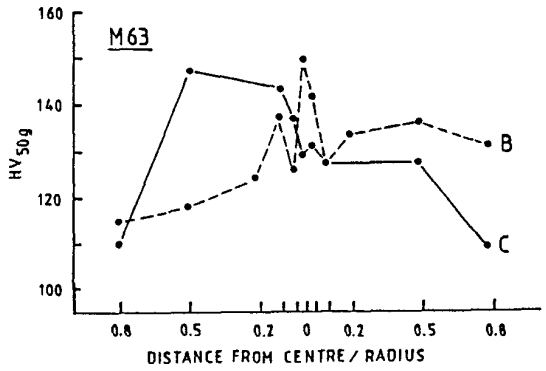
Macro hardness HV 30

Poland	75.6
Cape Town	111

Micro hardness of cross-sections HV_{50g}

	B	C
Range, below the cavitated area	115-150	110-148
Average, below the cavitated surface	131	130
Bulk material	93	88

3. Graph of micro hardness measurements below the cavitated surface



Scanning electron microscopy of the cavitated surface

Material: M63

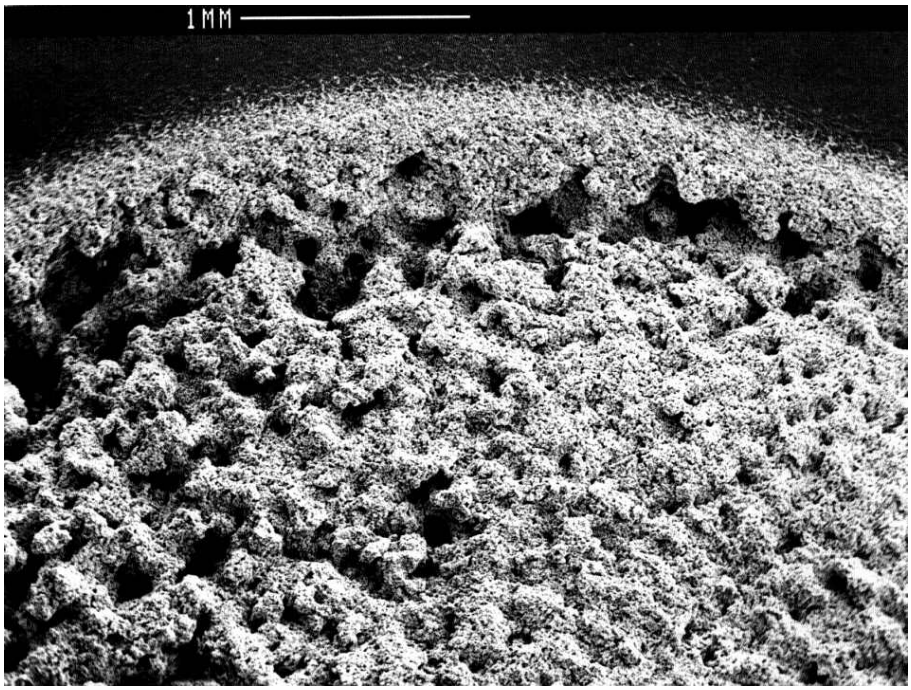


FIGURE 1 General view of the cavitated area

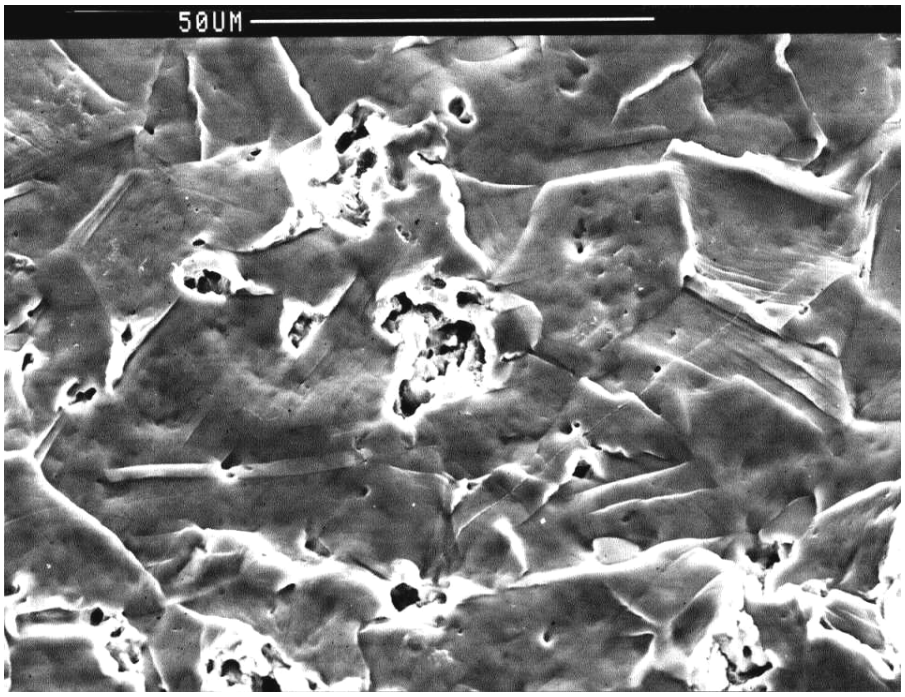


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

Scanning electron microscopy of the cavitated surface

Material: M63

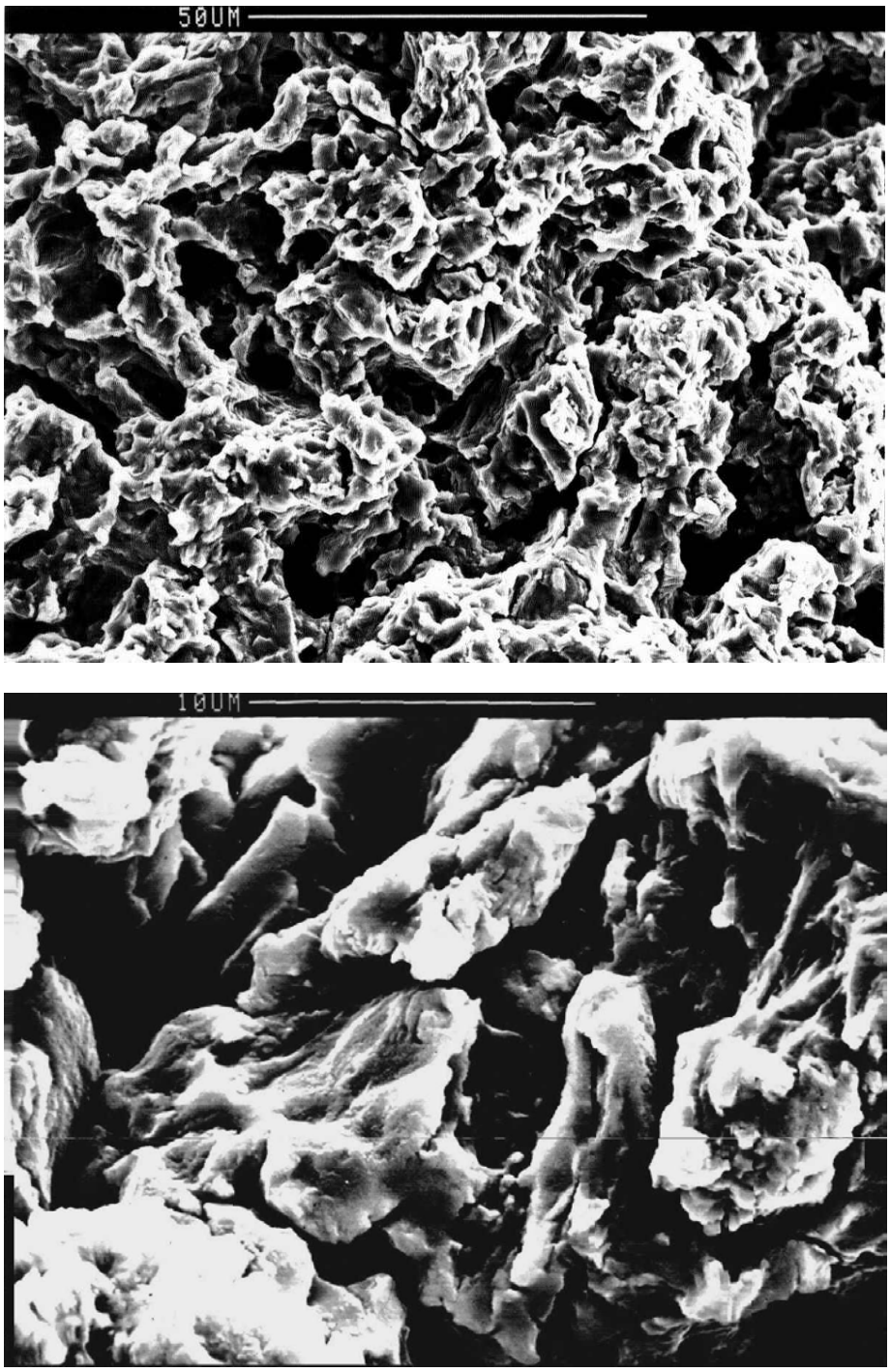


FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Optical microscopy of a cross-section

