ACCELERATED AND GRAVEYARD TESTS APPLIED TO BAMBOO STRIPS TREATED BY PRESSURE AND BY IMMERSION PROCESS

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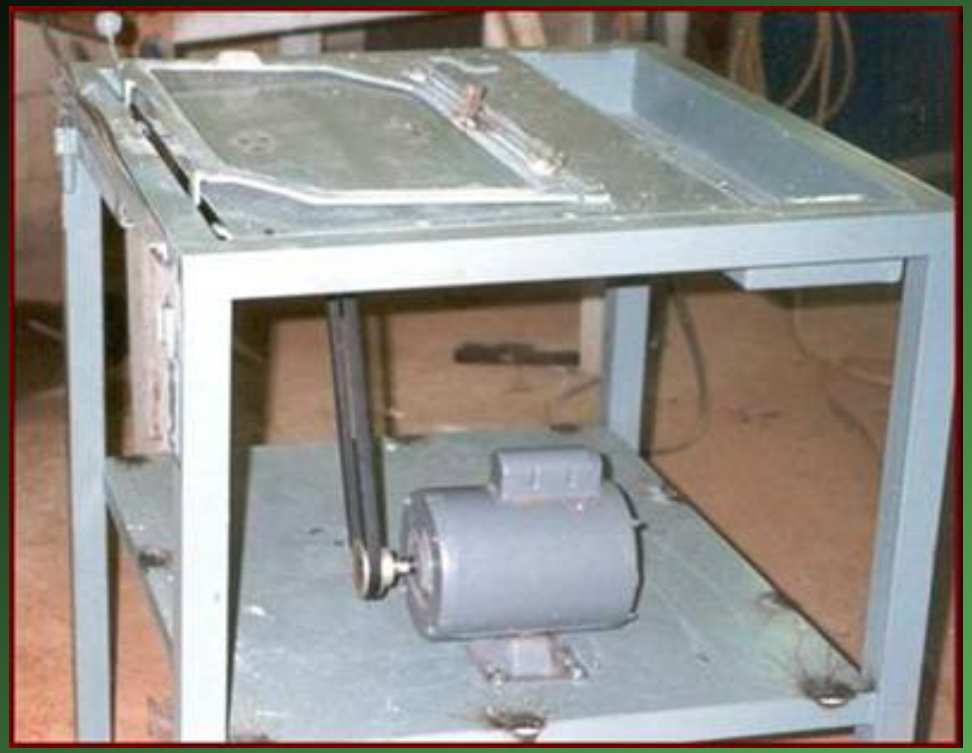
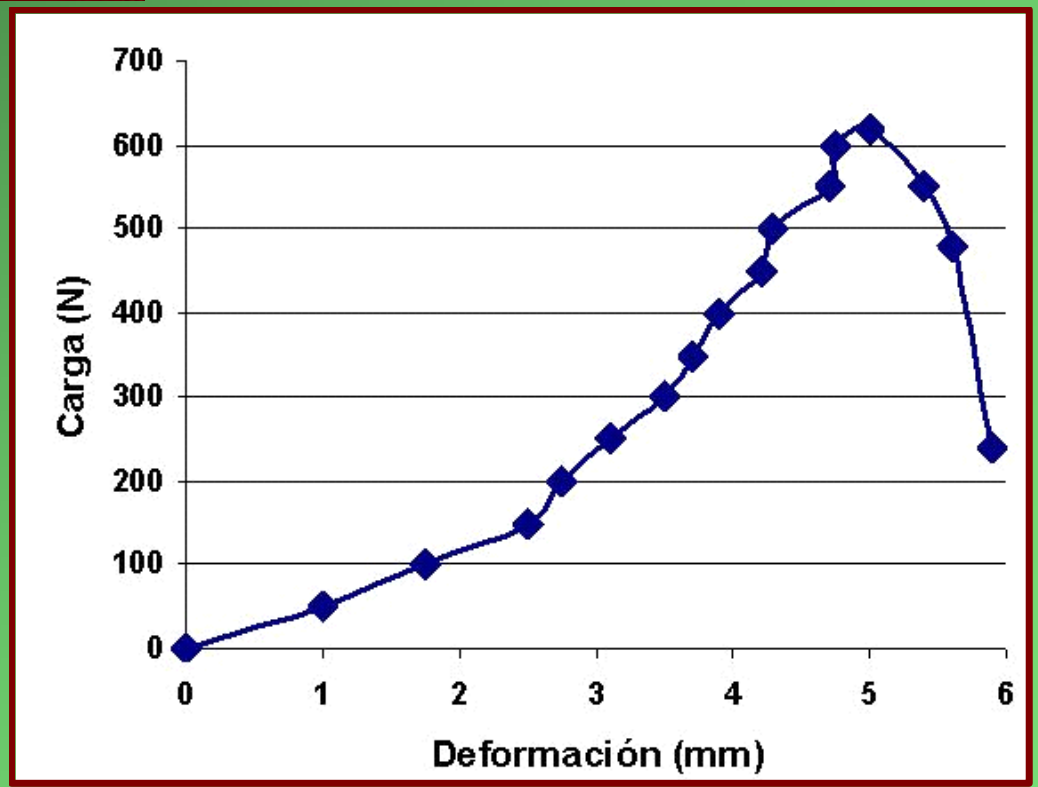


