

# NEW METAL-FREE LEATHER TANNING METHOD





14  
**Si**  
Silicon  
28.084

# Chromium: Key Issues and Challenges



**Societal  
challenges**

**Allergenic risk**

Cr (III) → Cr(VI)

Negative **consumer**  
perception

Waste and effluent  
**treatment**

**Resource** consumption



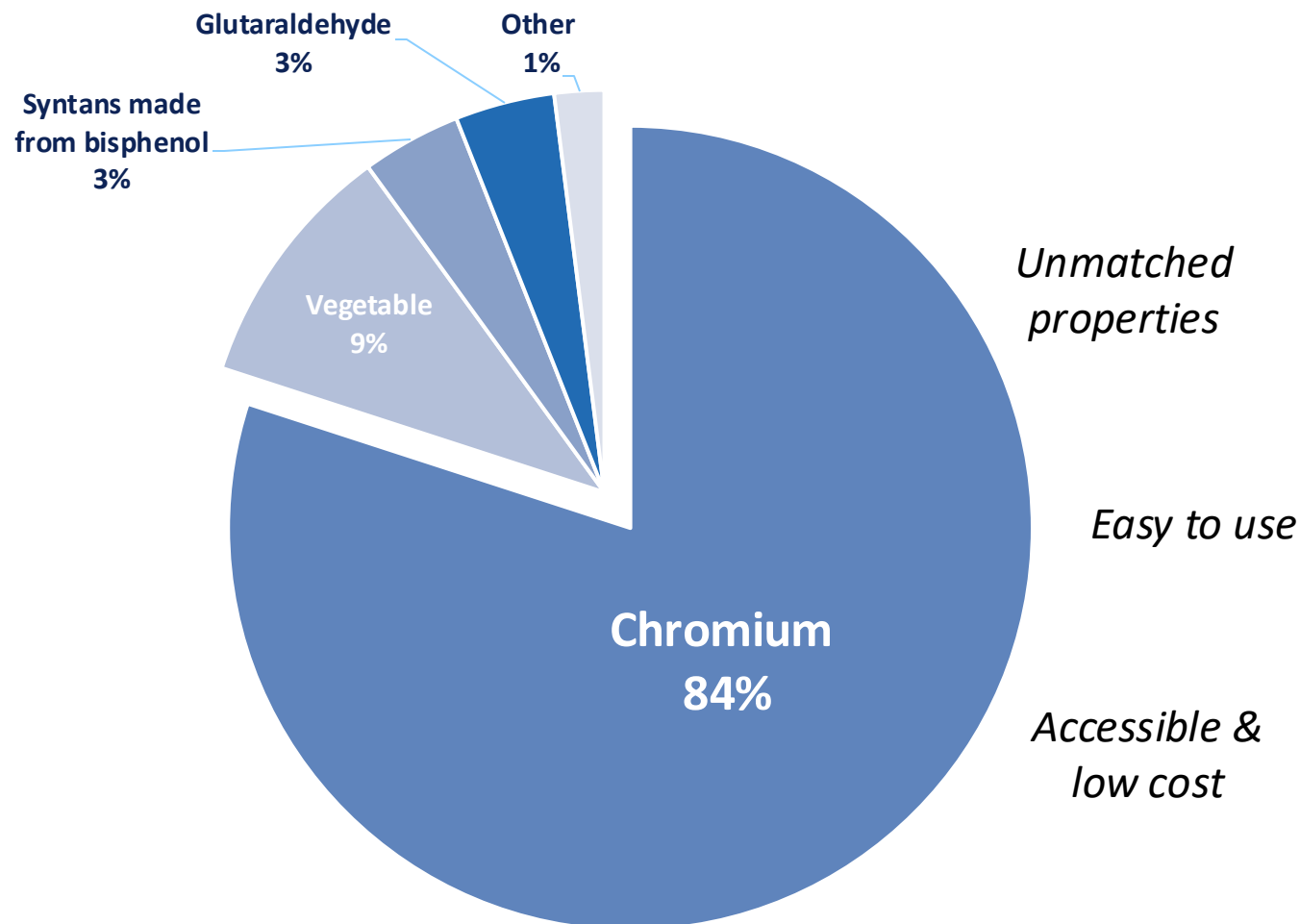
**Environmental  
challenges**



**Regulatory  
challenges**

Cr(VI) project < **1ppm**

Bisphenols / Glutaraldehyde



# Chromium: Key Issues and Challenges



**Societal challenges**

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Waste and effluent  
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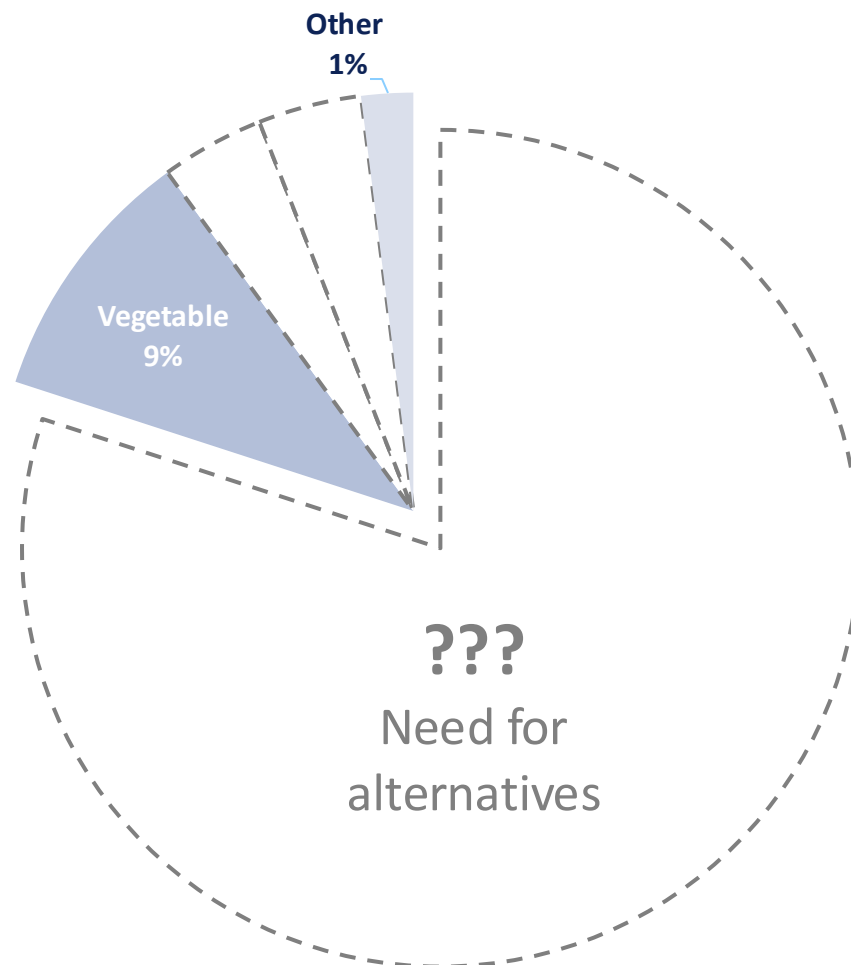
**Environmental challenges**