Material M63

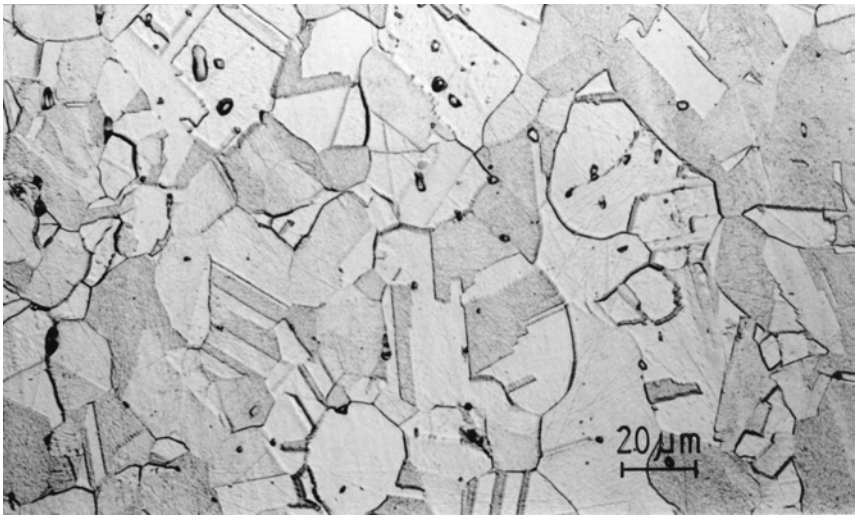


FIGURE 4
Microstructure
in the centre of the specimen

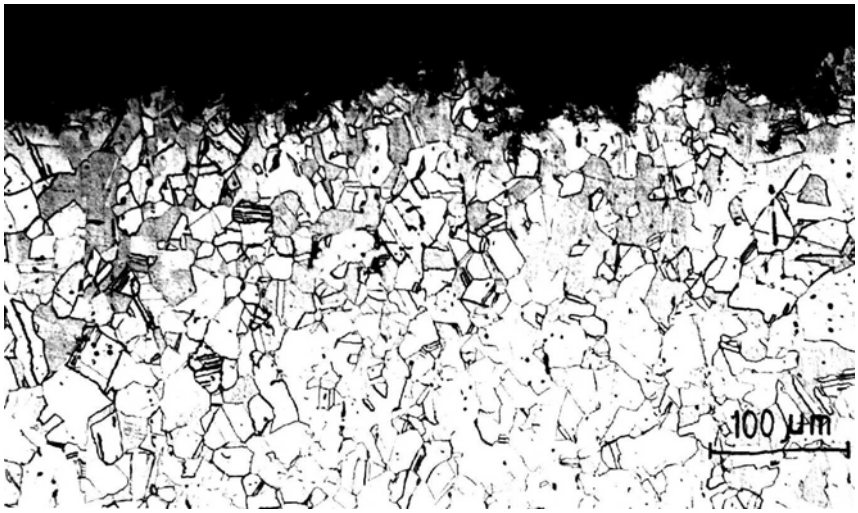


FIGURE 5
General view