Flexão estática



Bamboo decay

Borer

Soft-rot

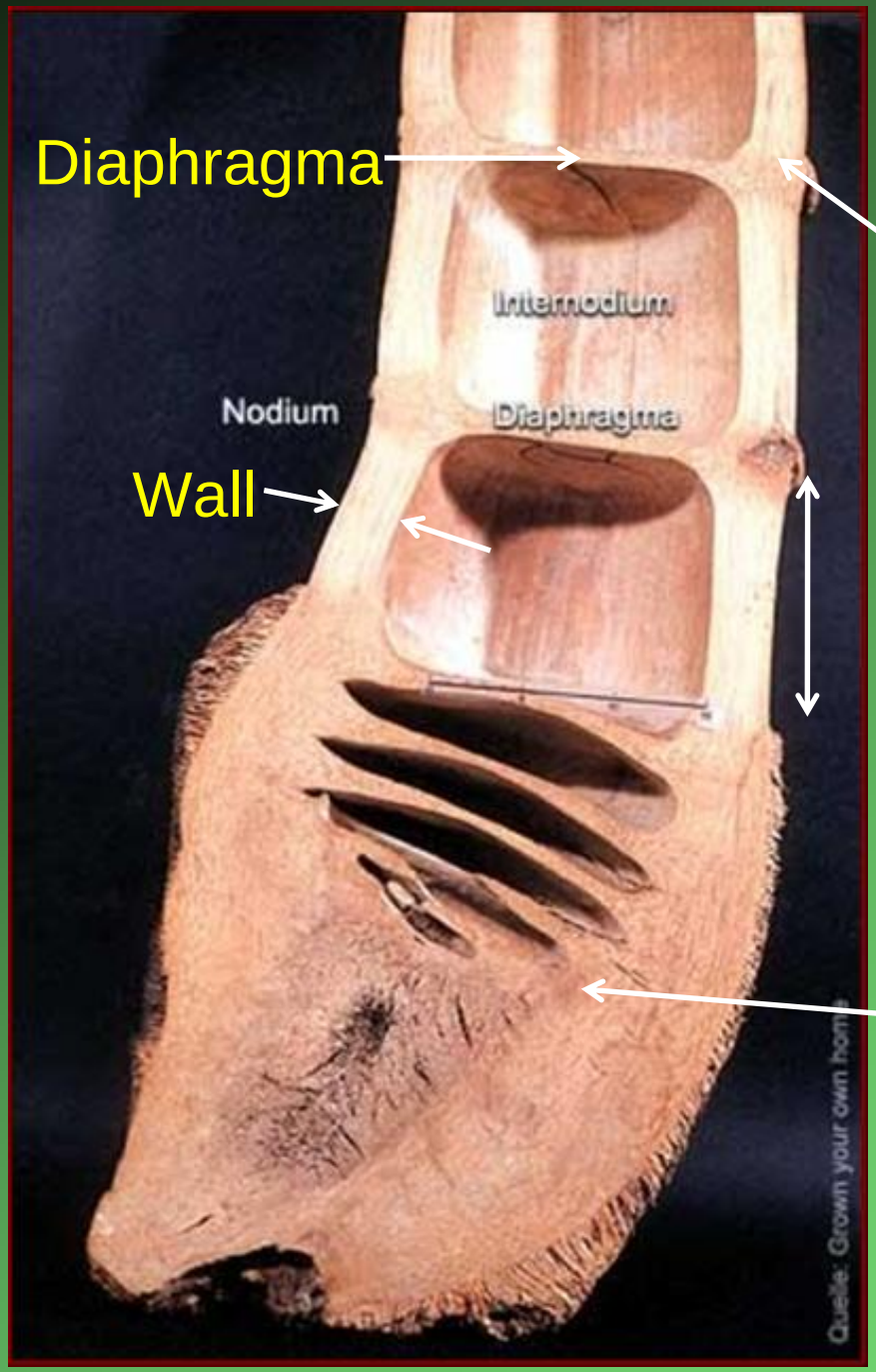
Termite

Holambra Flower Exposition

… after two months…

Bamboo anatomy

Bamboo culm longitudinal section

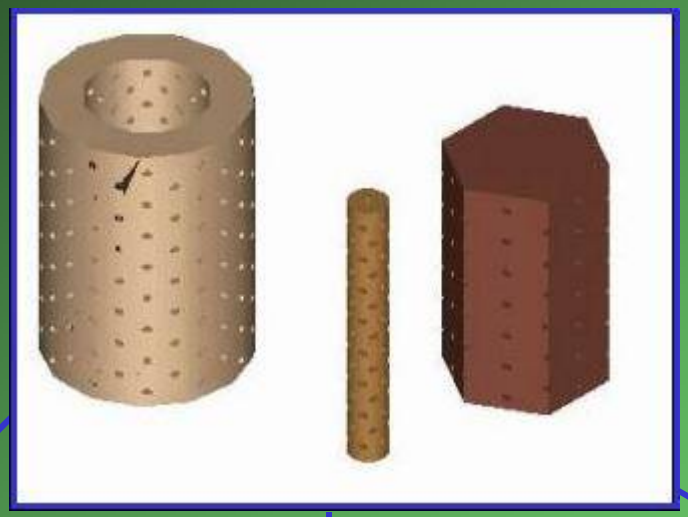


Nodium

Internodium

Rhizome

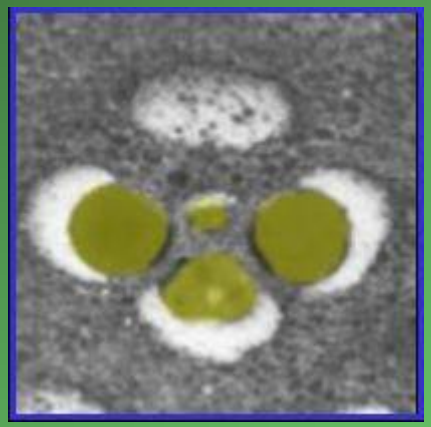
Adapted from W. Liese

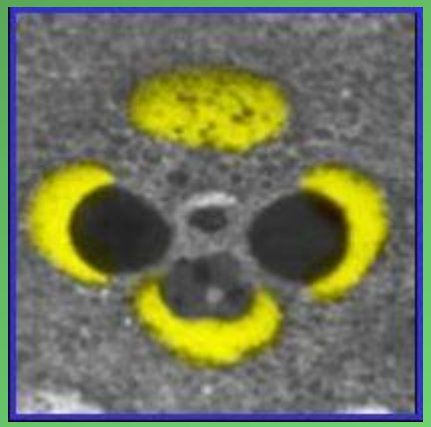


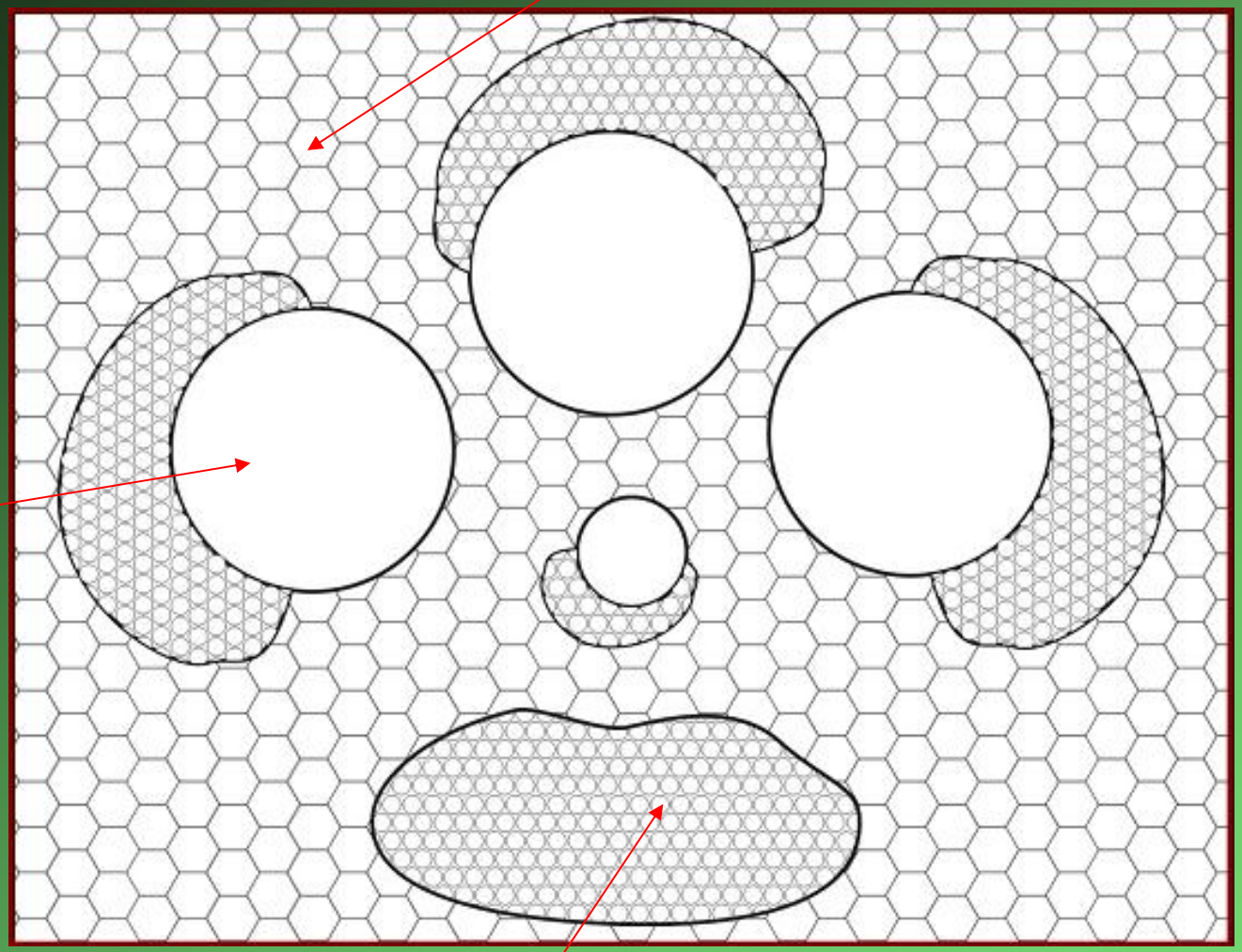
Vessel

Fiber

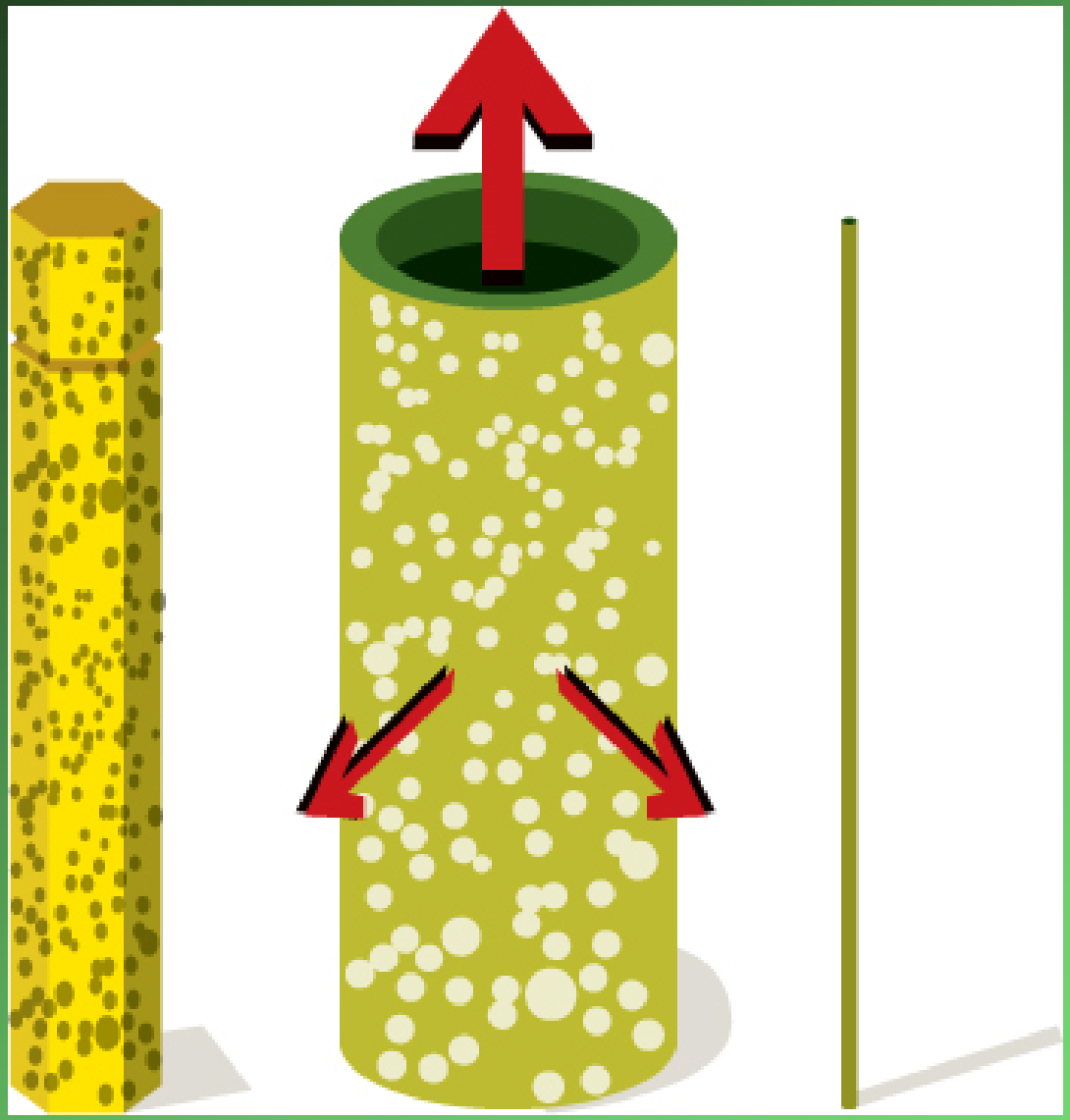
Parenchyma





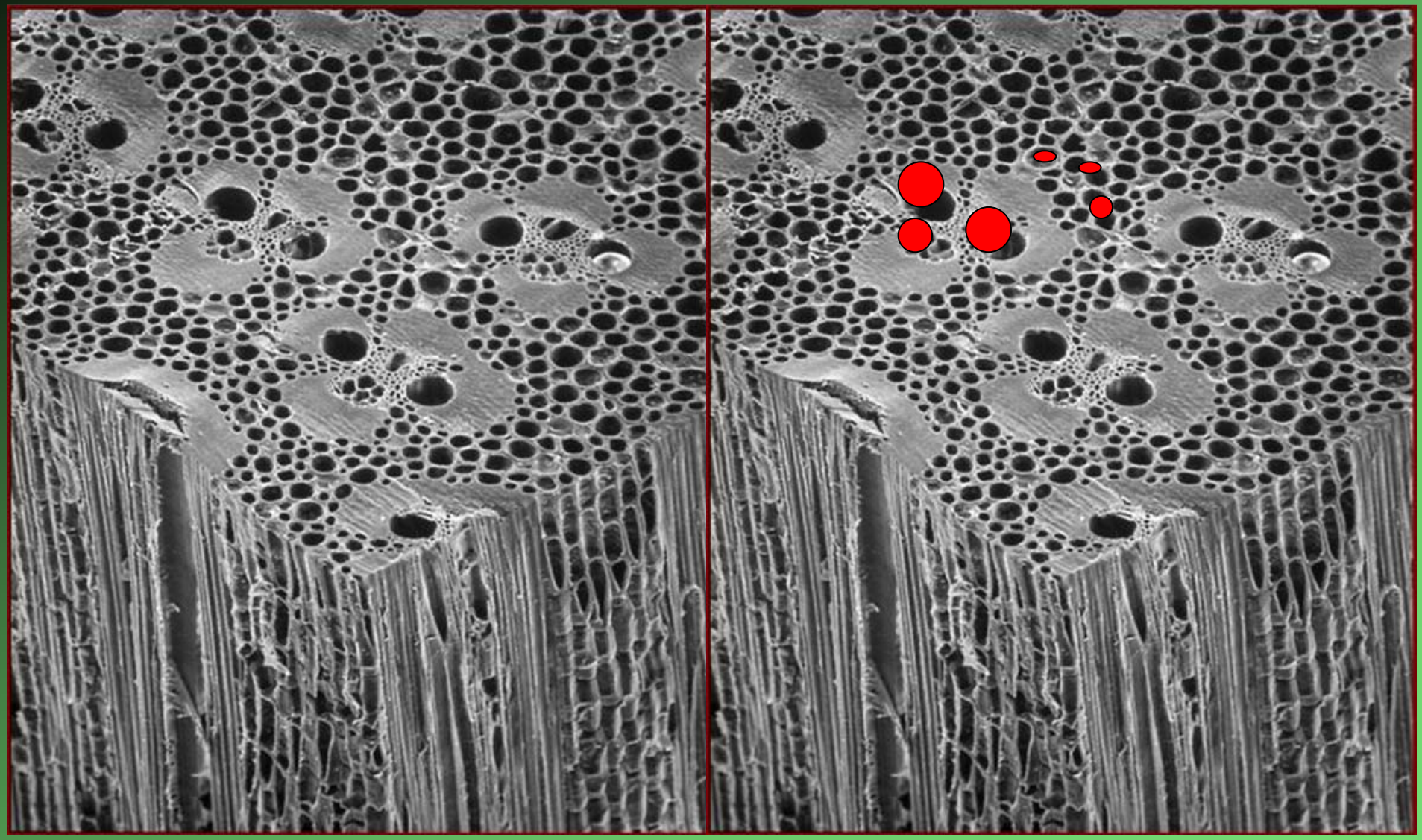

Parenchyma cells
Vessel
Bundle fibers

Parenchyma

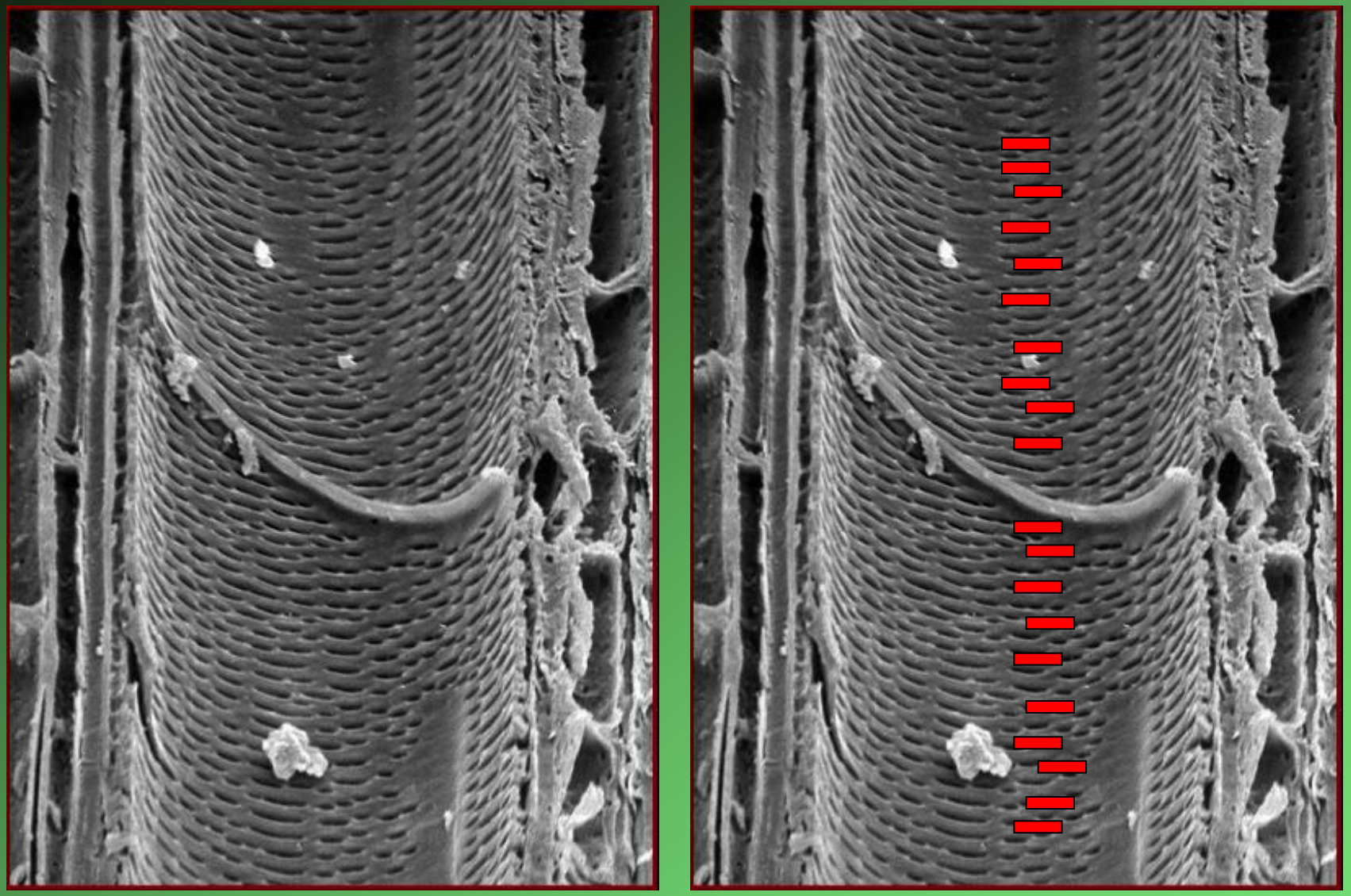


Fiber

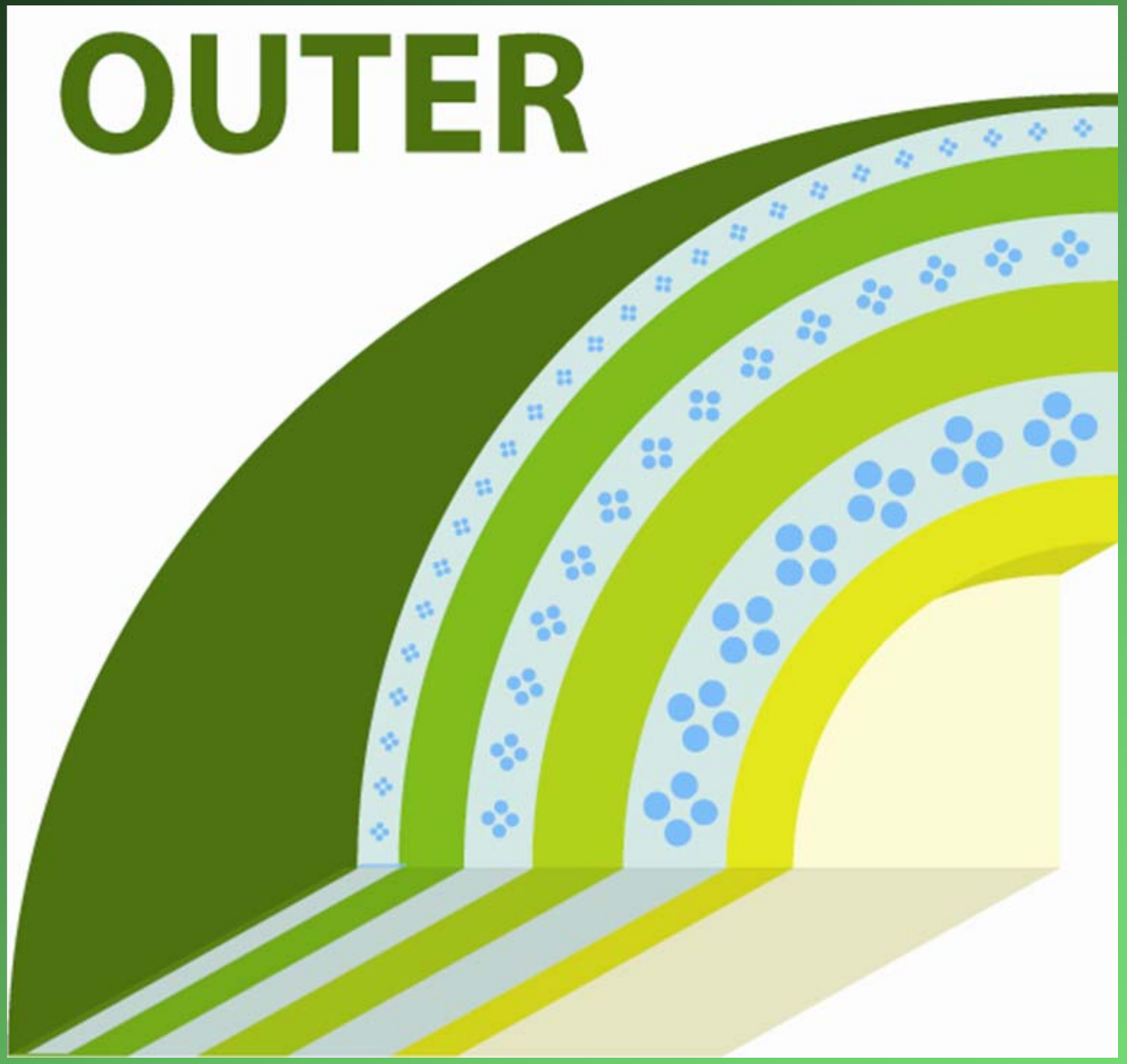
Vessel



Adapted from W. Liese

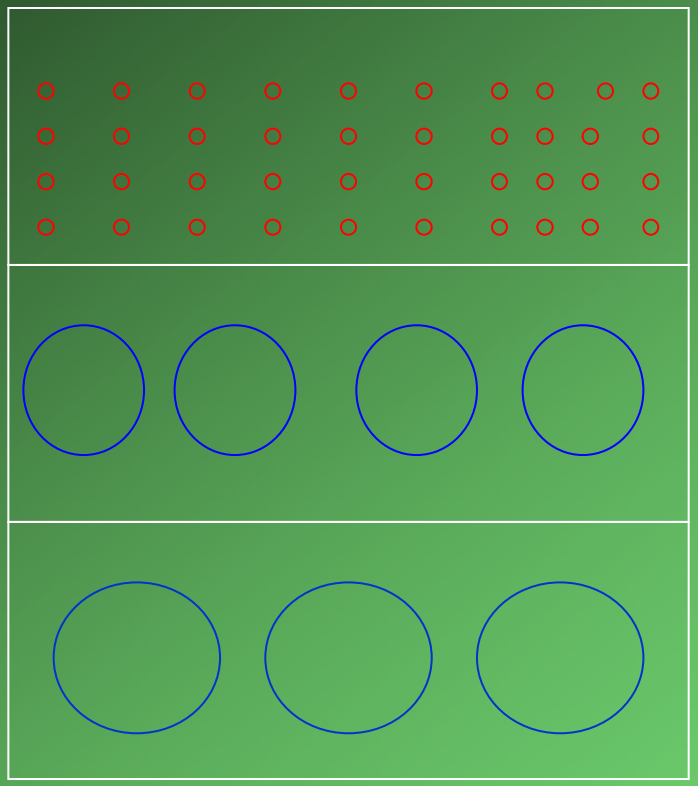


Adapted from W.Liese


OUTER

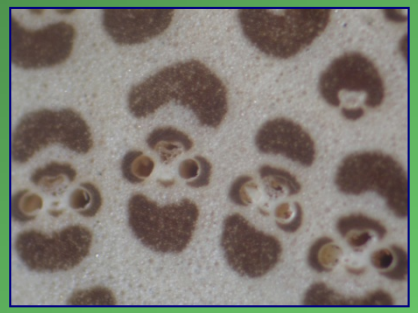
Solution flows across the bamboo cells

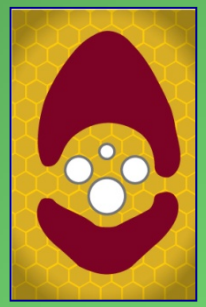
Bundle vessels



18 mm

10 mm





Diameter (μm)	Number
20	120
150	48
200	45

Friccion force ~ K.D^{-5}

Bamboo treatments

Method	Product	Retention ($kg.m^{-3}$)
