DEZINCIFACATION OF COPPER ALLOYS IMPELLERS USED FOR POTABLE WATER PUMPIMG

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Introduction

- In this paper we present the results of investigation of impellers failure made of:
- Silicon brass: UNS C87500 -*14.6%Zn, 3.75%Si*
- Silicon bronze: UNS C87600-*6.6%Zn, 3.37%Si*
- The two types of impellers failed after very short time.
- Dezincification is less excepted when zinc content is below 15%

Corroded Impeller
UNS C87600: Zn 6.6%, Si 3.8%

Corroded Impeller
UNS C87500: 14.6%Zn, 3.75%Si

Corroded Impellers

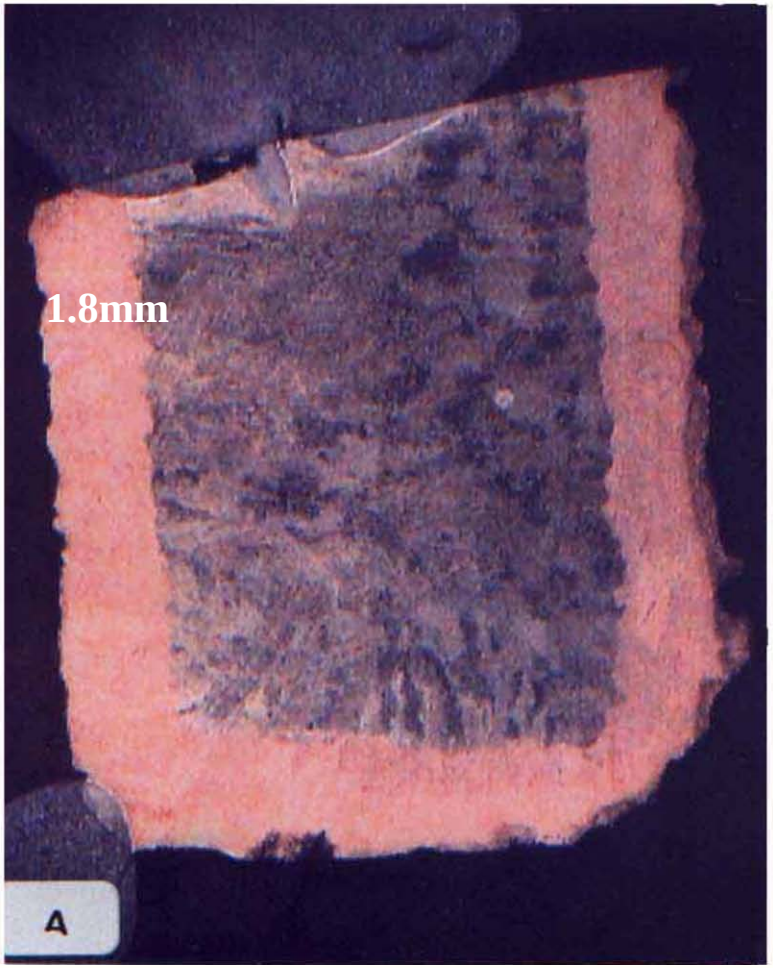
UNS C87500: 14.6%Zn, 3.75%Si

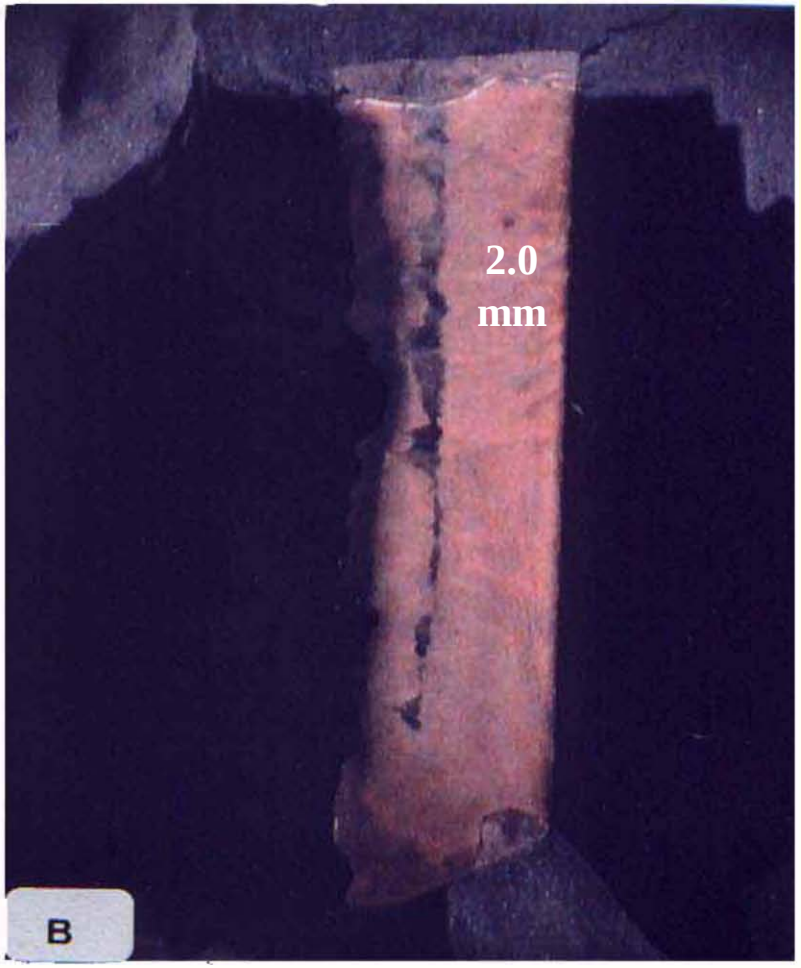
UNS C87600: 6.6% Zn, 3.8%Si

RESULTS