of the cavitated edge

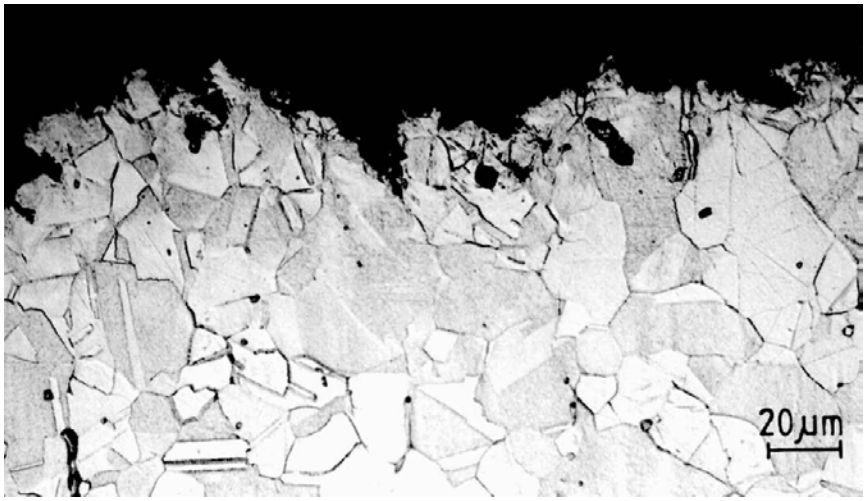


FIGURE 6
The cavitated edge
at higher magnification

Scanning electron microscopy of a cross-section