By pressure	CCB	4.0; 6.5
	BaB	4.0; 6.5
By immersion	CCB 1 week	4.0; 6.5
	CCB 2 weeks	4.0; 6.5
	BaB 1 week	8.0
	BaB 2 weeks	8.0

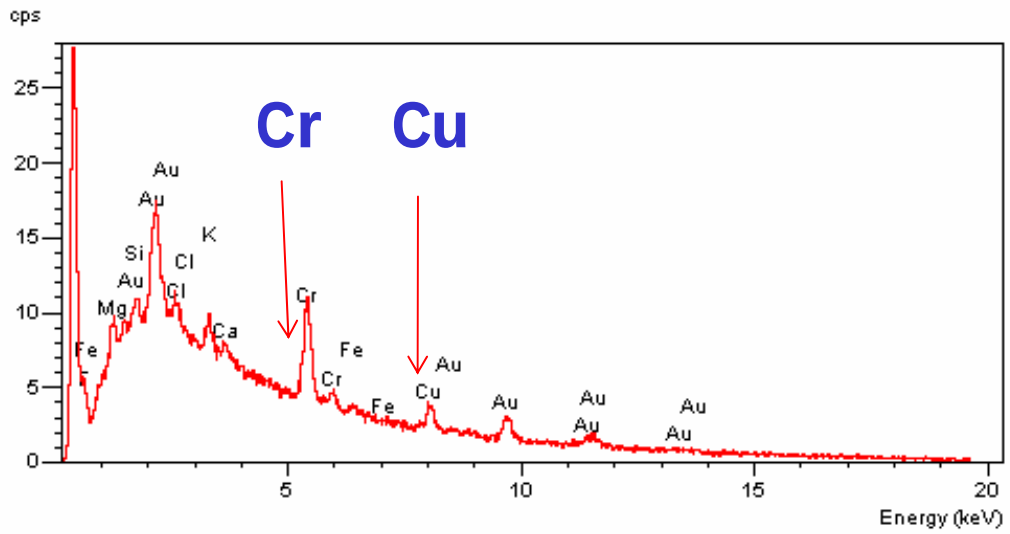
Cr=63.5% Cu = 26.0% B = 10.5%

Boric acid =40% Borax = 60%

Analysis

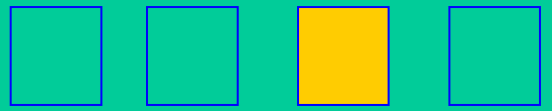
- Mass loss by Soft-rot and Termites IPT Method – Part D2
- SEM – Chemical products traceability
- Graveyard test – ASTM D-1758.02; AWPA E7-07

Traceability

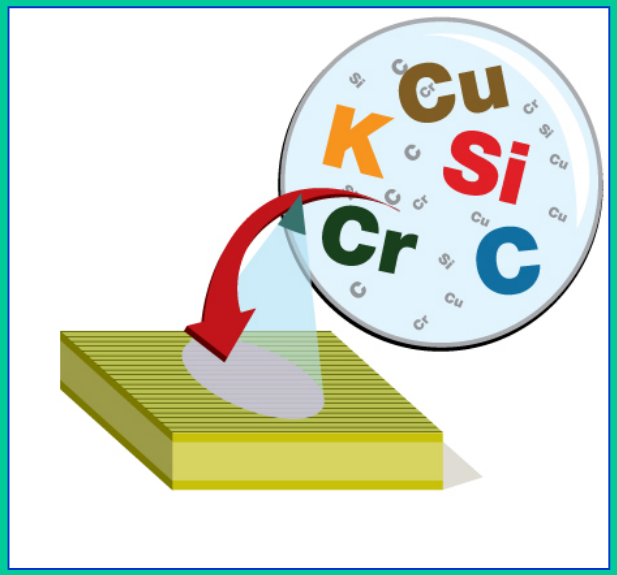


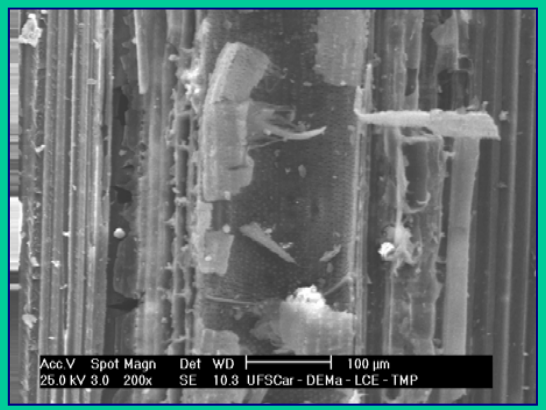
Bamboo wall

Regions



A B Vessel C





Graveyard test

Field evalution

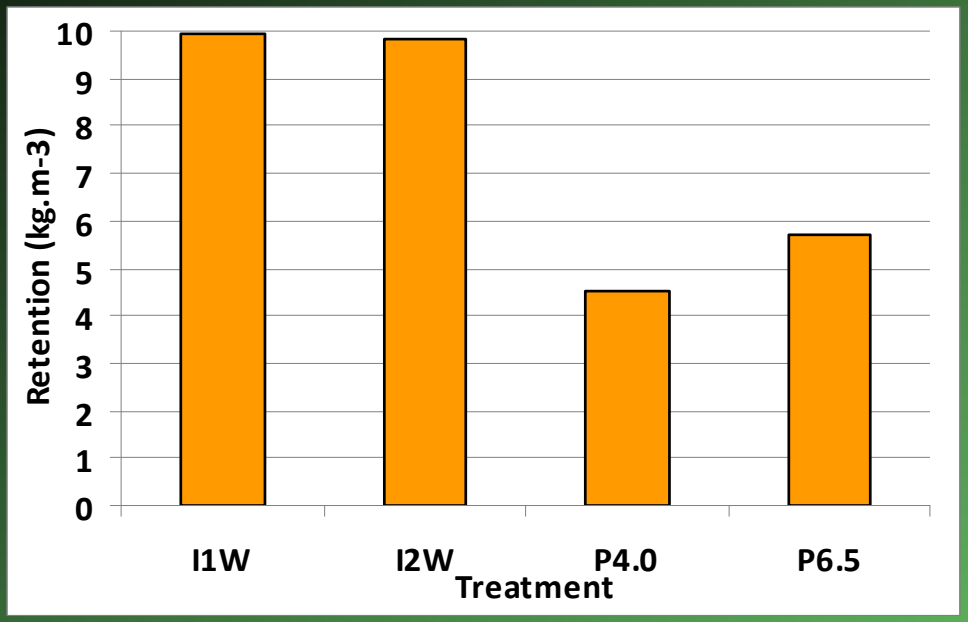
Pinus

1 Month 2 Months 8 Months

Soft-rot decay	Classification	Termites attack
Description	**Grade**	Description
Without decay or a superficial decay	**10**	Without attack, or with1 to 2 bites
0% to 3% of decay	**9**	0% to 3% of attack
3% to 10% of decay	**8**	3% to 10% of attack
10% to 30% of decay	**7**	10% to 30% of attack
30% to 50% of decay	**6**	30% to 50% attack
50% to 75% of decay	**4**	50% to 75% of attack
Destroyed	**0**	Destroyed