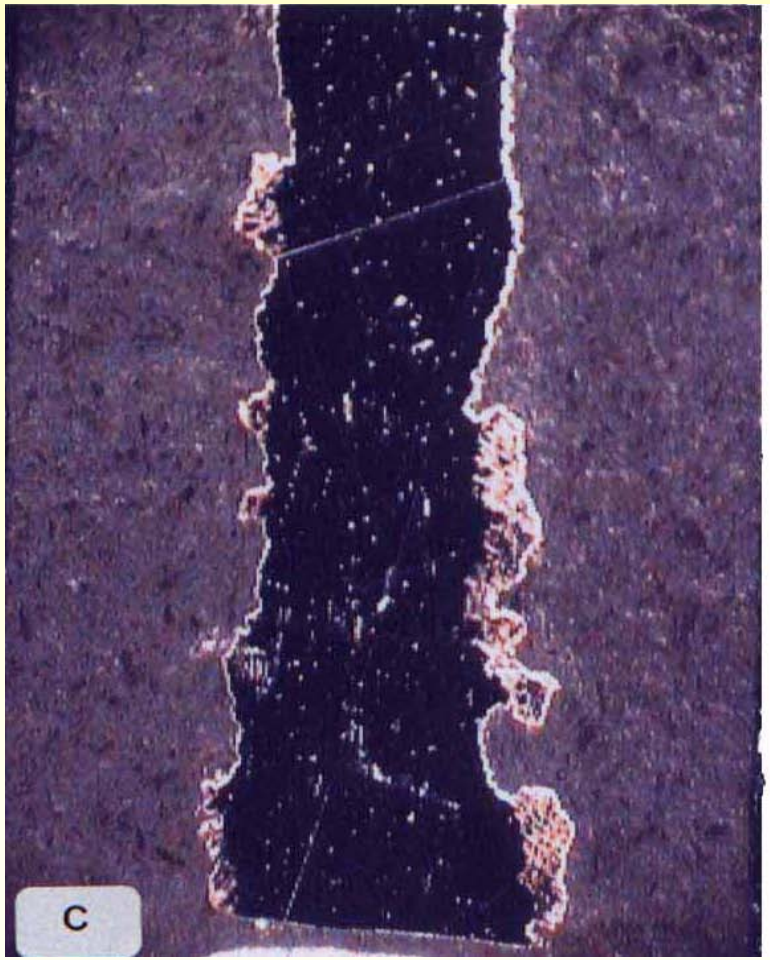
Cross-Section

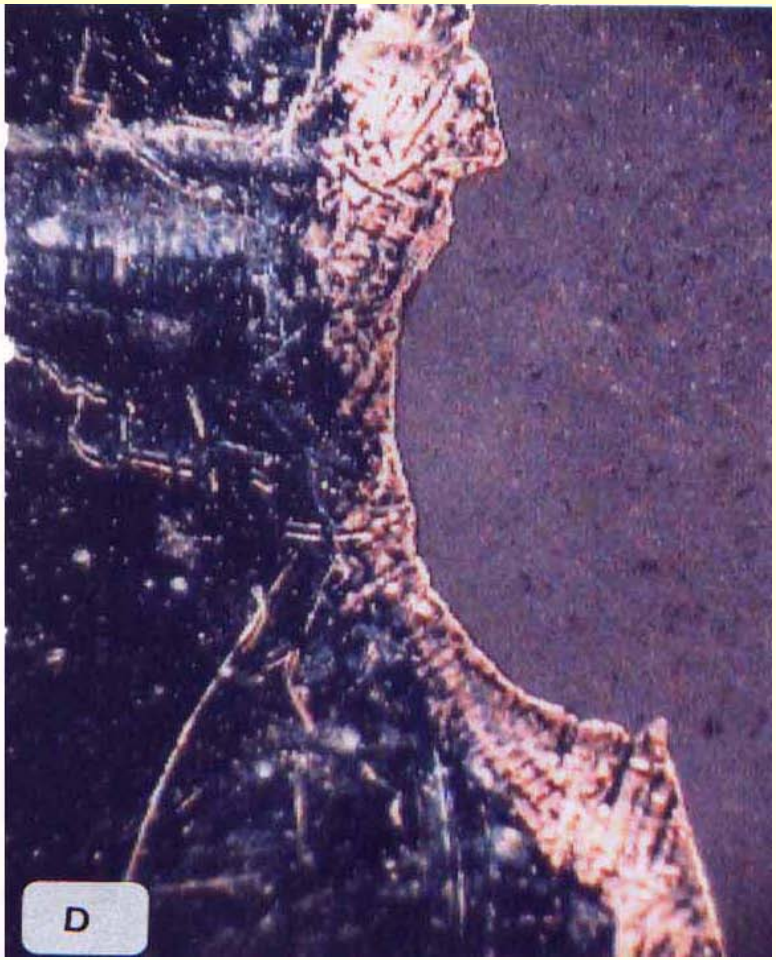
UNS C87500: 14.6%Zn, 3.75%Si





UNS C87500: 14.6%Zn, 3.75%Si





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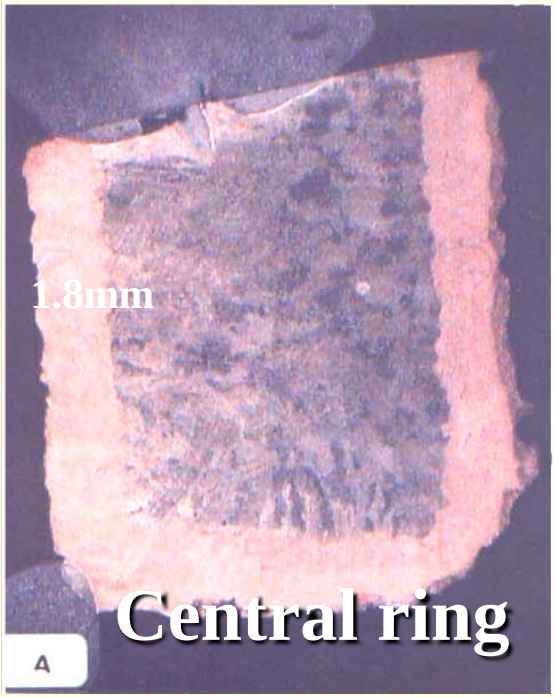
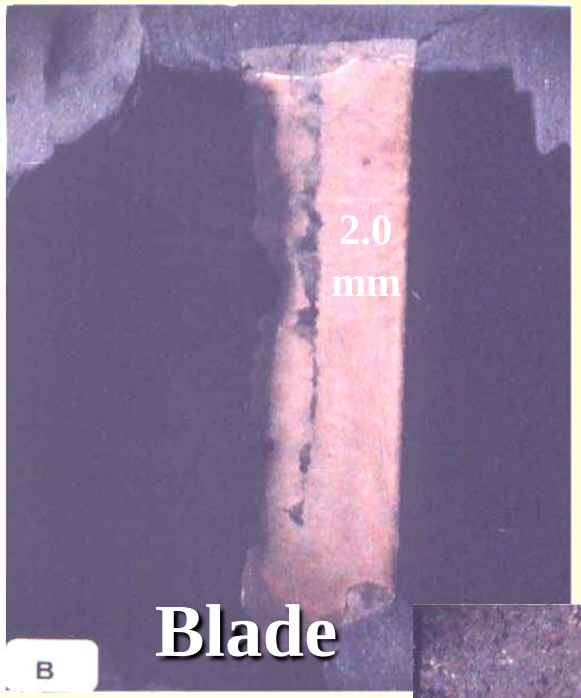
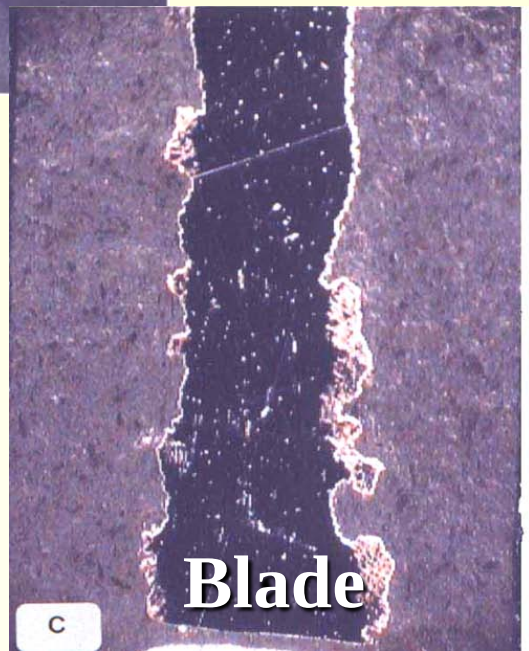
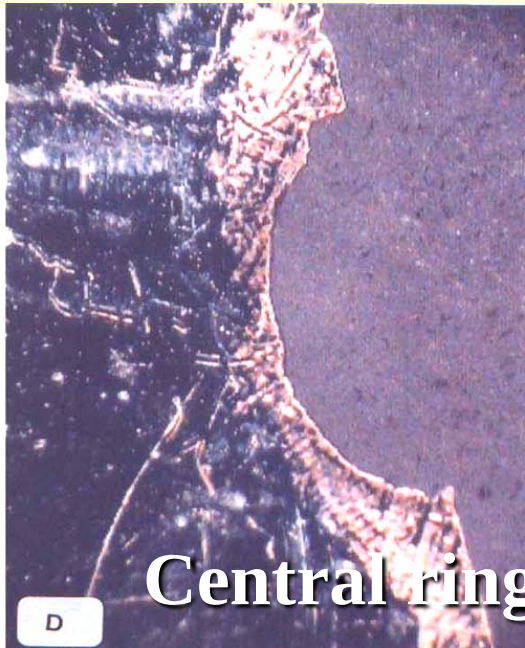