Material M63

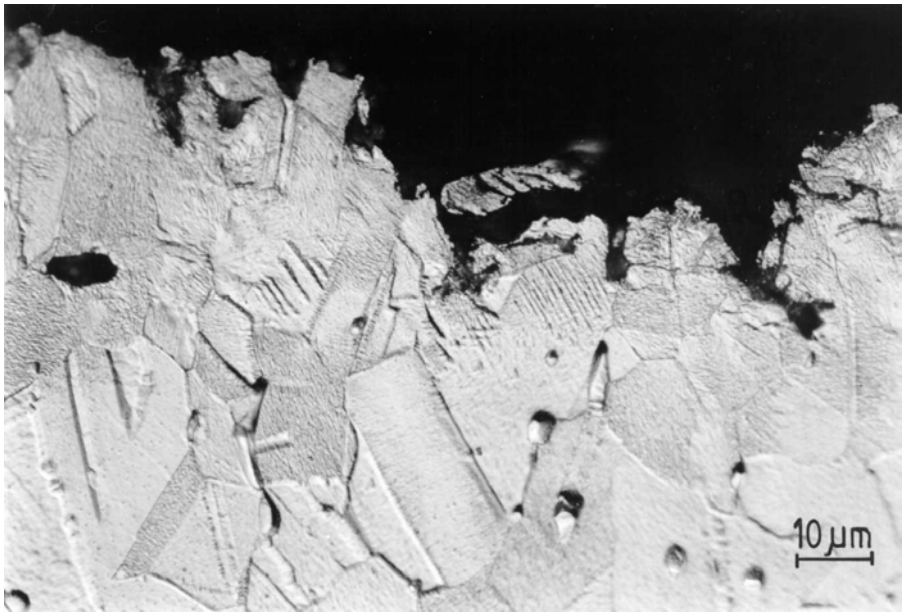


FIGURE 7 The cavitated edge

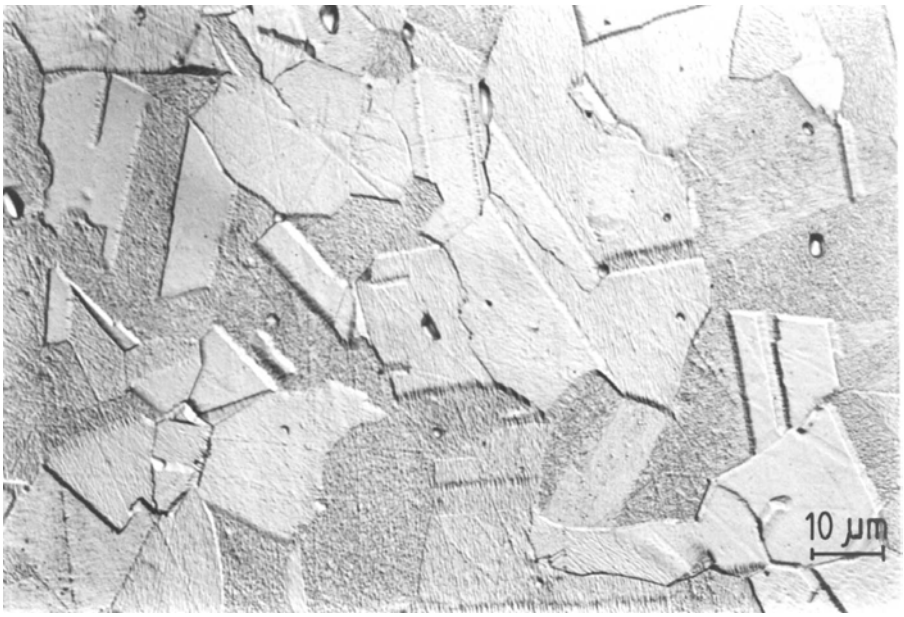
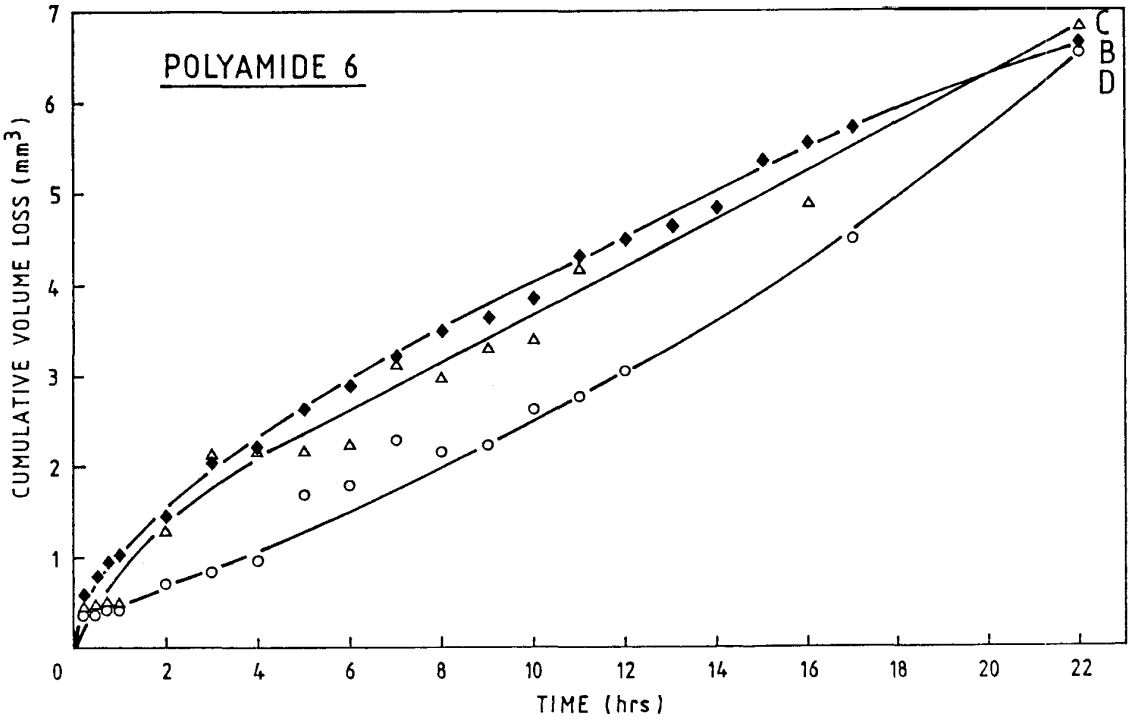