Results

Retention evaluation



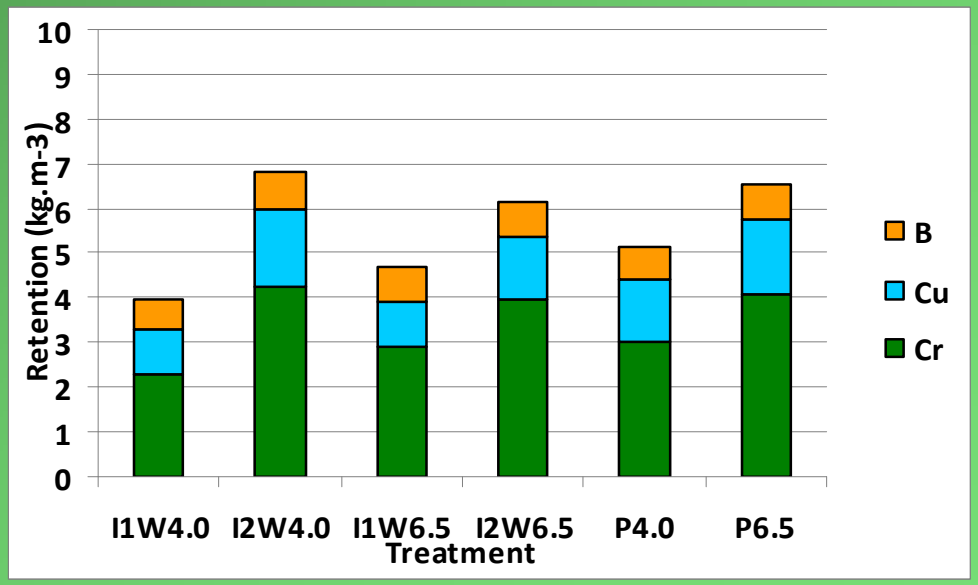
BaB

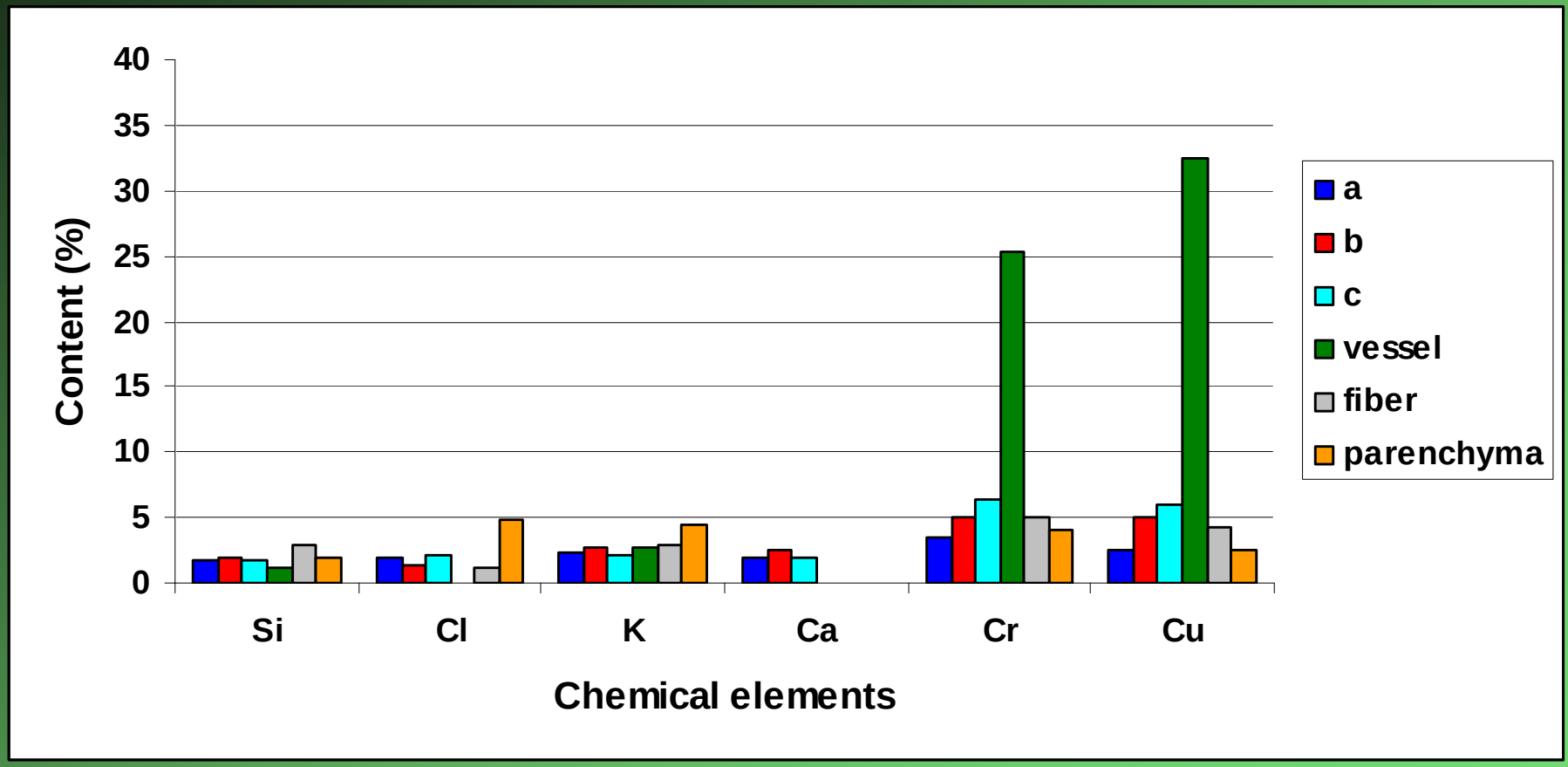
Boron

I = Immersion P = Pressure

Boron, Chromium and Copper

CCB

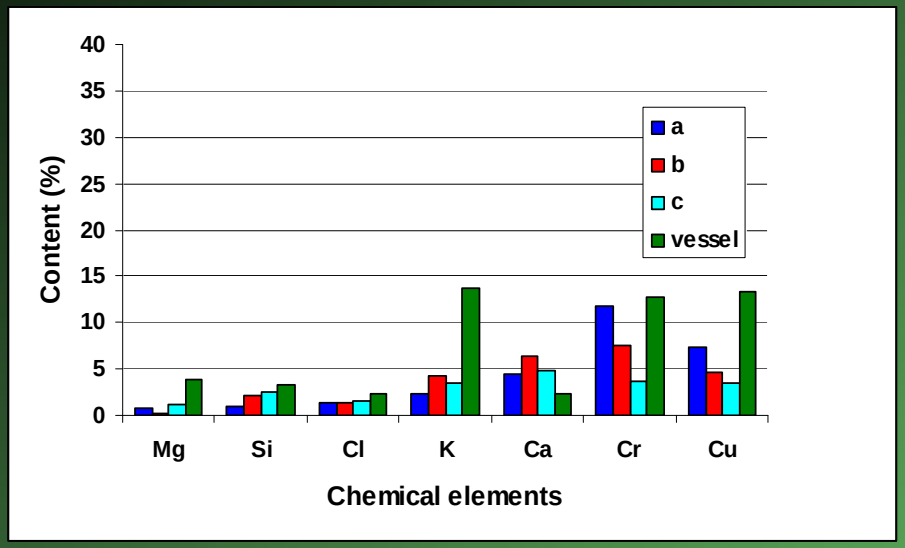



40
35
30
25
20
15
10
5
0
Content (%)
Si
Cl
K
Ca
Cr
Cu
Chemical elements
a
b
c
vessel
fiber
parenchyma