**Regulatory challenges**

Cr(VI) project < **1ppm**

Bisphenols / Glutaraldehyde





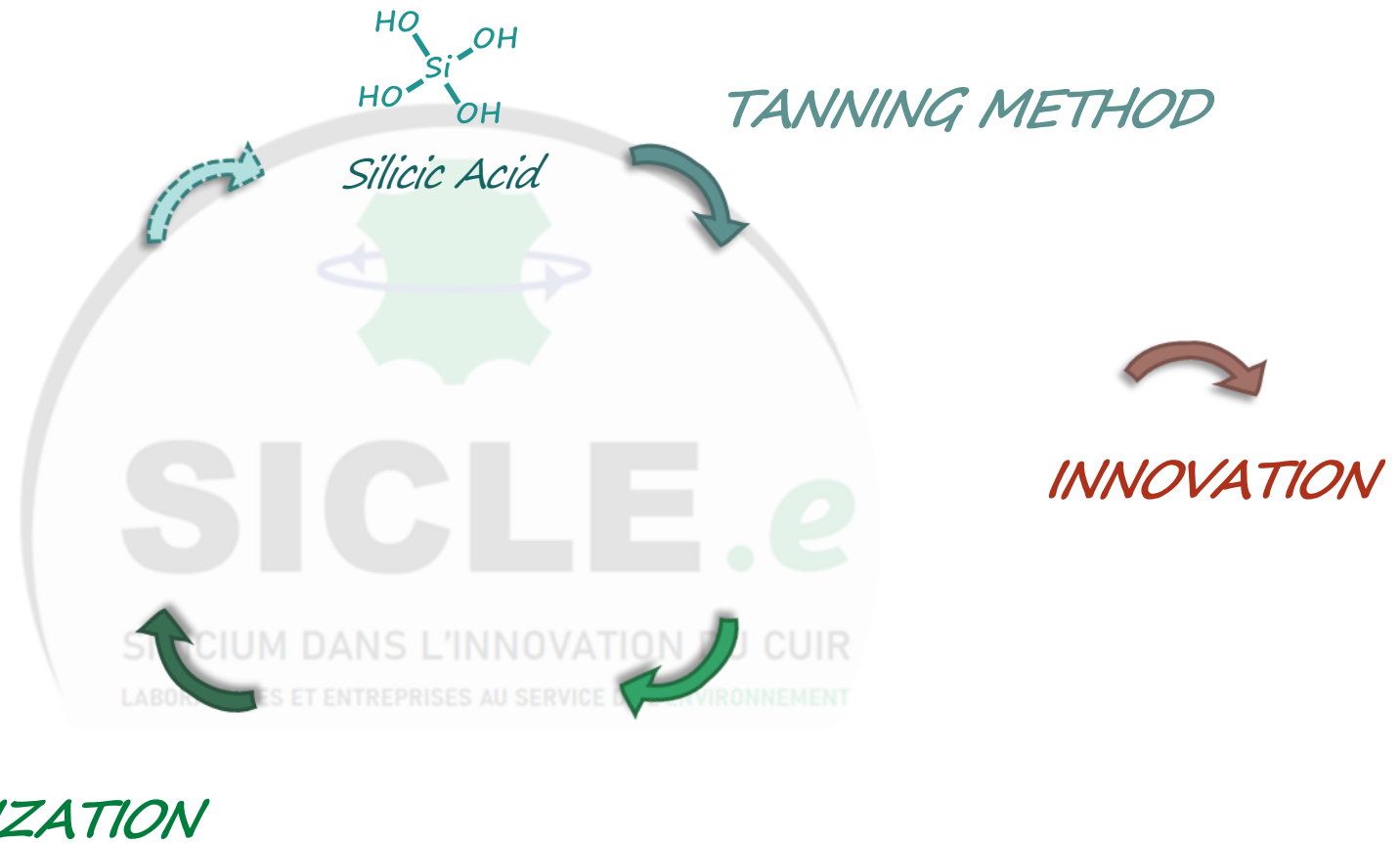
# SICLE.e



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# SICLE.e



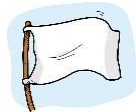
# Our tanning method



**Biocompatible**



Silicon: the second most  
**abundant** element on  
Earth



**White**

*Leathers are...*



**Safe**

(raw materials, product, and by-products)

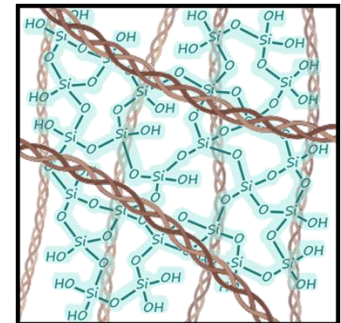
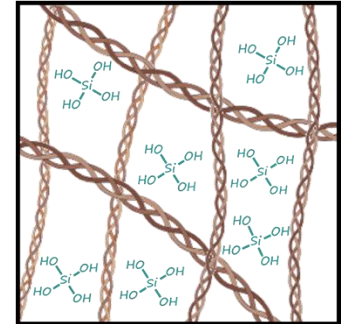
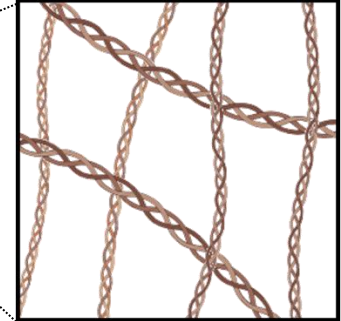
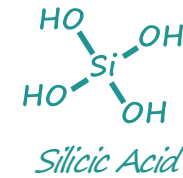
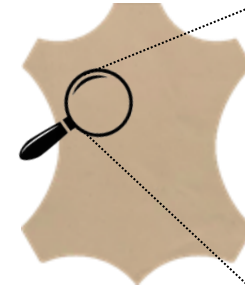
*Silicic acid is...*