FIGURE 8 Centre of the specimen

Material: Polyamide 6

1. Graph showing cumulative volume loss against time for 3 specimens



2. Hardness measurements

Poland	1500 kg/cm^2
Cape Town	79 (Shore D)

Scanning electron microscopy of the cavitated surface

Material: Polyamide 6

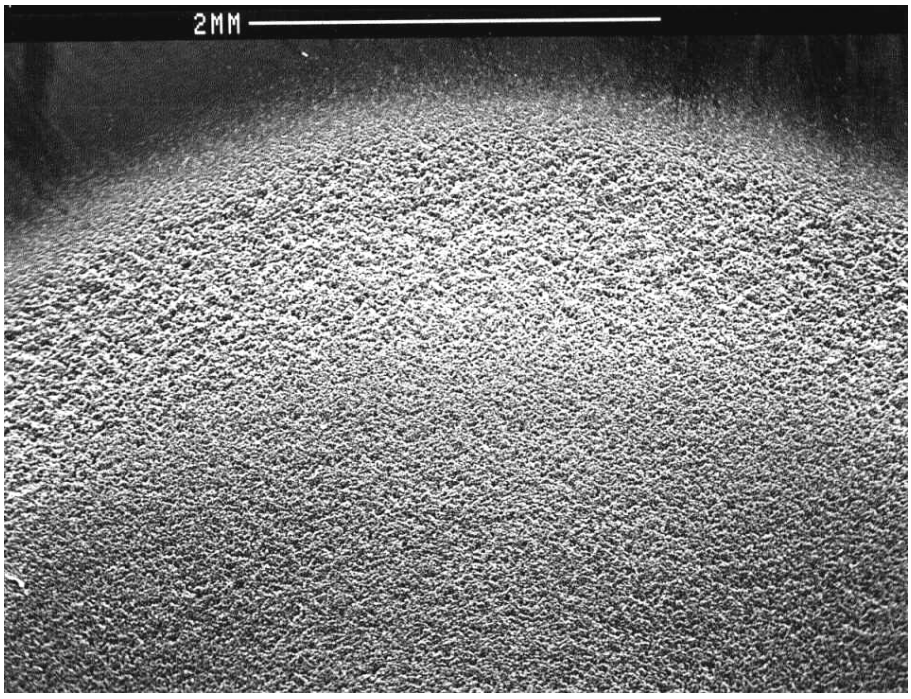