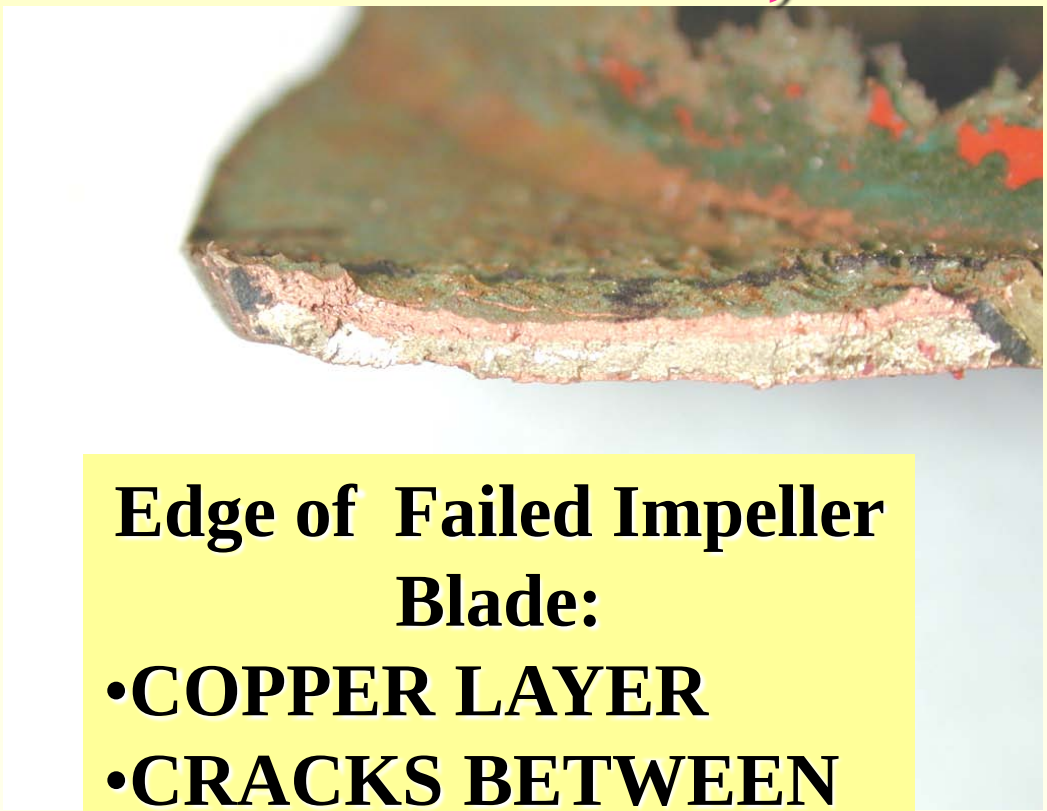
CrossSections

- Layer type dezincification
- Erosion of copper layer





UNS C87600:6.6%Zn, 3.37%Si



Edge of Failed Impeller Blade:

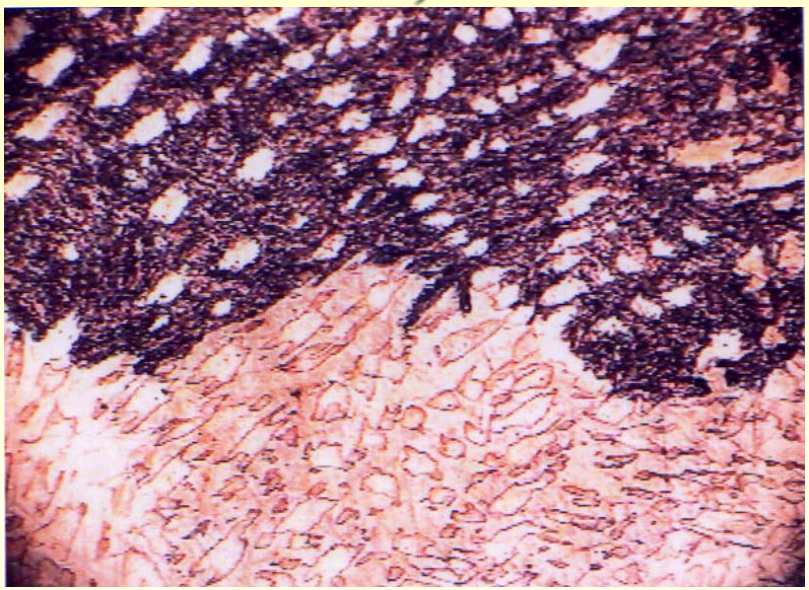
- **COPPER LAYER**
- **CRACKS BETWEEN COPPER LAYER AND UNCORRODED ZONE**

Microhardness

UNS No.	Yellow Region HV	Pink Region HV
C87500 14.6%Zn, 3.75%Si	195-210	40-60
	195-200	55-60
C87600 6.6%Zn, 3.37%Si	170-190	100-105