**Used** in healthcare,  
agriculture, and  
construction



**Comparable** to the  
Chrome process

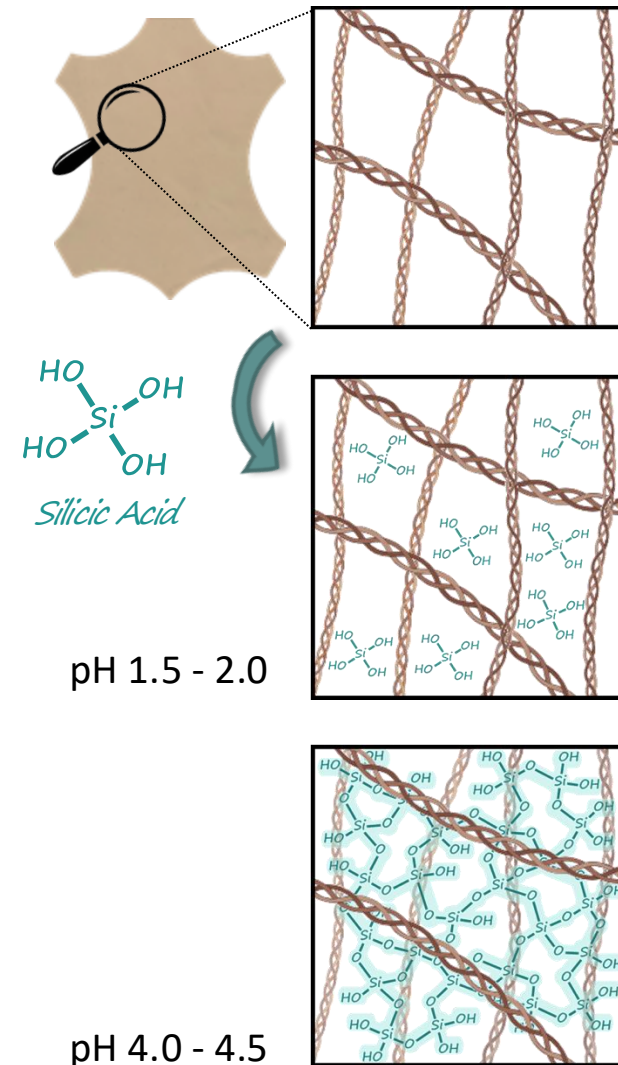
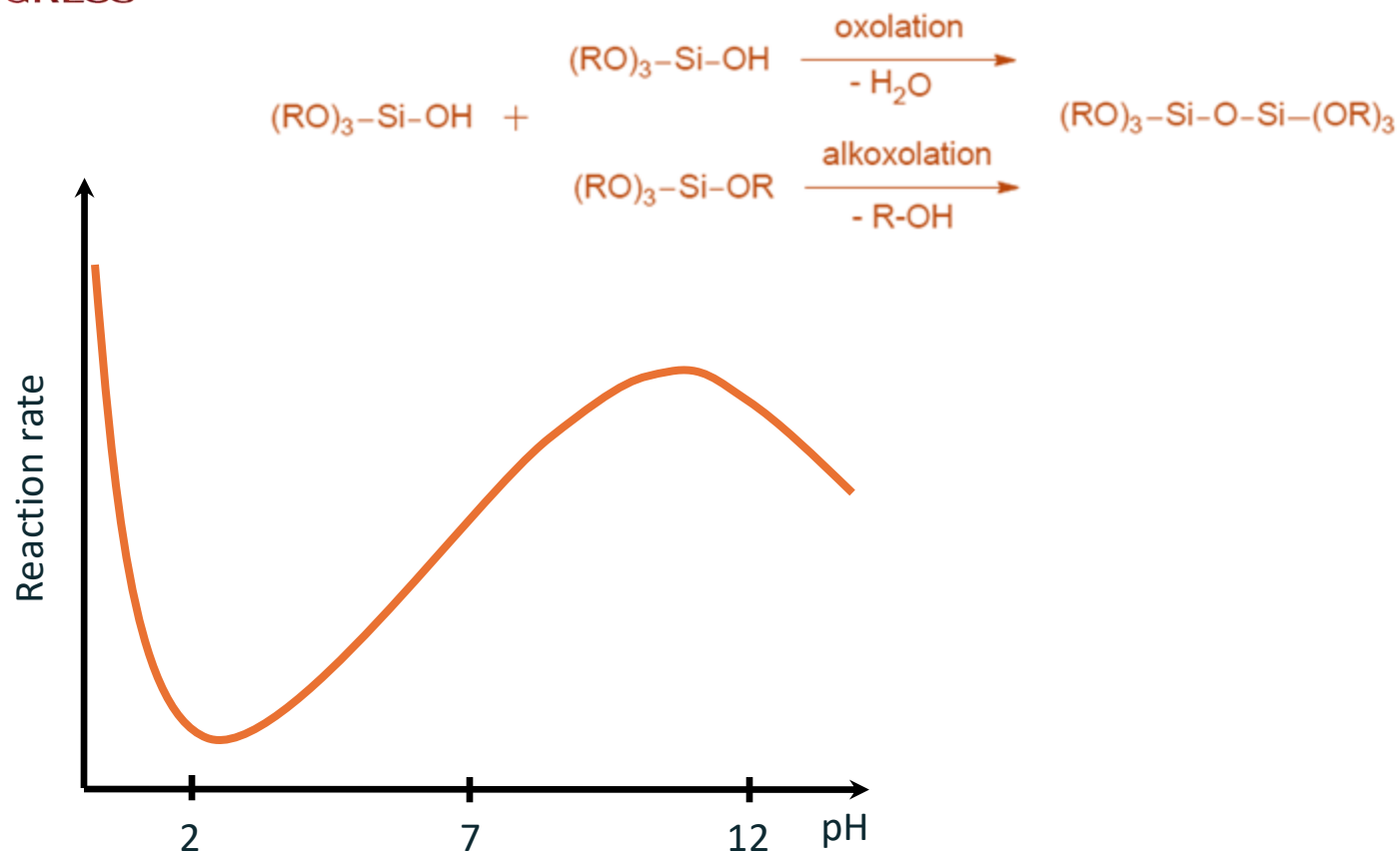