FIGURE 1 General view of the cavitated area

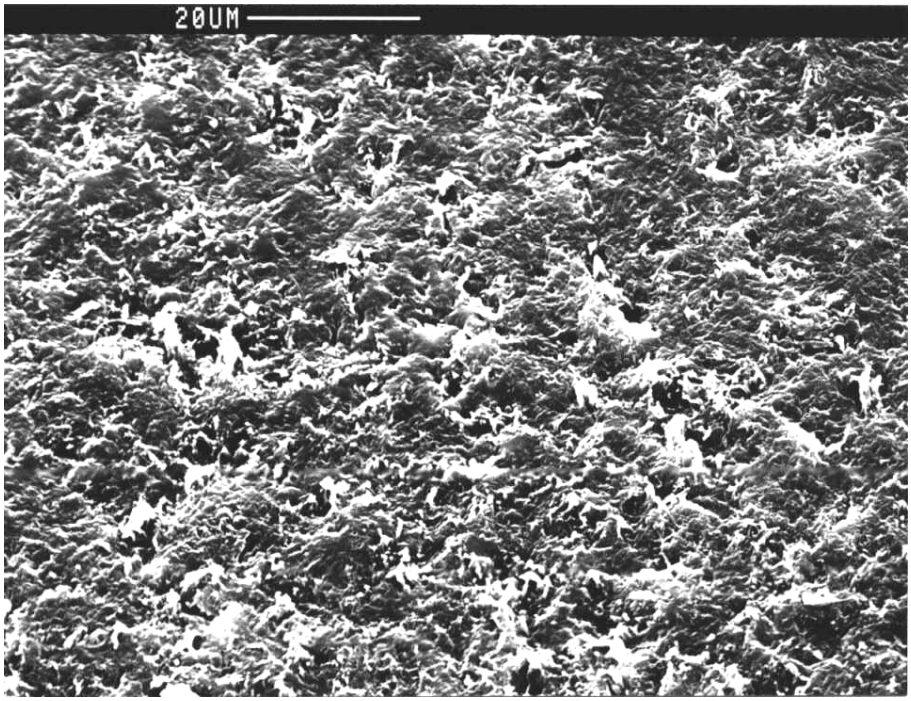


FIGURE 2 Initial cavitation damage as seen at the edge of the cavitated area

Scanning electron microscopy of the cavitated surface

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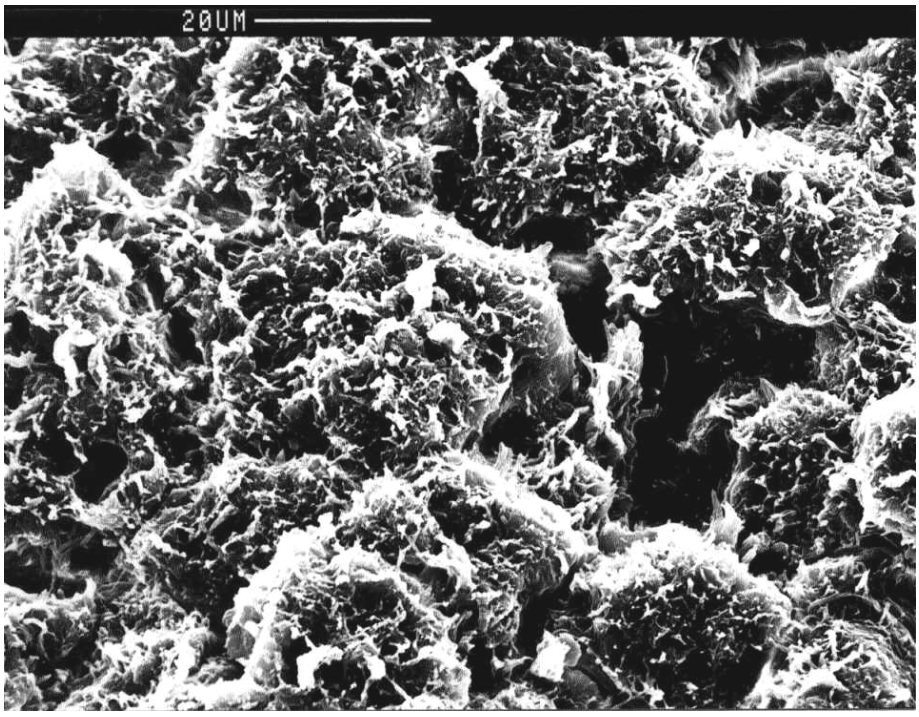