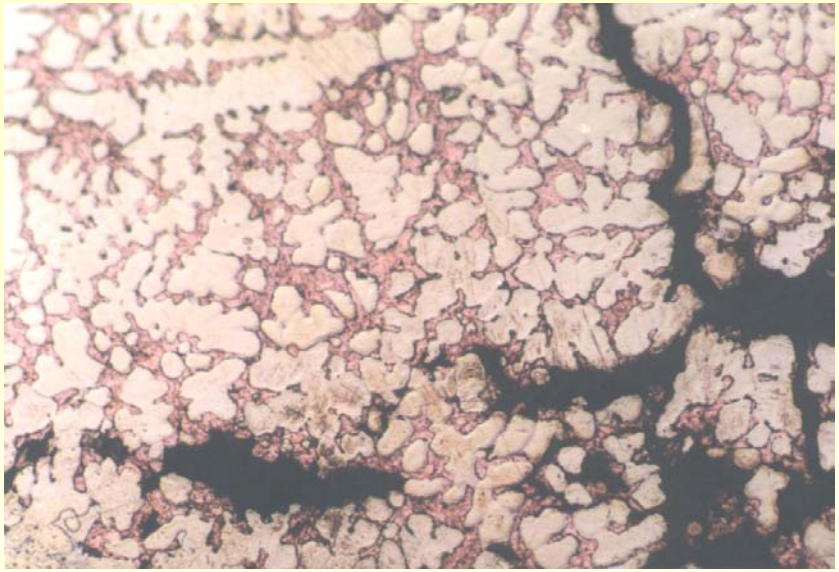
Metallographic Examinations

UNS C87500:
14.6%Zn, 3.75%Si



Copper layer

UNS C87600:
6.6%Zn, 3.37%Si



- Copper rich zones at grain boundaries
- Cracks at grain boundaries

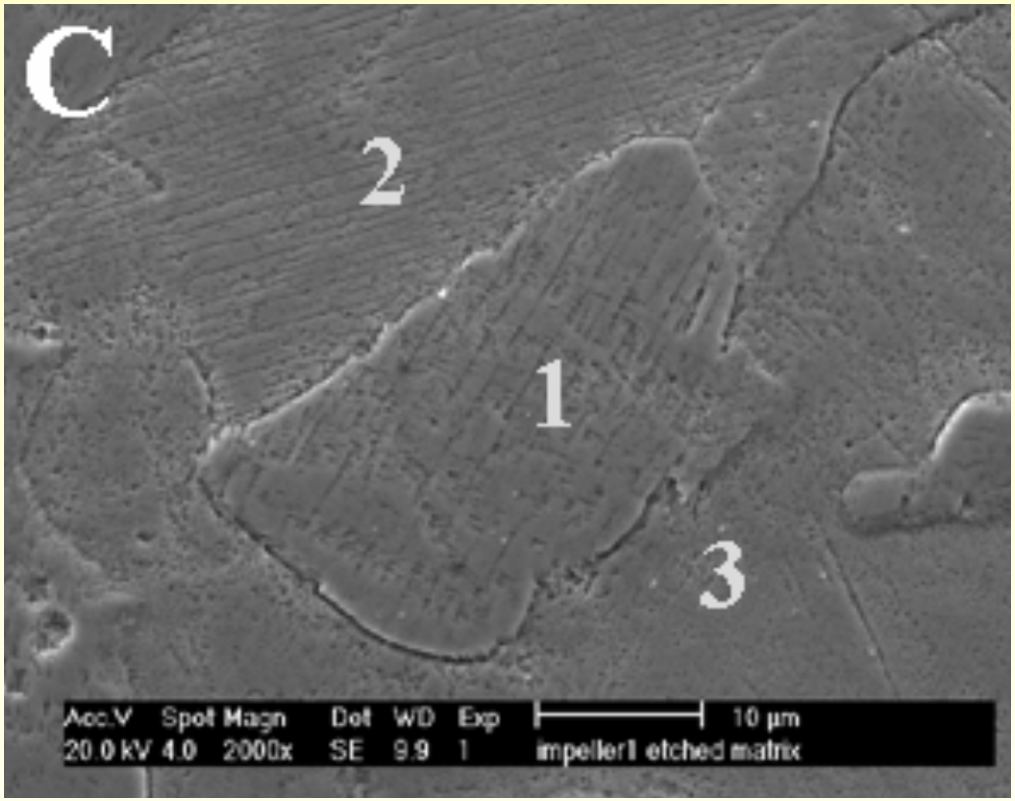
SEM and EDS

Cross-section

UNS C87600:6.6%Zn, 3.37%Si

	1	2	3	4	5
Si		5.4	3.3	2.7	2.2
Cu	100	88.4	90	88.7	90