*Collagen fiber cross-linking*



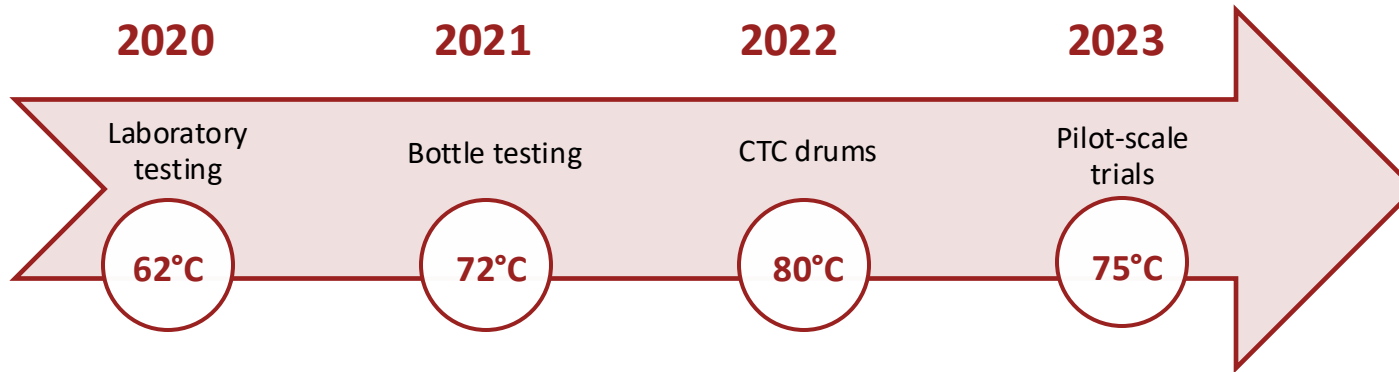
# Our tanning method

## The Sol-Gel Process



# Our tanning method

## So far, So (almost) good

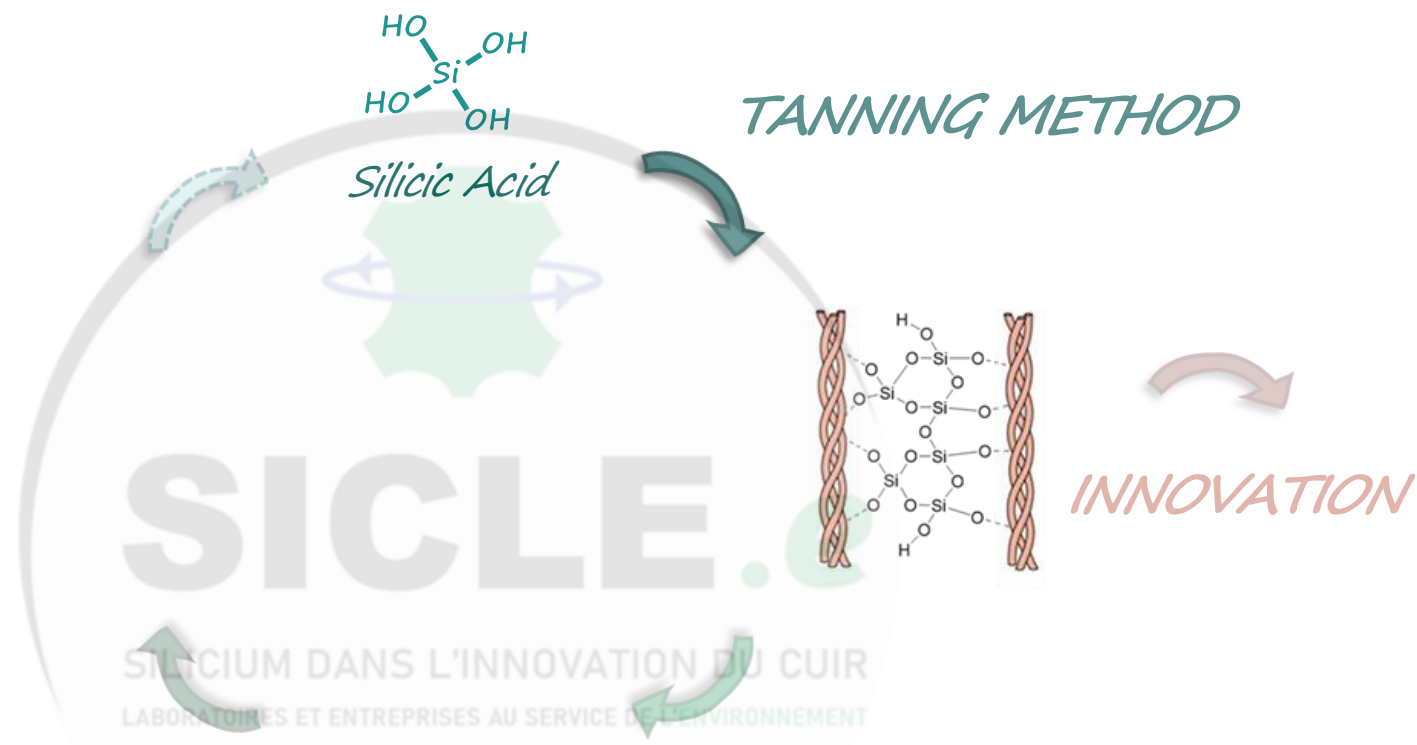


Surface aesthetics

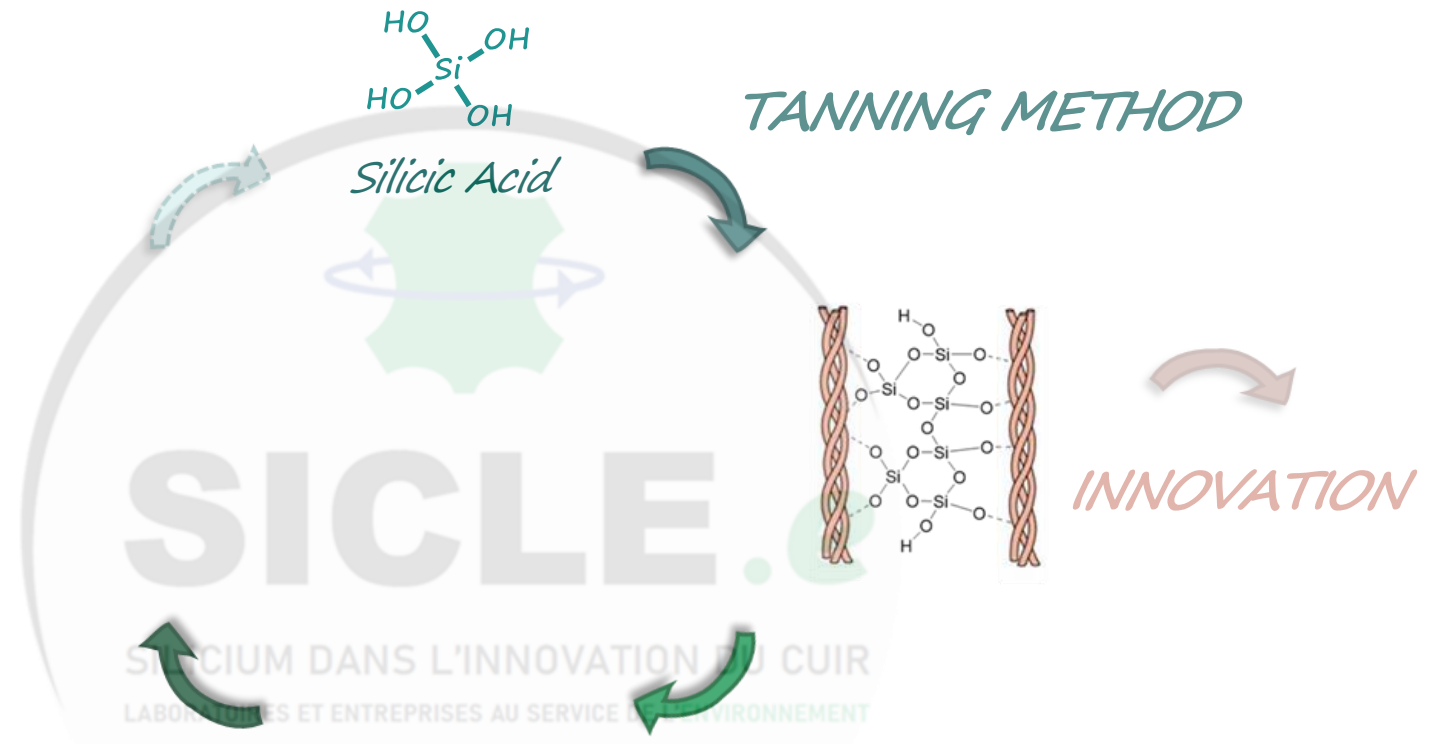
Tanning agent pot-life



# SICLE.e



# SICLE.e



VALORIZATION

# Valorization

## Towards agricultural supplements and new materials

### Biochars

(carbon sequestration, soil amendment and fertilization,...)



### Composite materials

→ Tunable properties

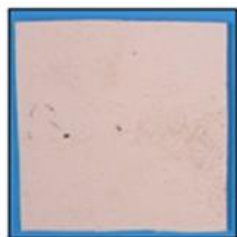


*From quick and cost-effective solutions...*

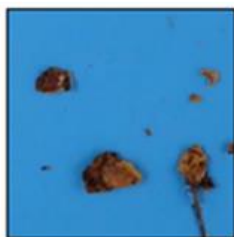
*...to high value-added valorization*

Biodegradability (ISO 14855-1)

Compostability (ISO 16929)



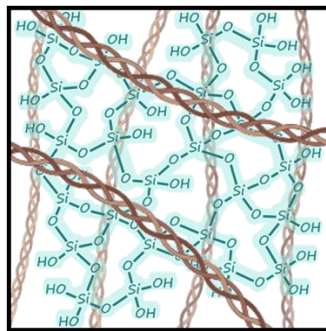
At start



1 week



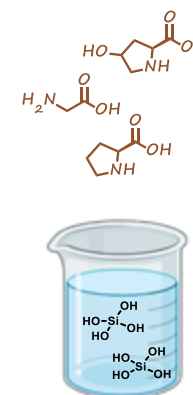
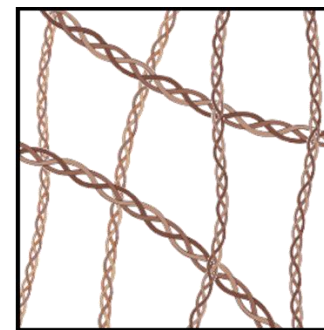
2 week



Detanning



pH > 10





# Valorization Biosourced $\text{Si}(\text{OH})_4$



Communication

## Avoiding Carbothermal Reduction: Distillation of Alkoxysilanes from Biogenic, Green, and Sustainable Sources

Richard M. Laine, Joseph C. Furgal, Phi Doan, David Pan, Vera Popova, Xingwen Zhang

[doi.org/10.1002/anie.201506838](https://doi.org/10.1002/anie.201506838) | Citations: 48



Chemical Engineering Journal  
 Volume 495, 1 September 2024, 153377



## Valorization of agriculture waste: Preparation of alkoxysilanes from mix straw and rice husk ash



Hybrid Advances  
 Volume 4, December 2023, 100111



Shanshan Feng, Chenyu Ge, Qianxin Sun, Wanping Zheng, Guiying Li, Changwei Hu

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<https://doi.org/10.1016/j.cej.2024.153377>

Get rig

## Silica extraction from rice husk: Comprehensive review and applications

P.U. Nzereogu<sup>a</sup>, A.D. Omah<sup>a</sup>, F.I. Ezema<sup>b</sup>, E.I. Iwuoha<sup>d</sup>, A.C. Nwanya<sup>b</sup>

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<https://doi.org/10.1016/j.hybadv.2023.100111>

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Valorized wastes from silicon tanned leather  
 (fertilizer / bio stimulant / repellent)



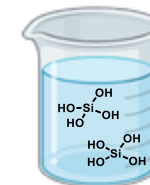
Plant growth



Rice husk  
 (food waste)