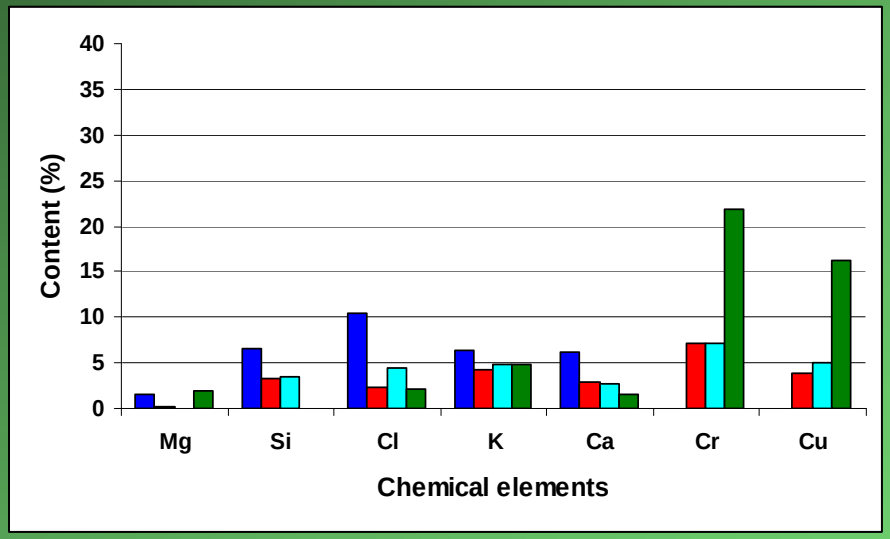
CCB

Soaking

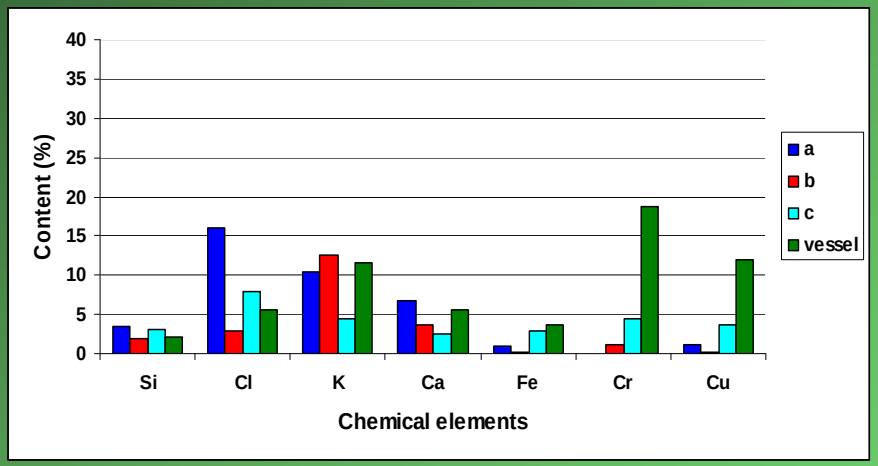
CCB



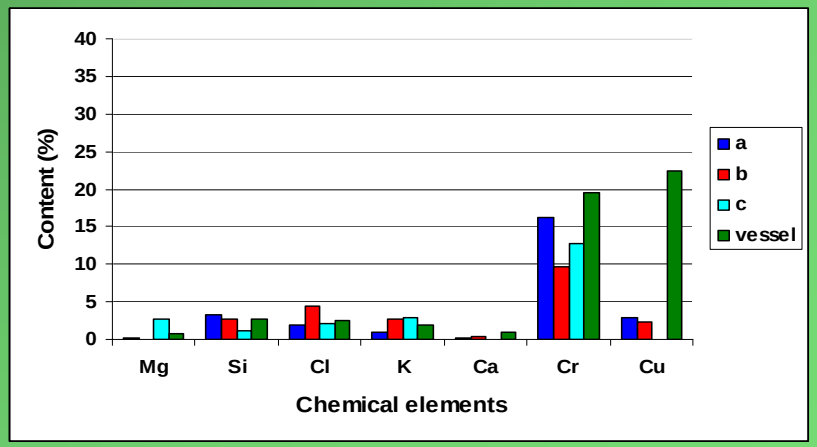
One week 4.0



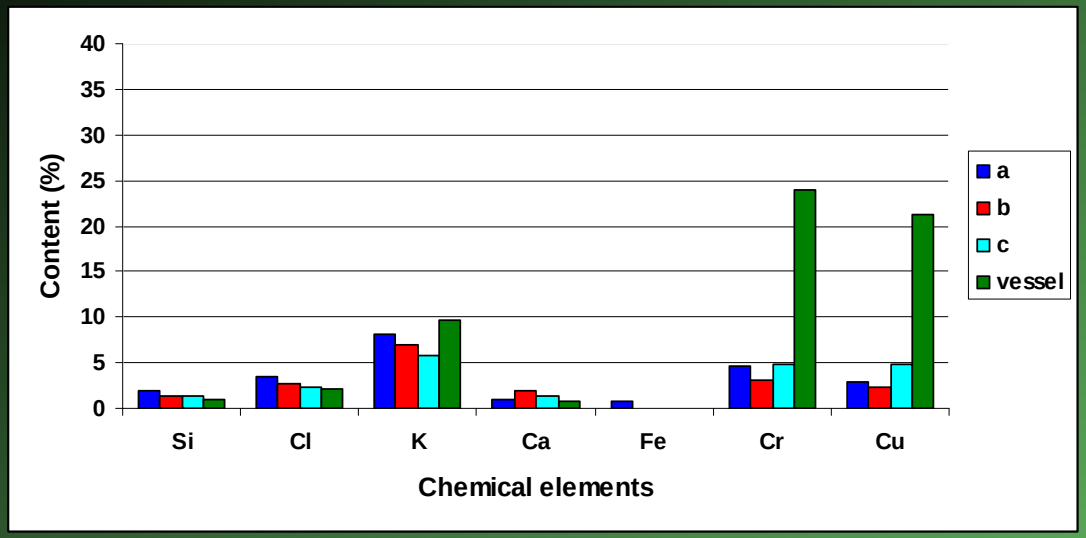
Two weeks 4.0



One week 6.5



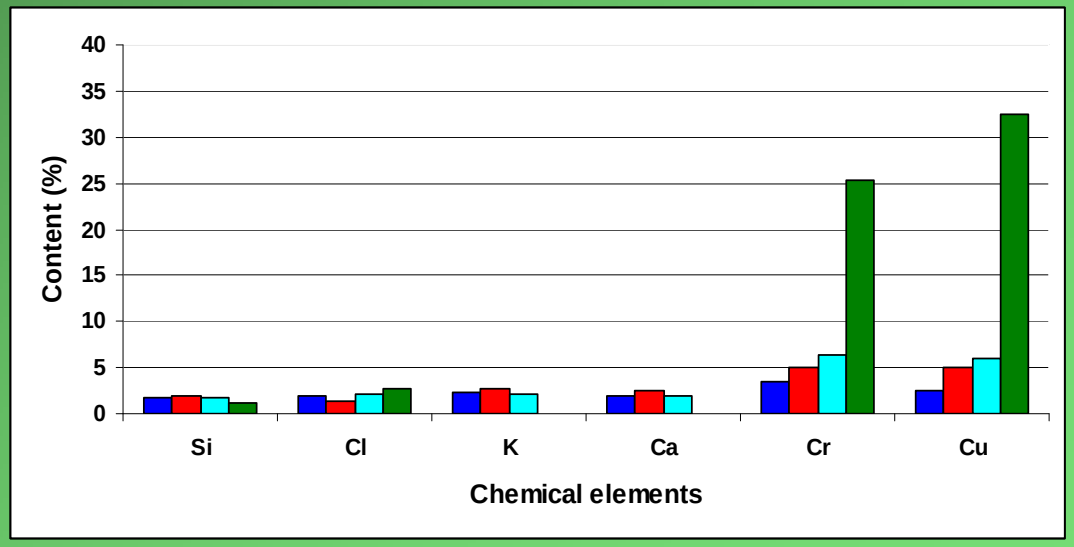
Two weeks 6.5

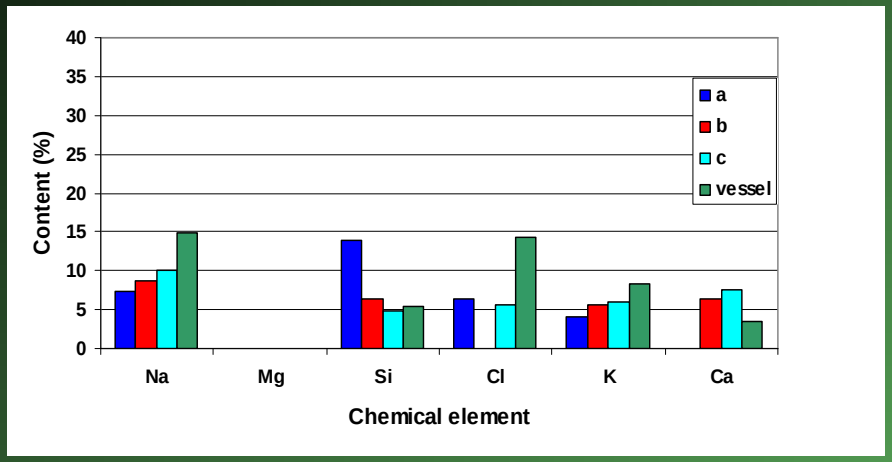


Pressure 4.0

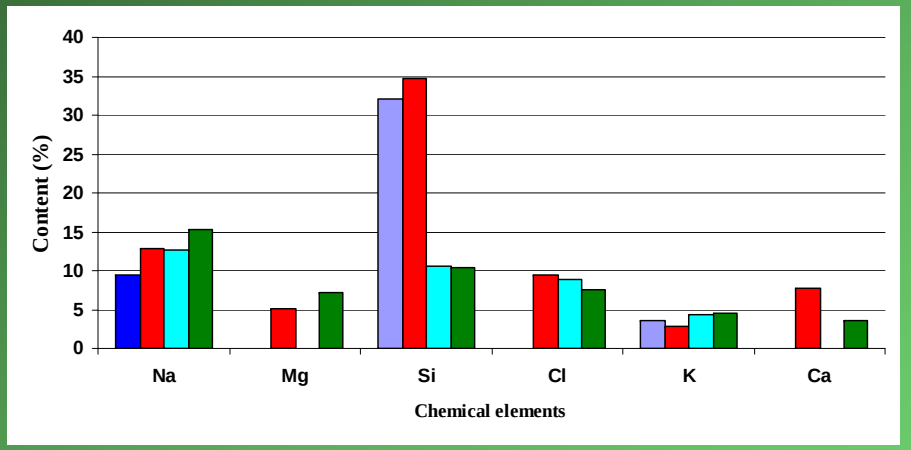
CCB

Pressure 6.5



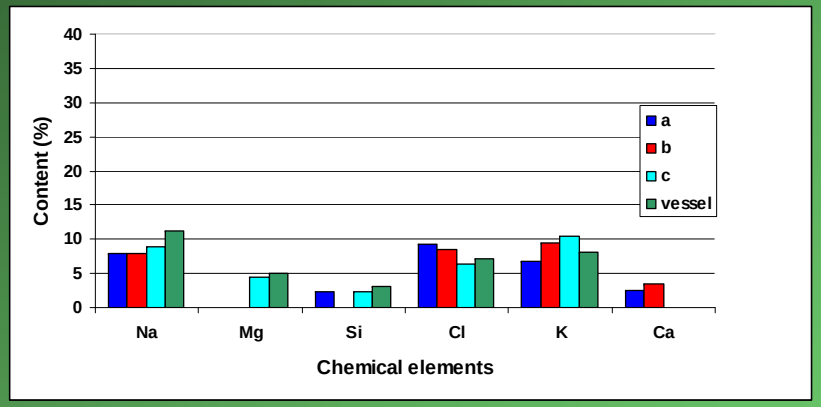


Soaking one week

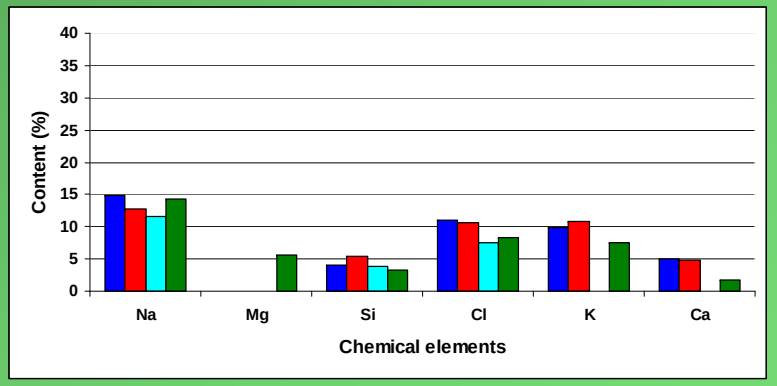


Soaking two weeks

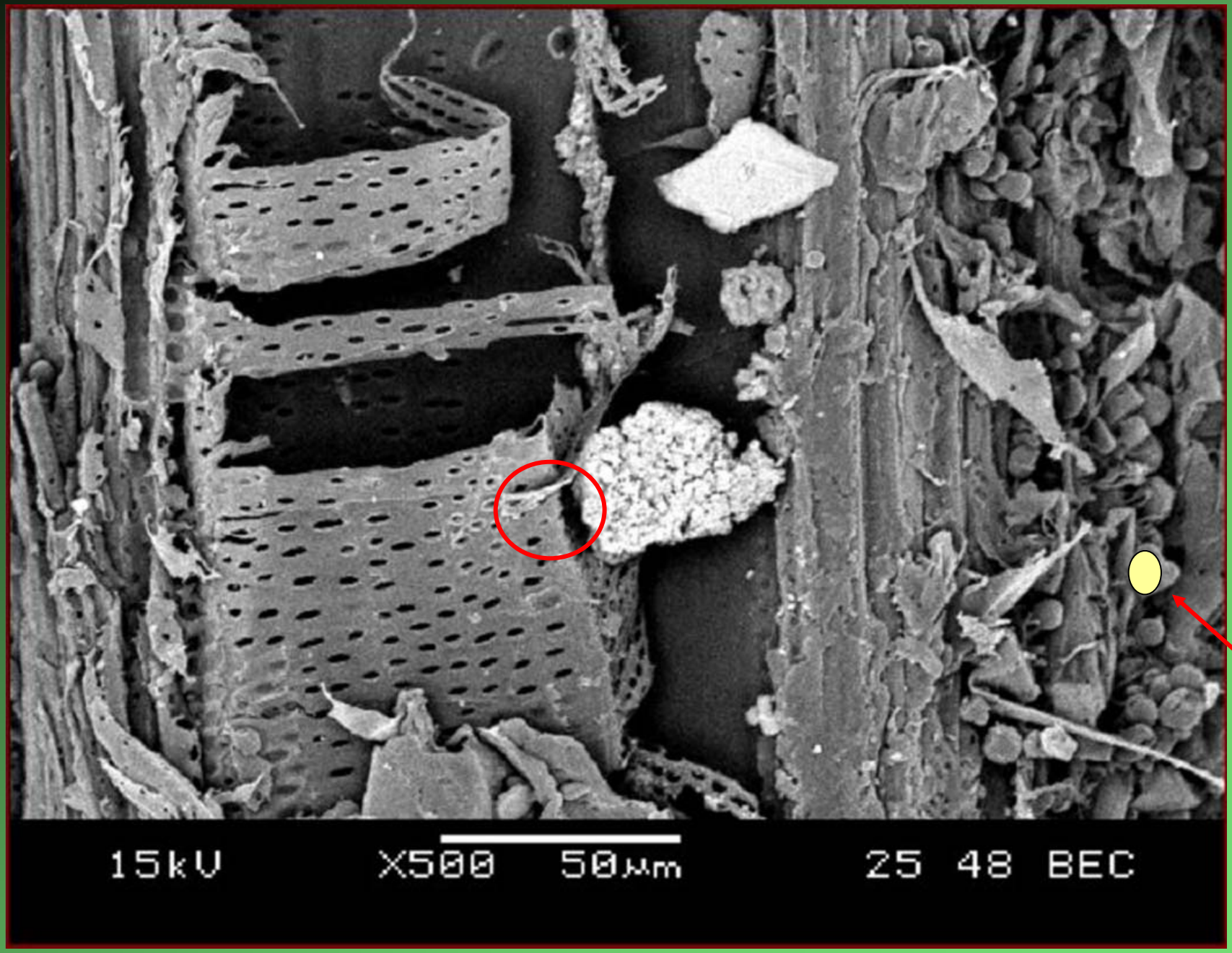
BaB

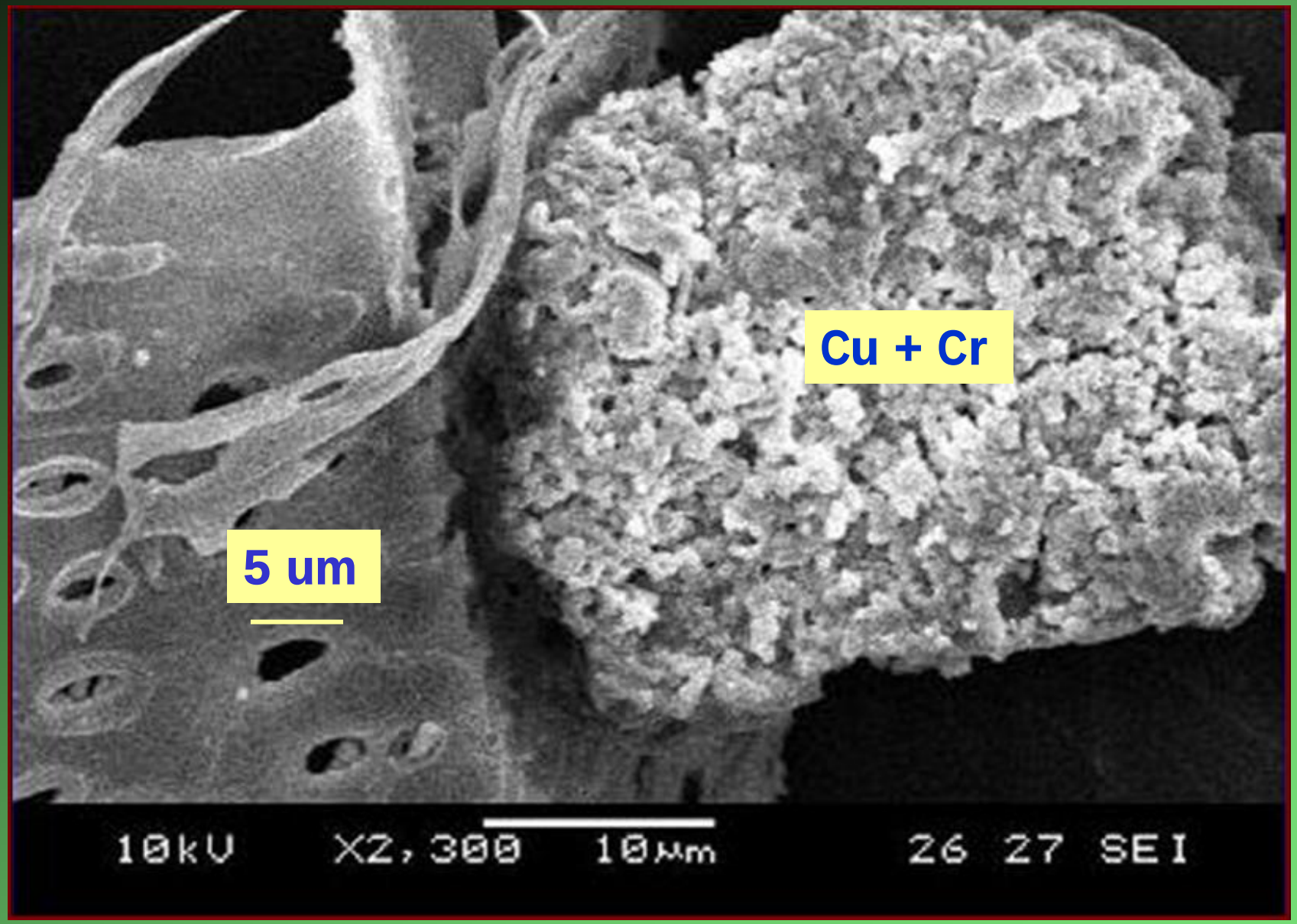