Zn		6.2	6.6	8.5	7.6

UNS C87500: 14.6%Zn, 3.75%Si

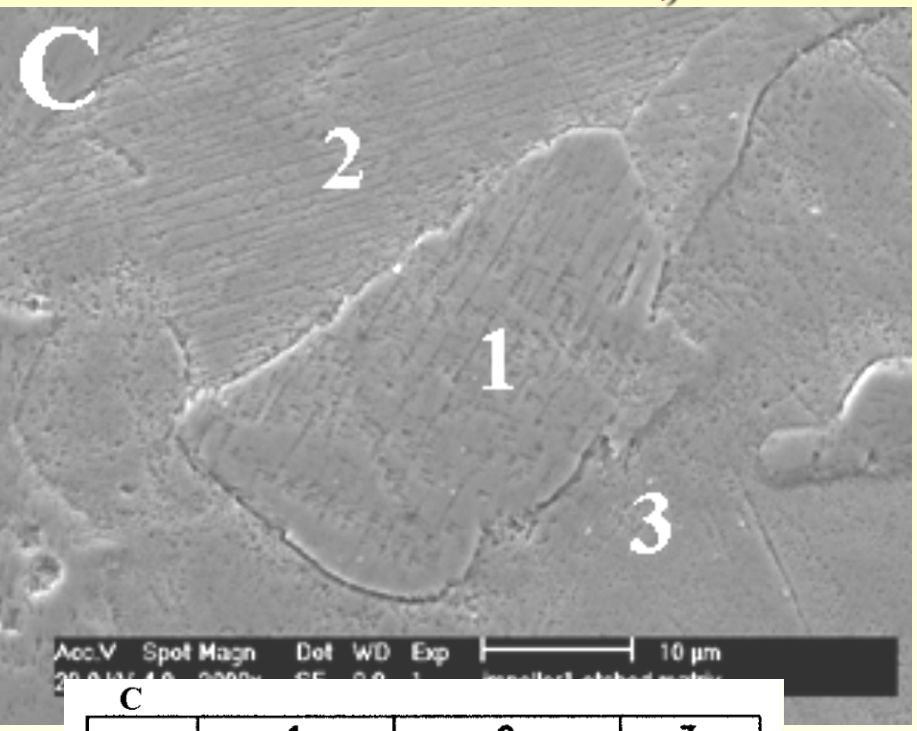


C

	1	2	3
Si	4.7	3.6	3.6
Cu	82.8	83.4	83.4
Zn	12.5	14.1	14.1

SEM and EDS

UNS C87500: 14.6%Zn, 3.75%Si



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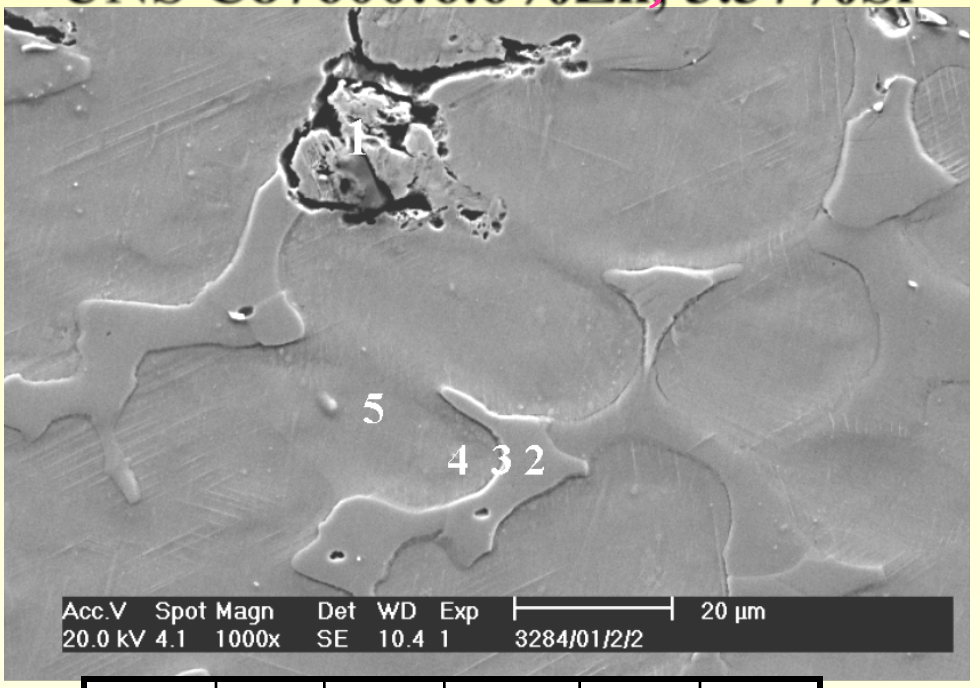
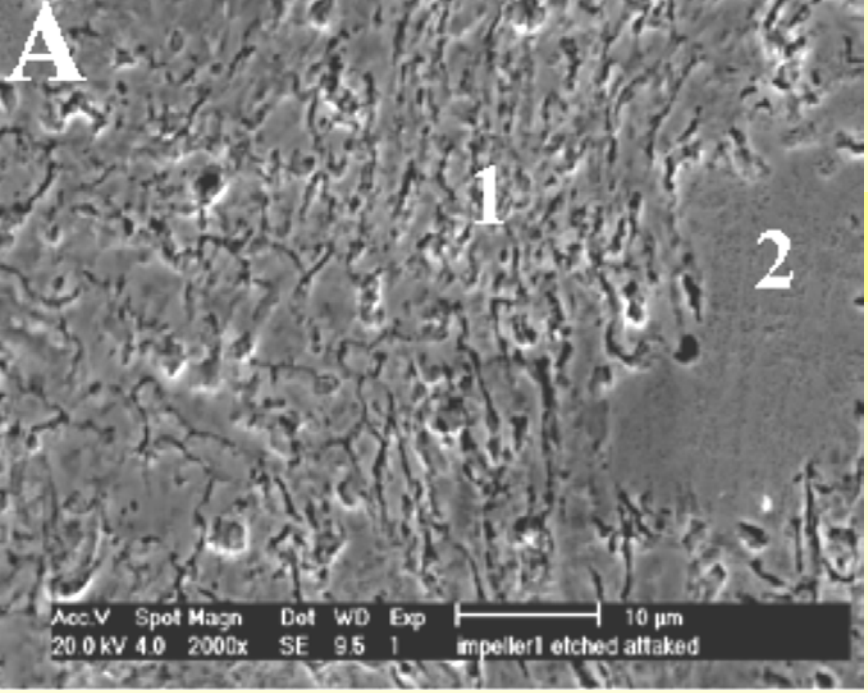
UNS C87600:6.6%Zn, 3.37%Si