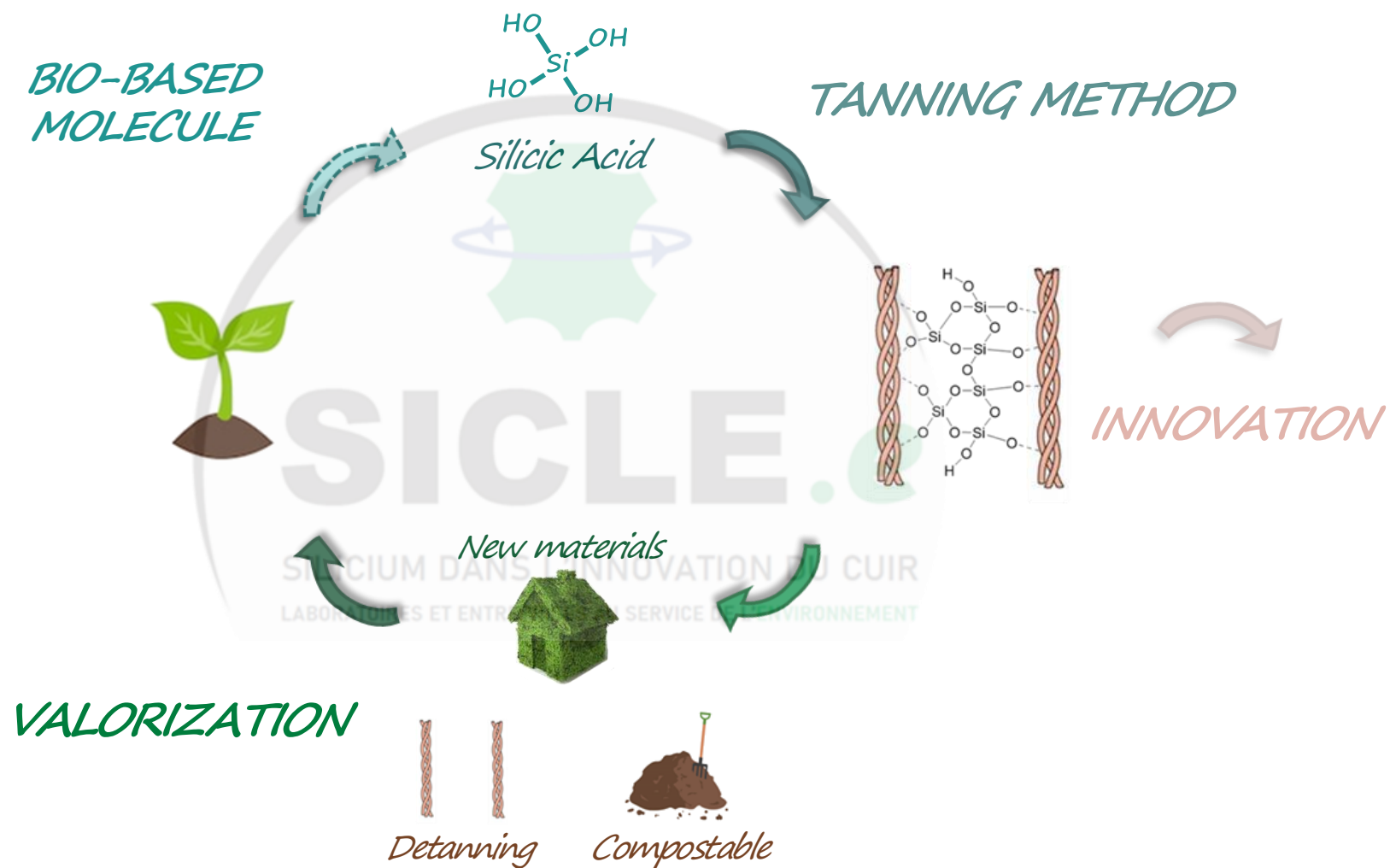
Calcination



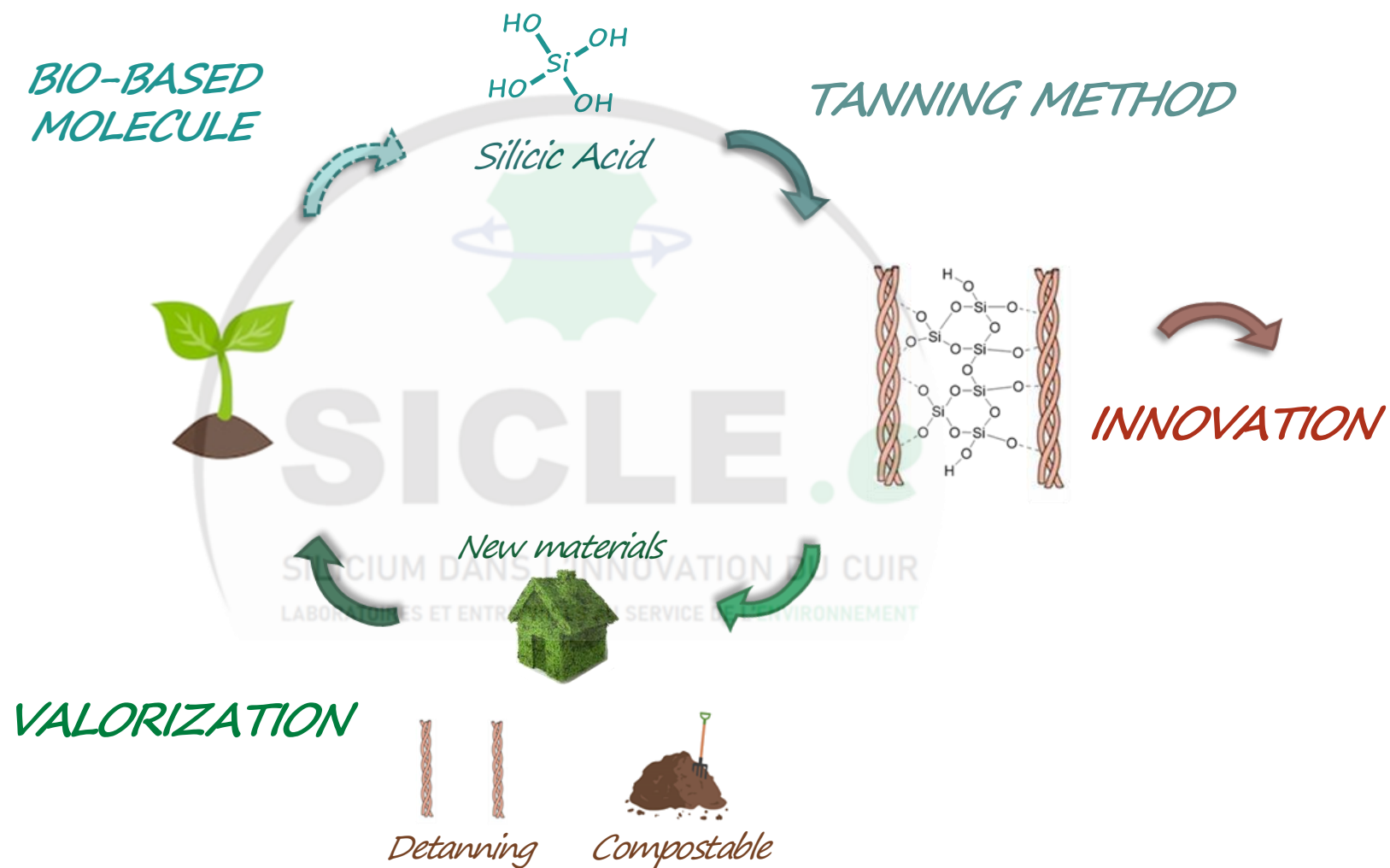
pH adjustments



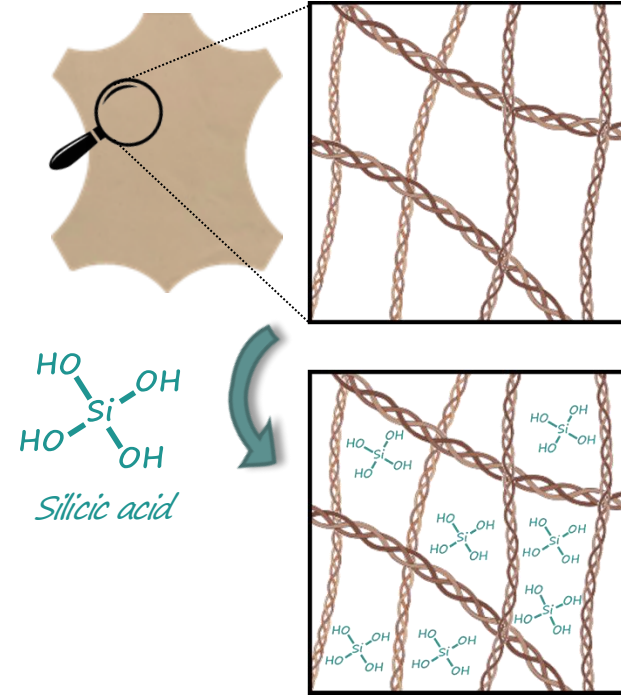