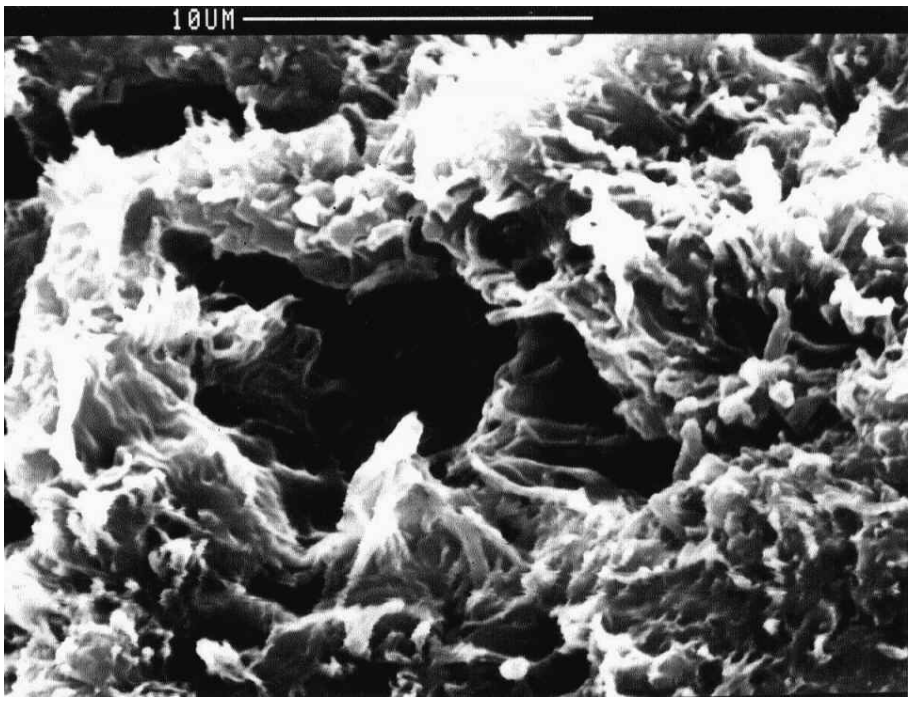

FIGURE 3 (a) and (b) Cavitation damage in the centre of the specimen

Scanning electron microscopy of a cross-section

Material Polyamide 6

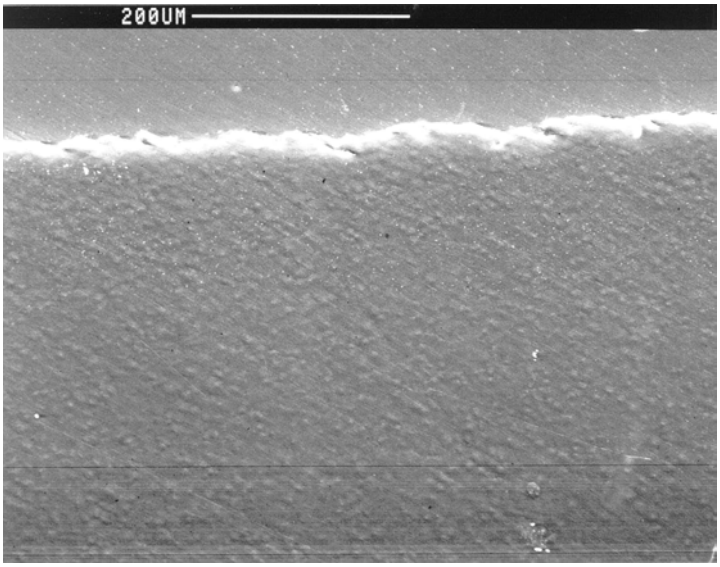

FIGURE 4
General view of the cavitated edge

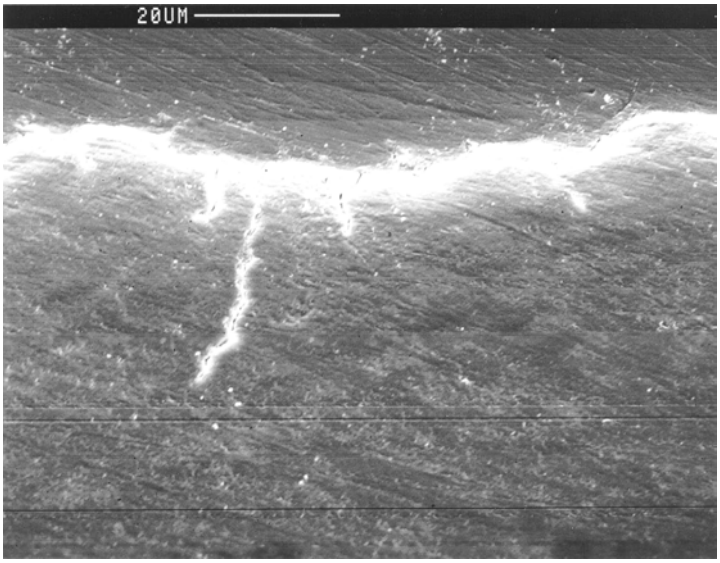

FIGURE 4
The cavitated edge
at higher magnification