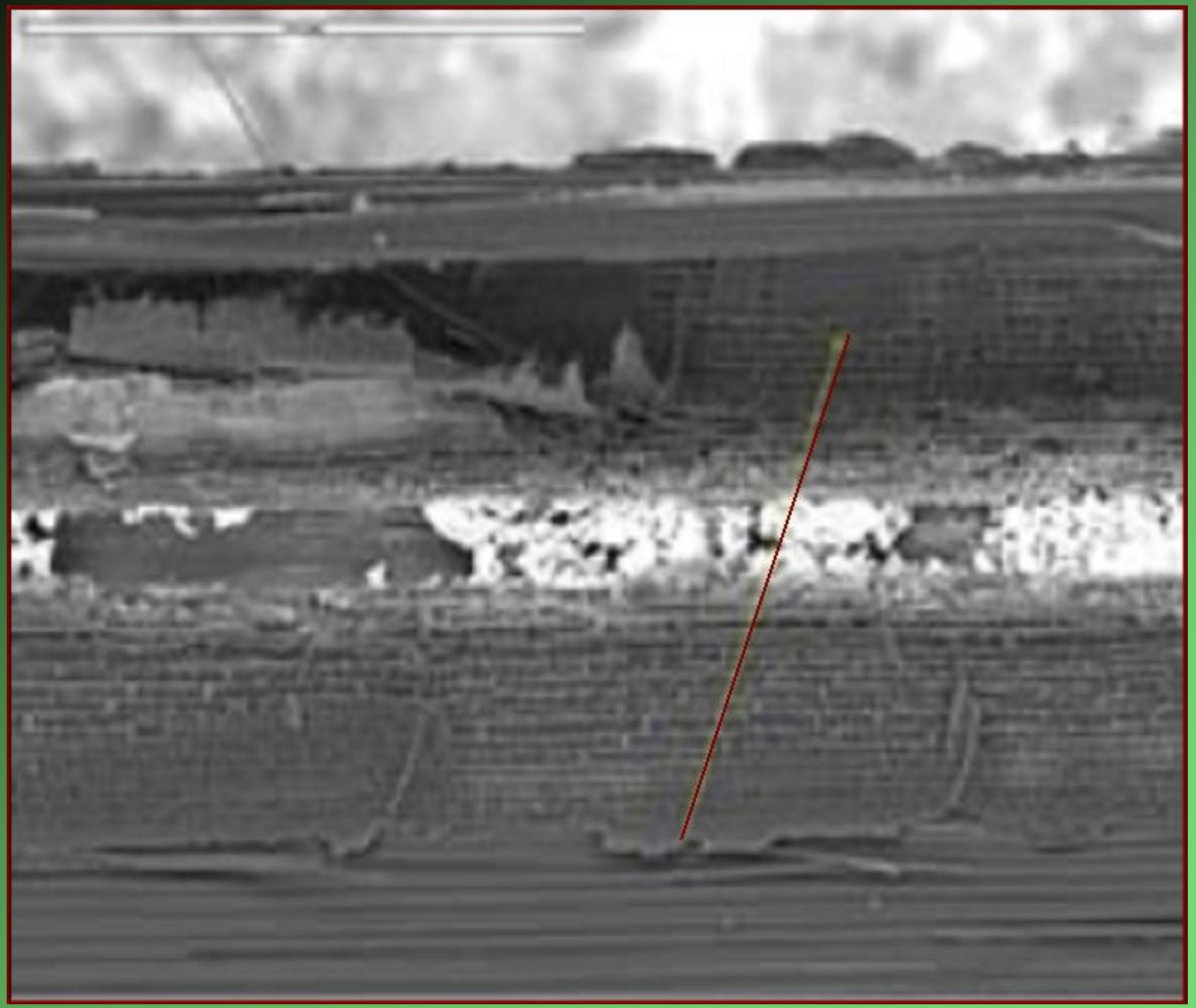
Pressure 4.0

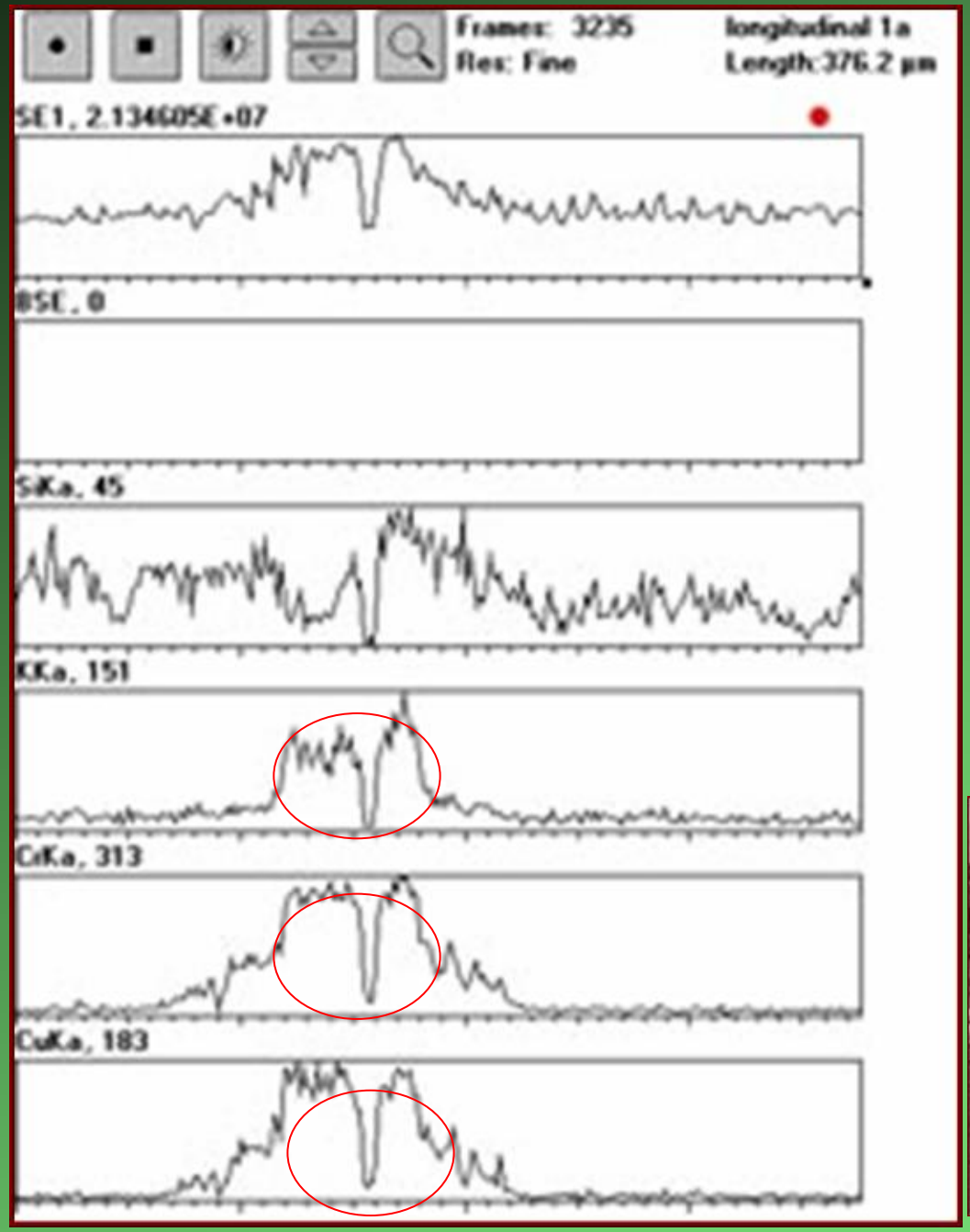


Pressure 6.5


15kV X500 50µm 25 48 BEC


Cu + Cr
5 um
10kV X2,300 10µm 26 27 SEI





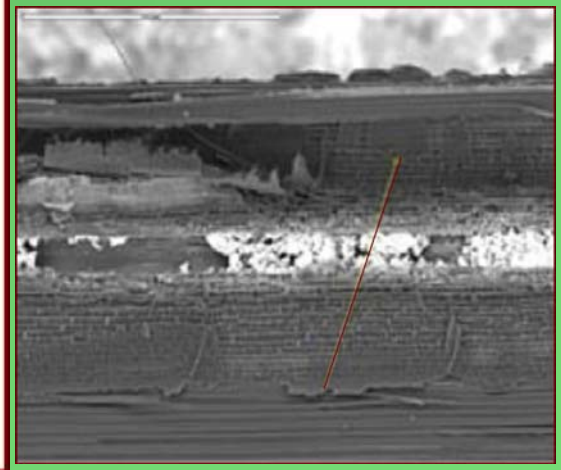
Si →

K →

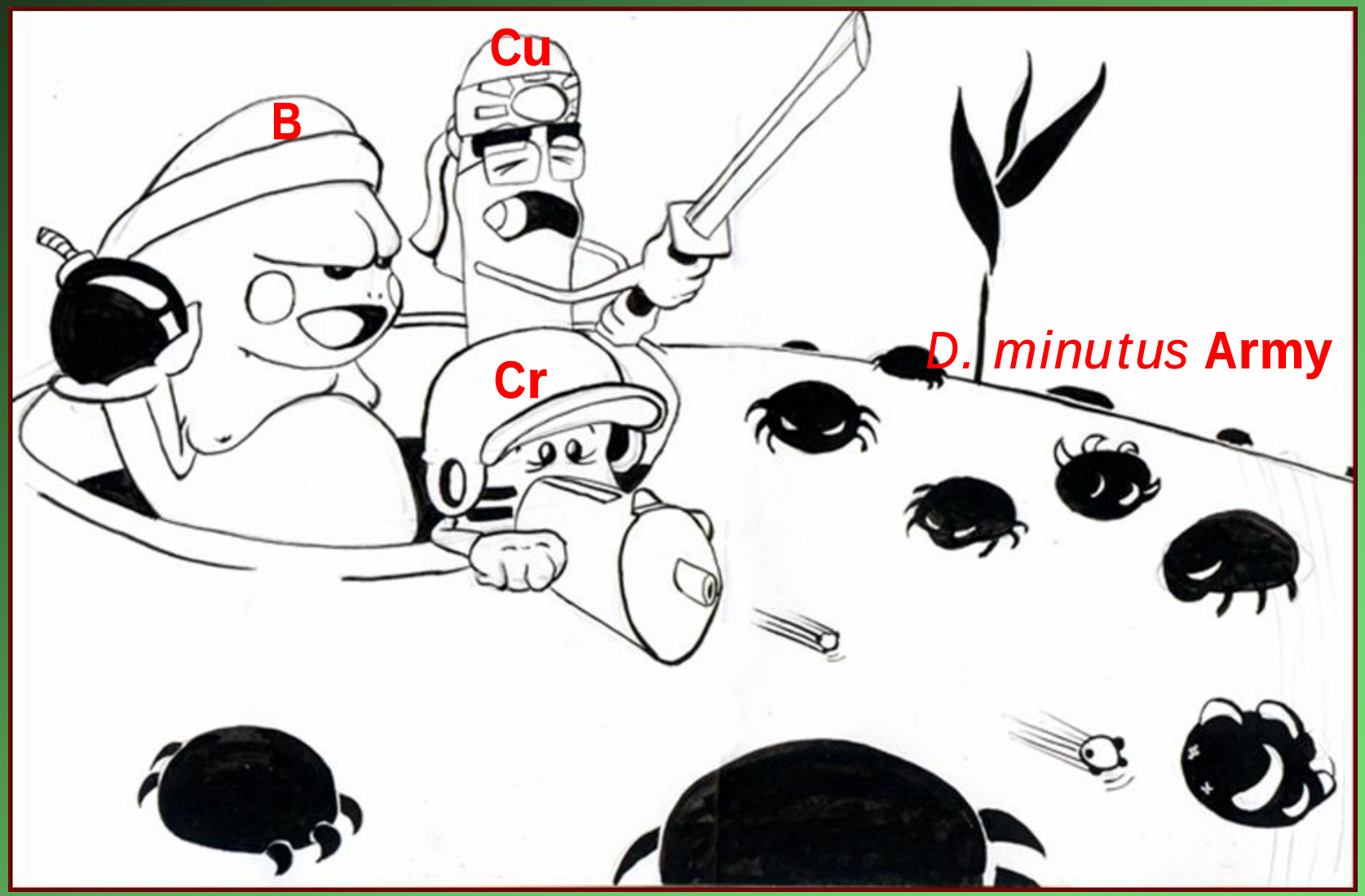
Cr →

Cu →

Traceability of the chemical elements

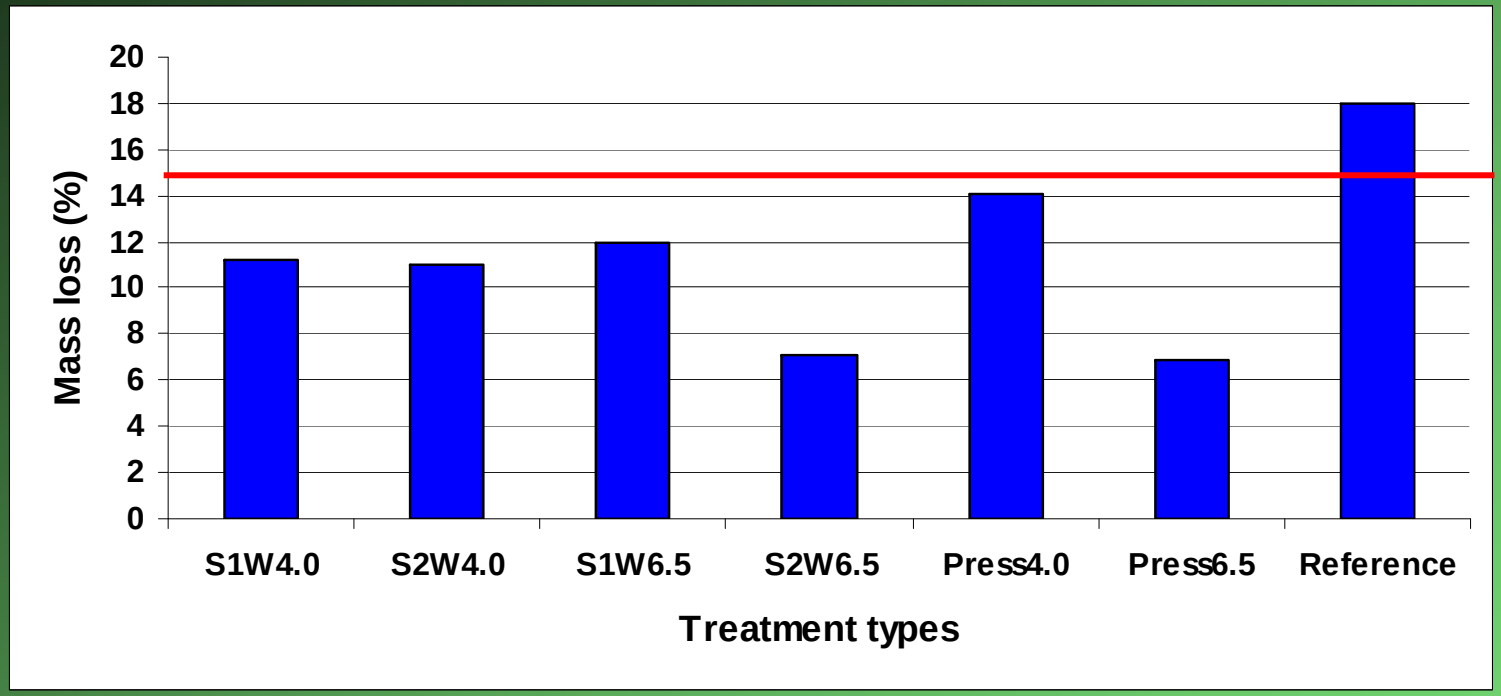


Bunker´s Theory



Mass Loss (%) after 56 days of accelerated test

CCB



E. grandis

S1W4.0 = Soaking, 1 week, 4.0 kg/m^3

S2W4.0 = Soaking, 2 weeks, 4.0 kg/m^3

S1W6.5 = Soaking, 1 week, 6.5 kg/m^3