# SICLE.e

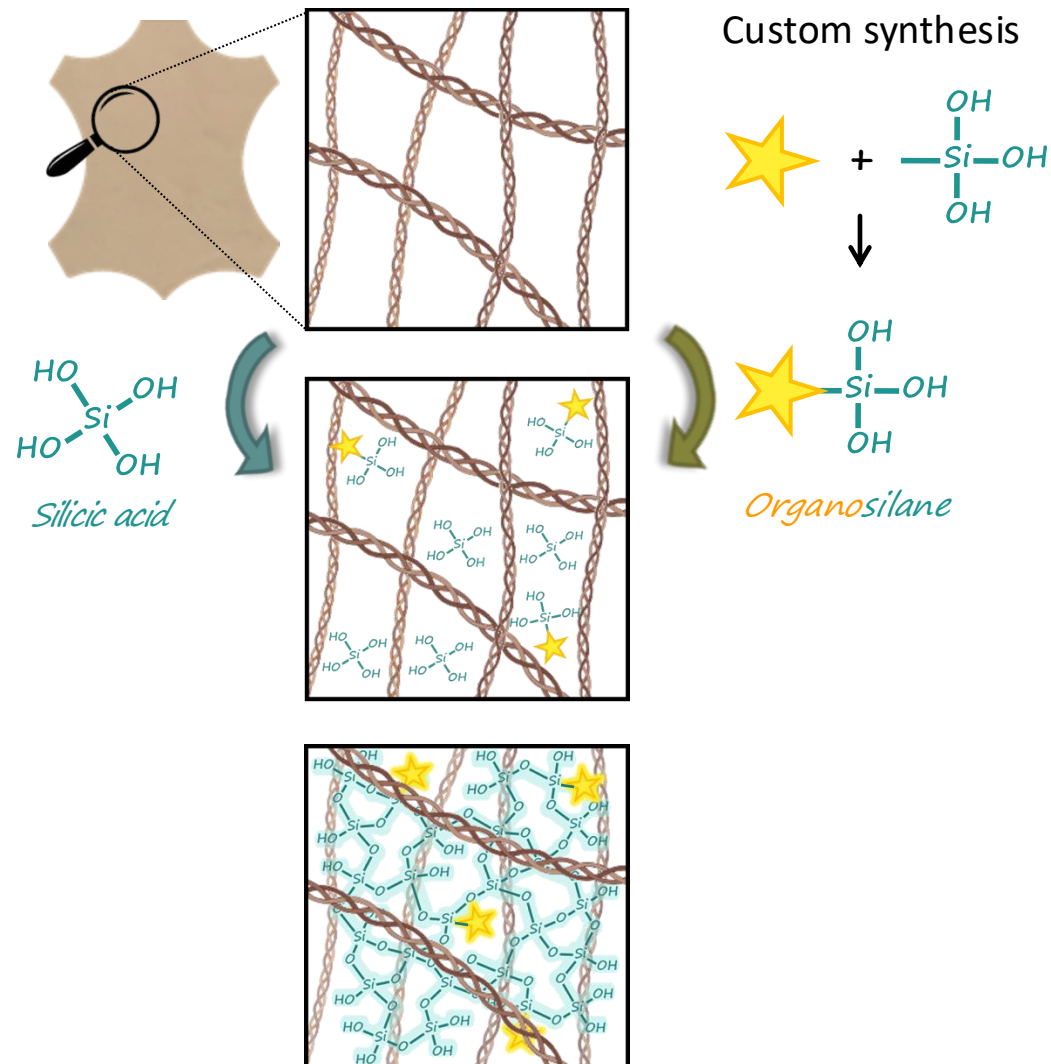


# SICLE.e



# Innovation by functionnalisation

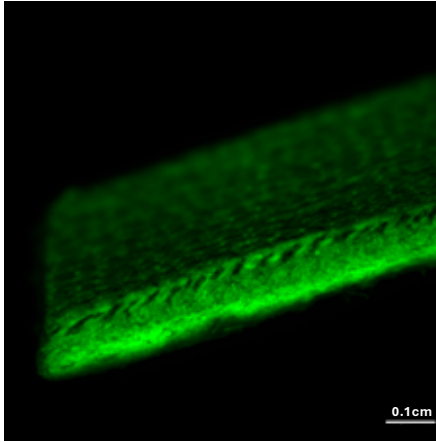






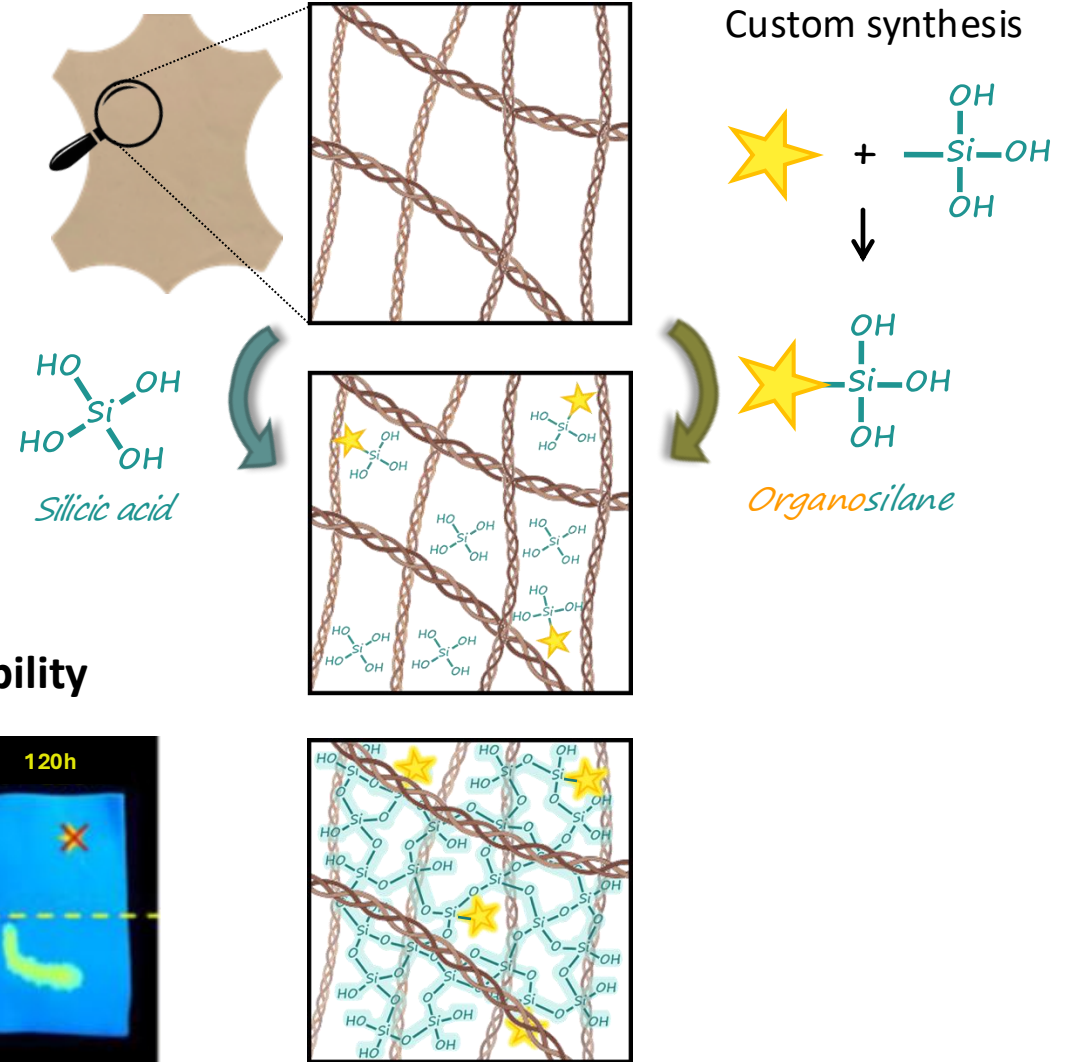