	1	2	3	4	5
Si		5.4	3.3	2.7	2.2
Cu	100	88.4	90	88.7	90
Zn		6.2	6.6	8.5	7.6

Grains with different Si content

Higher Si content at grain boundaries



UNS C87500: 14.6%Zn, 3.75%Si

Corroded porous layer- copper layer

A

	1	2
Si	0.3	3.2
Cu	99.6	82.9
Zn	0.1	13.9

Near corroded layer – Difference in Si content

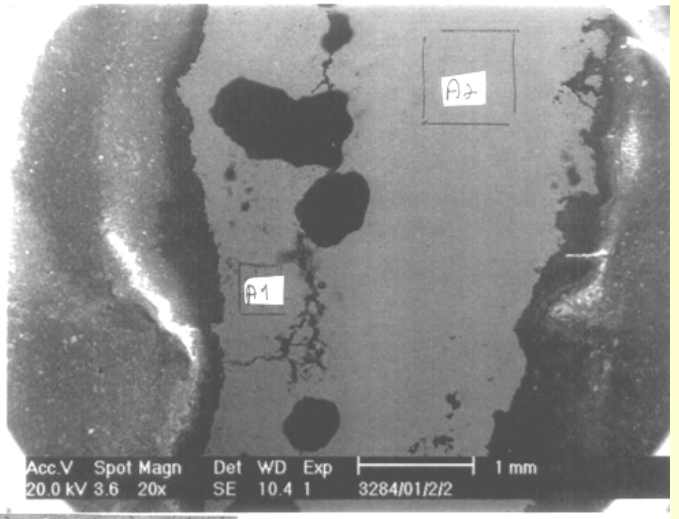
B

	1	2
Si	3.6	5.4
Cu	83.2	81.3
Zn	13.3	13.4

UNS C87600:6.6%Zn, 3.37%Si

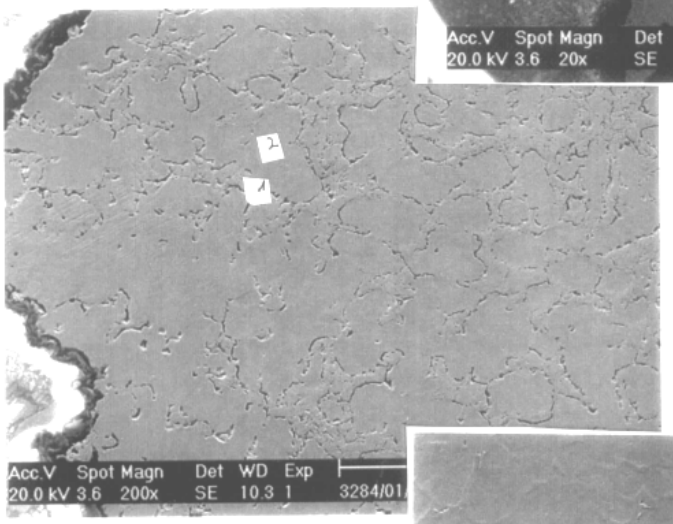
CROSS -SECTION IMPELLER BLADE

	A1	A2
Si	2.2	3.1
Zn	4.9	7.9
Cu	92.9	89.0



Corroded area

- Copper rich zone on grain boundaries
- Cracks on grain boundaries



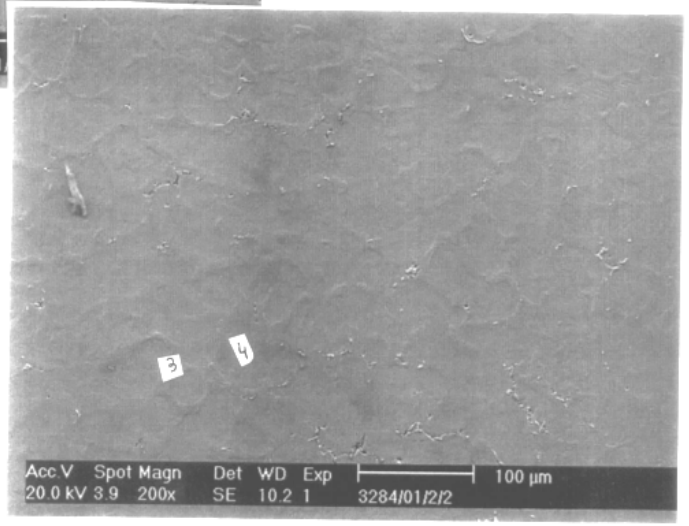
A1

	1	2
Si	1.1	2.4
Zn	-	6.8
Cu	98.9	90.8

Near corroded layer

- Higher Si content in grain boundaries

A2		
	3	4
Si	2.8	2.2
Zn	8.0	6.5
Cu	89.2	91.3



Microhardness

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Summary

UNS C87500: 14.6%Zn, 3.75%Si

The dezincification in silicon brass (about 15% Zn) had a form of:

- Pink -copper rich layer. Zinc and silicon disappeared and the remained area contained pure copper and had a porous microstructure.

- This layer had porous structure and low microhardness, and therefore, when appeared on the impeller's blade it exhibited poor mechanical properties and could failed by erosion.

UNS C87600:6.6%Zn, 3.37%Si

The dezincification of silicon bronze (about 7% Zn) was characterized by:

- Copper- rich zones on grain boundaries, having a pink color.
- Stress corrosion cracking was developed on the impeller's blade because of mechanical stresses, while dezincification without cracking was observed on the impeller's ring .
- The dezincification of this alloy containing low amount of zinc is attributed to the presence of higher amount of Si, in grain boundaries (>5%) as compared to the matrix (about 2 % Si)