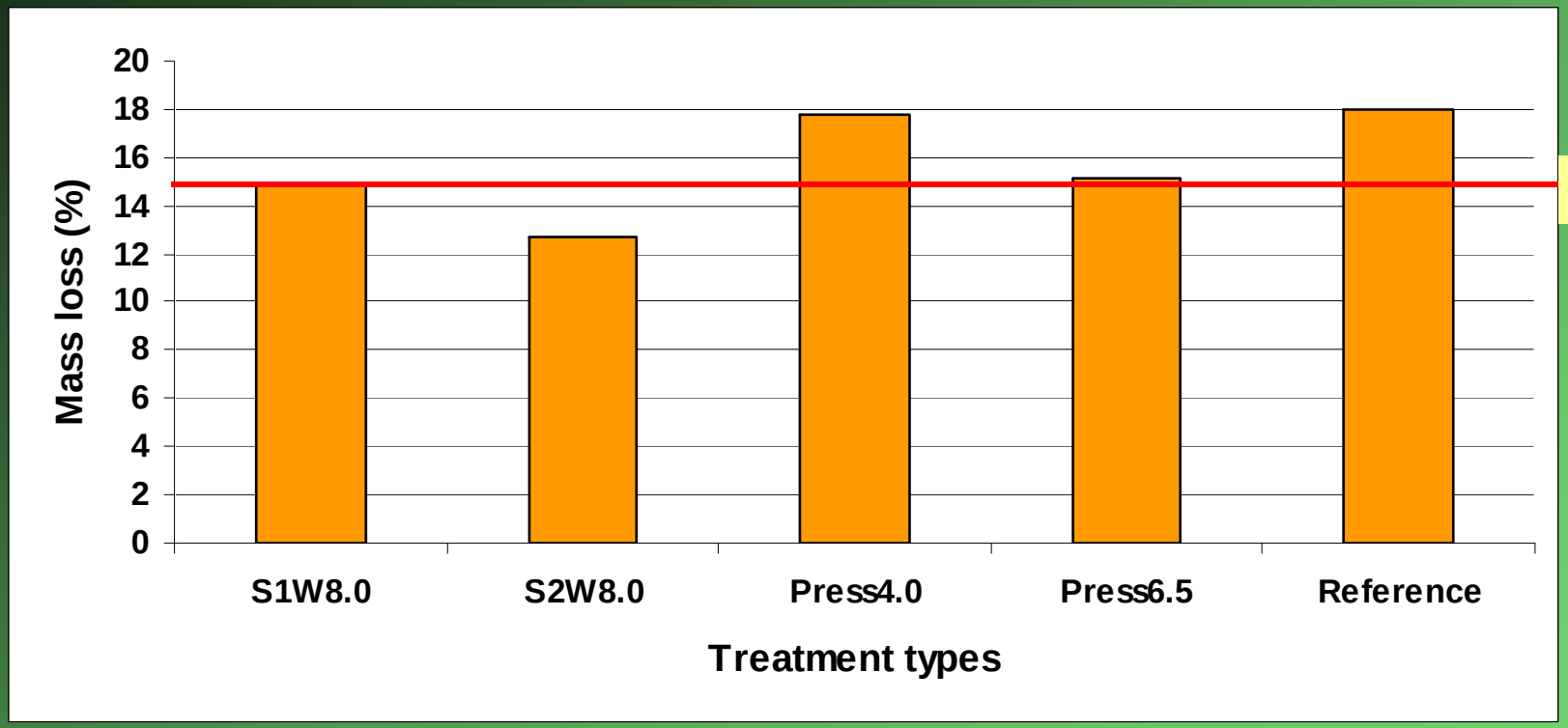
S2W6.5 = Soaking, 2weeks, 6.5 kg/m^3

Press4.0 = Pressure, 4.0 kg/m^3

Press6.5 = Pressure, 6.5 kg/m^3

Mass Loss (%) after 56 days of accelerated test

BaB



S1W8.0 = Soaking, 1 week, 8.0%

S2W8.0 = Soaking, 1 week, 8.0%

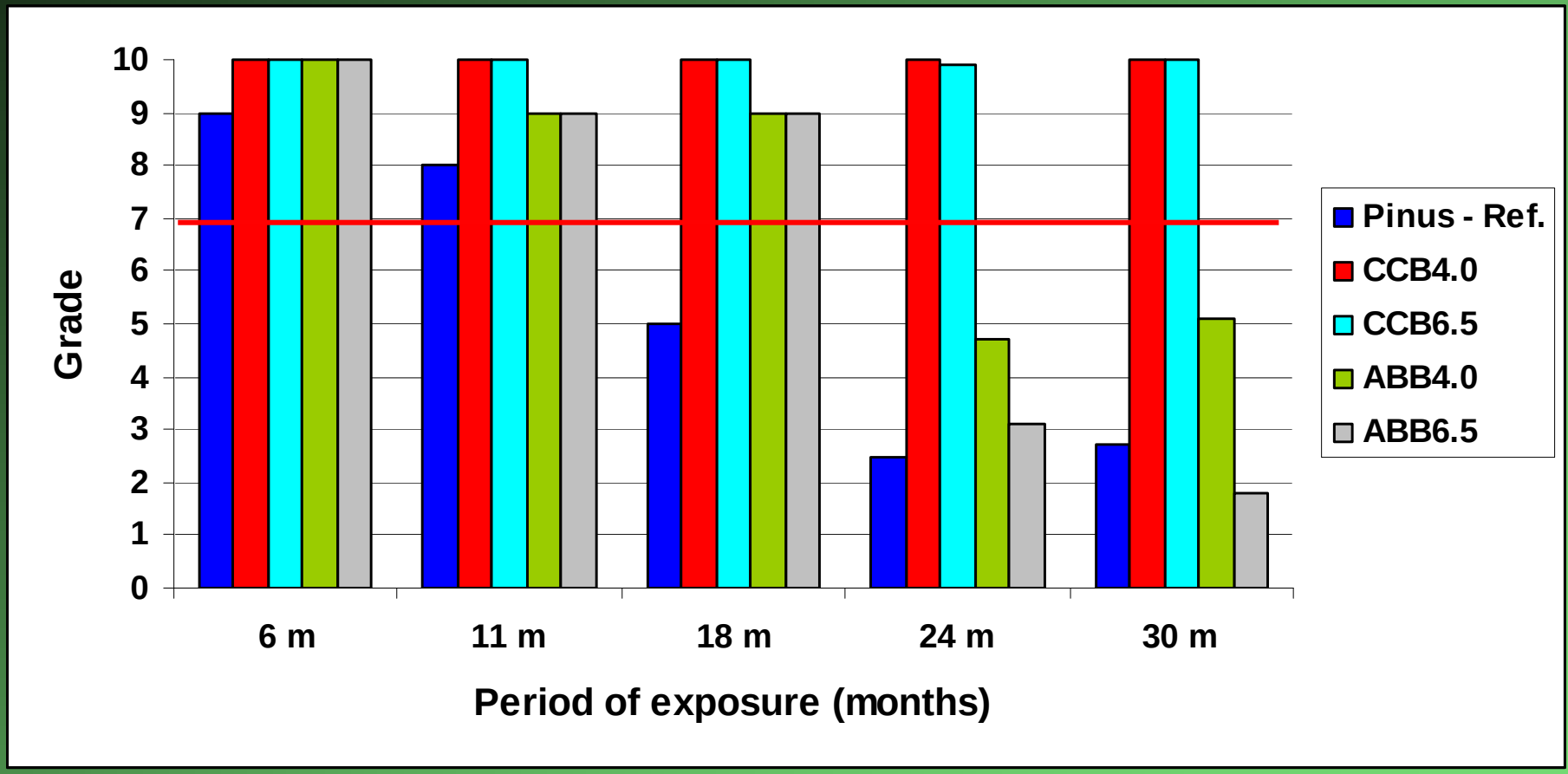
Press4.0 = Pressure, 4.0 kg/m^3

Press6.5 = Pressure, 6.5 kg/m^3

- Ranking -
Method’s efficiency

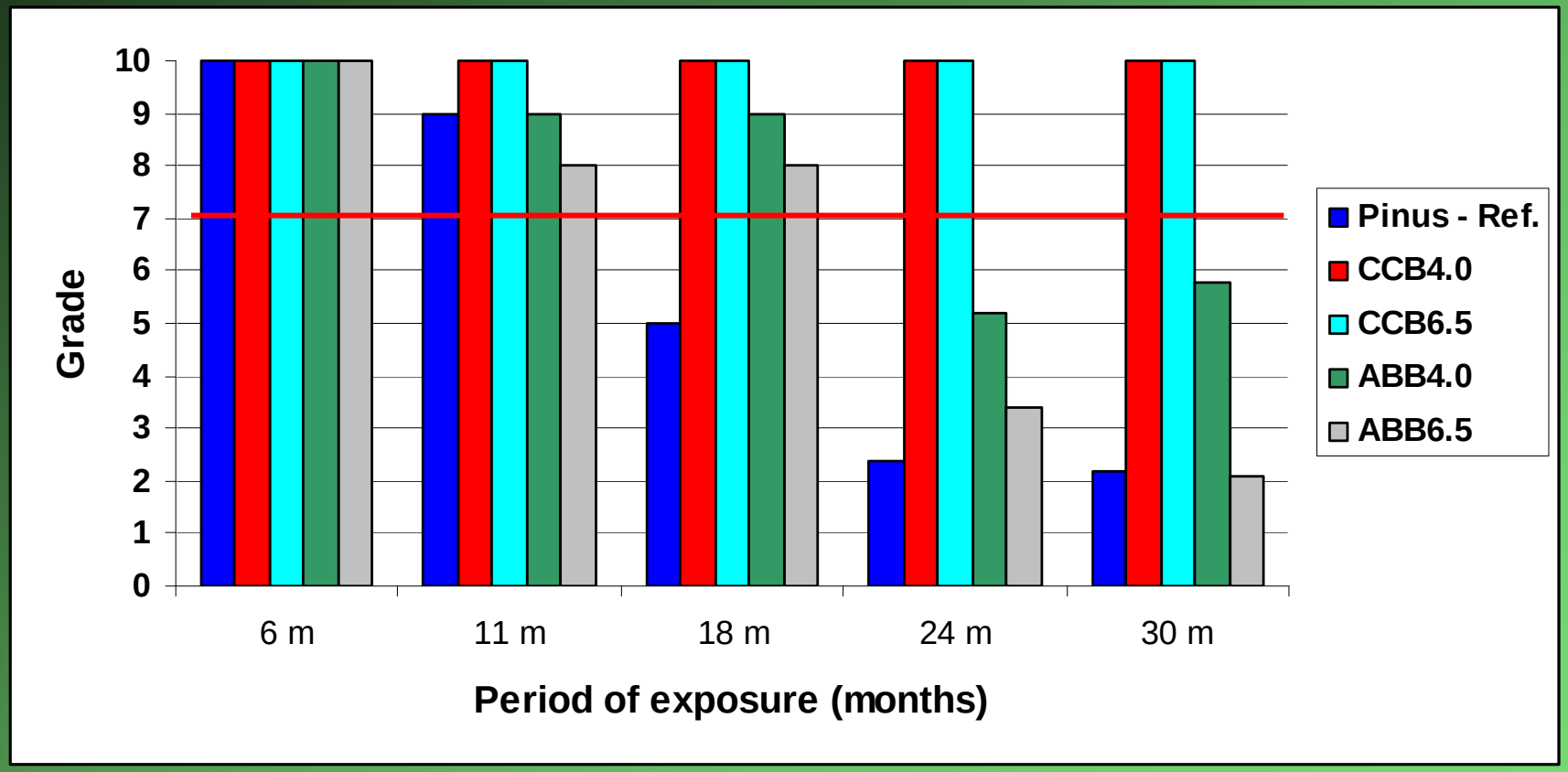
- **CCB p6.5 = CCB im 2w6.5**
- **CCB im 2w4.0 = CCB im 1w4.0 = CCB im1w6.5 = BaB im 2w8.0**
- **E. grandis = BaB im1w8.0 = BaB p6.5 = CCB p4.0**
- **BaB p4.0 = Reference Bamboo**

Pinus

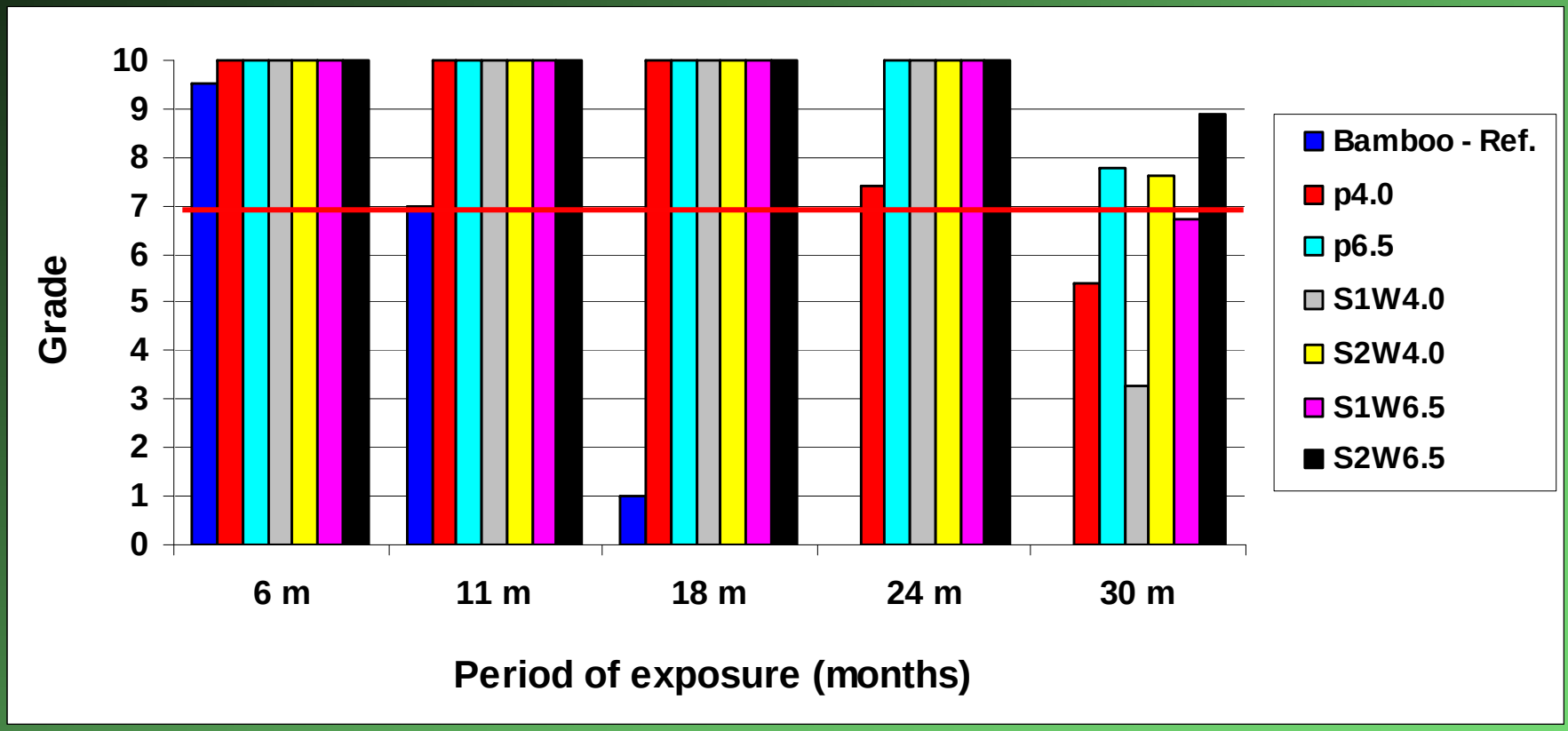


Soft-rot

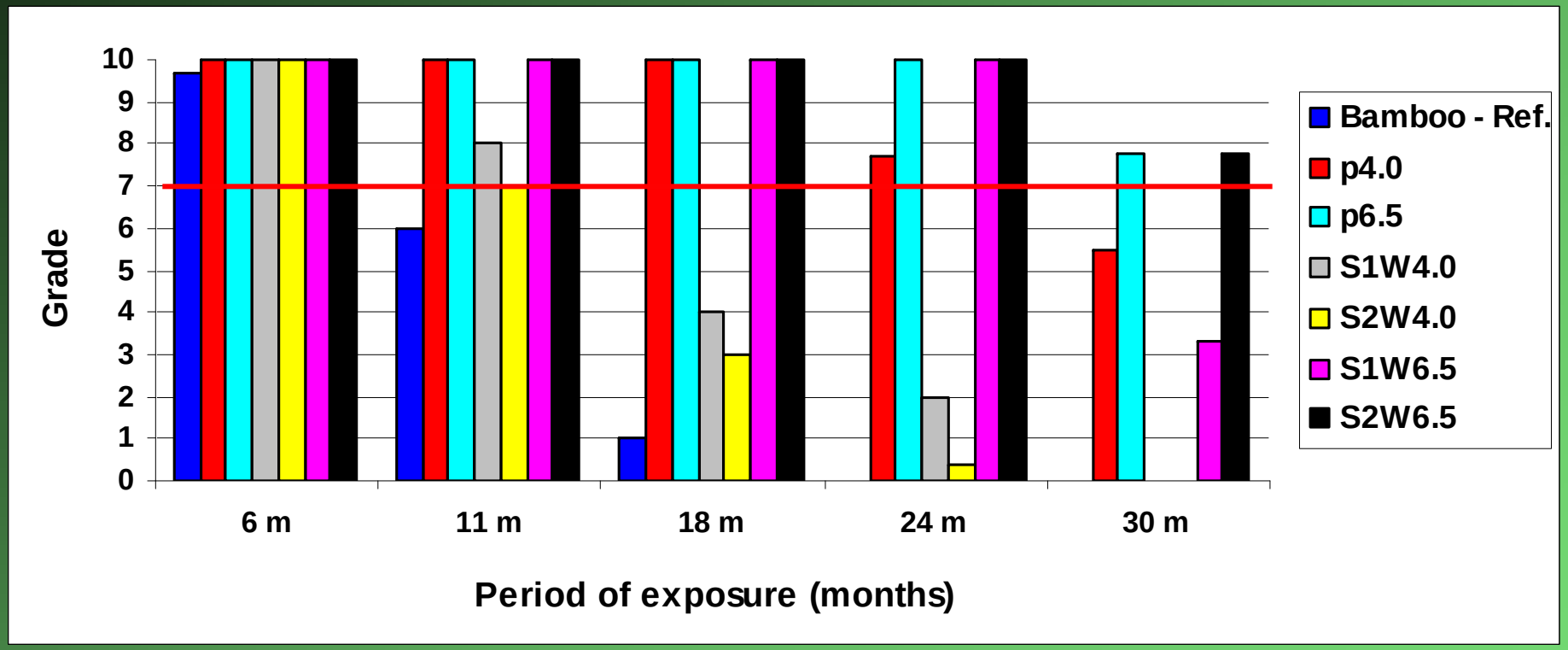
Pinus



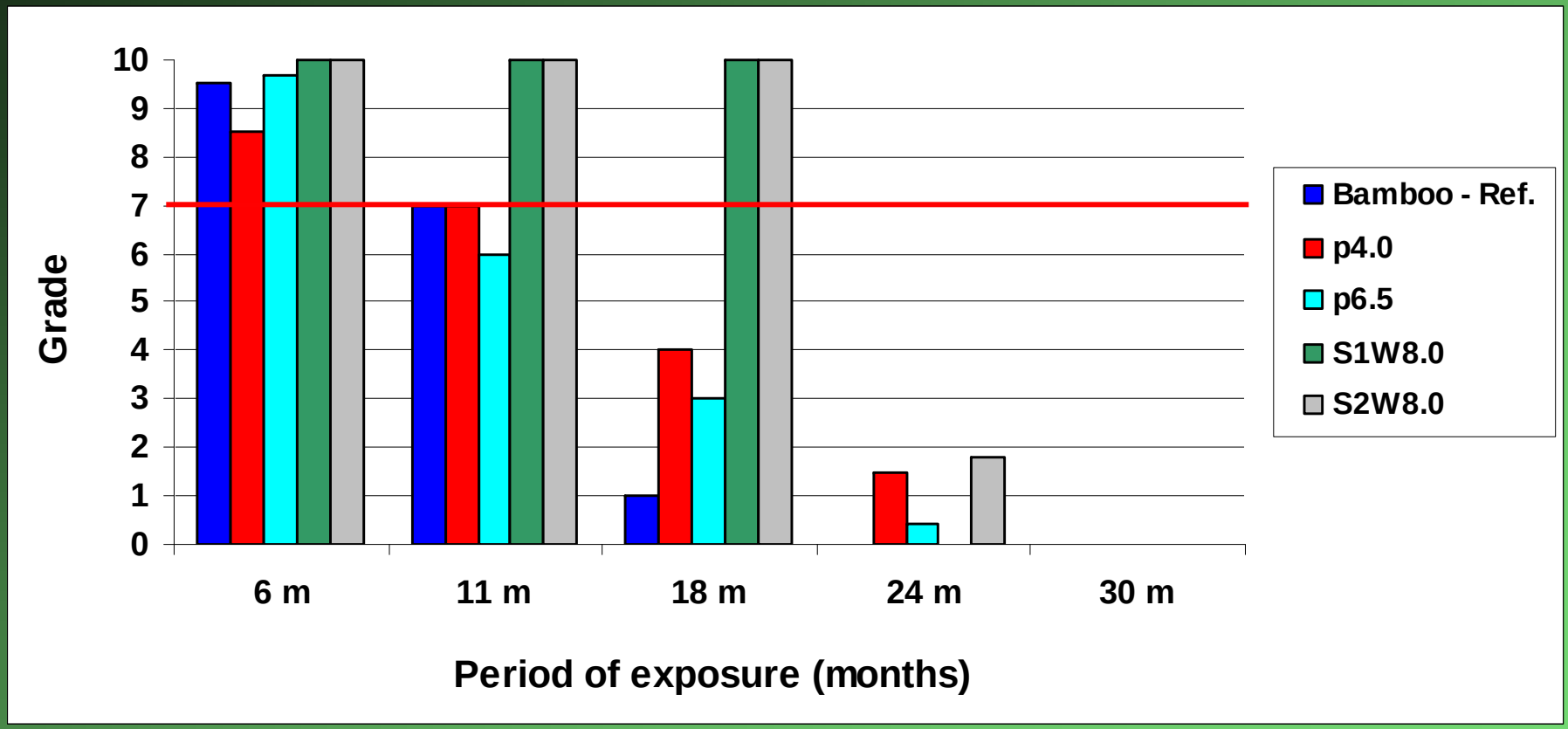
Termites


Grade
10
9
8
7
6
5
4
3
2
1
0
6 m
11 m
18 m
24 m
30 m
Period of exposure (months)
Bamboo - Ref.
p4.0
p6.5
S1W4.0
S2W4.0
S1W6.5
S2W6.5

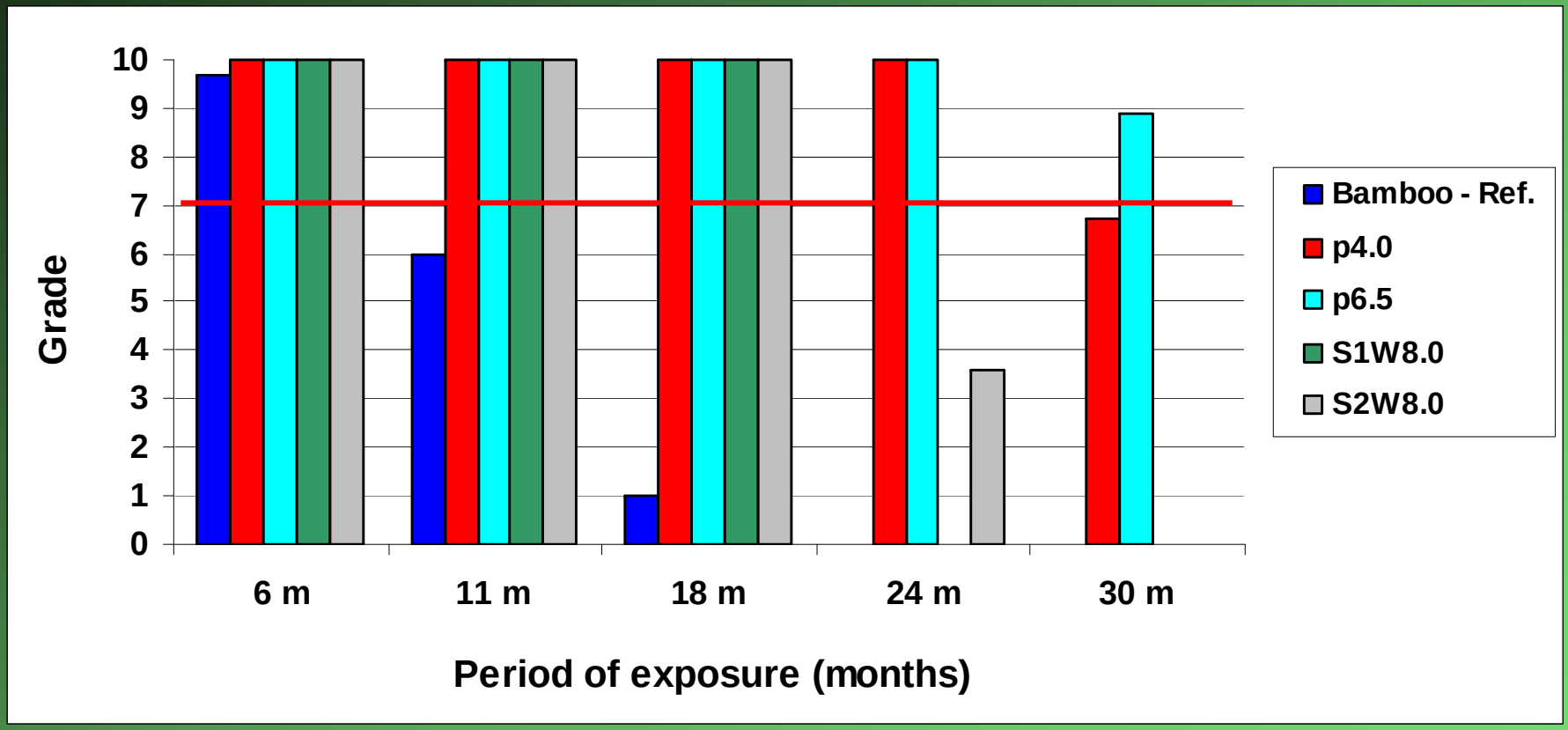
Soft-rot CCB



Termites- CCB


Grade
10
9
8
7
6
5
4
3
2
1
0
6 m
11 m
18 m
24 m
30 m
Period of exposure (months)
Bamboo - Ref.
p4.0
p6.5
S1W8.0
S2W8.0

Soft-rot - BaB



Termites - BaB

Conclusions

Bamboo protection efficiency depends on:

-Treatment types;

- Chemical products and theirs concentrations;

- Exposure types;

-..and anatomical bamboo regions...

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