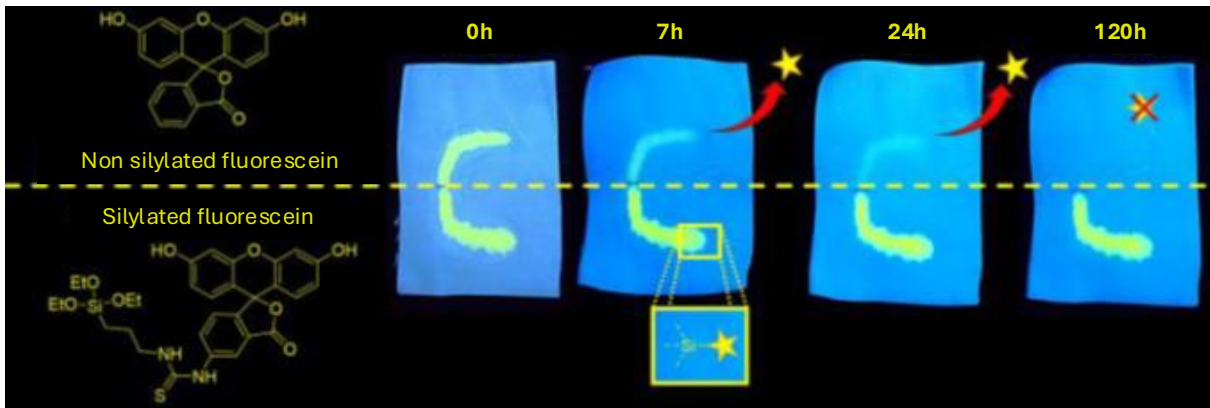
# Innovation by fonctionnalisation

One pot



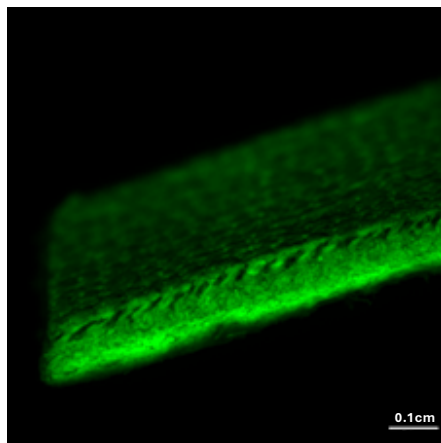
Grafting = Long-term **stability**

Post tanning



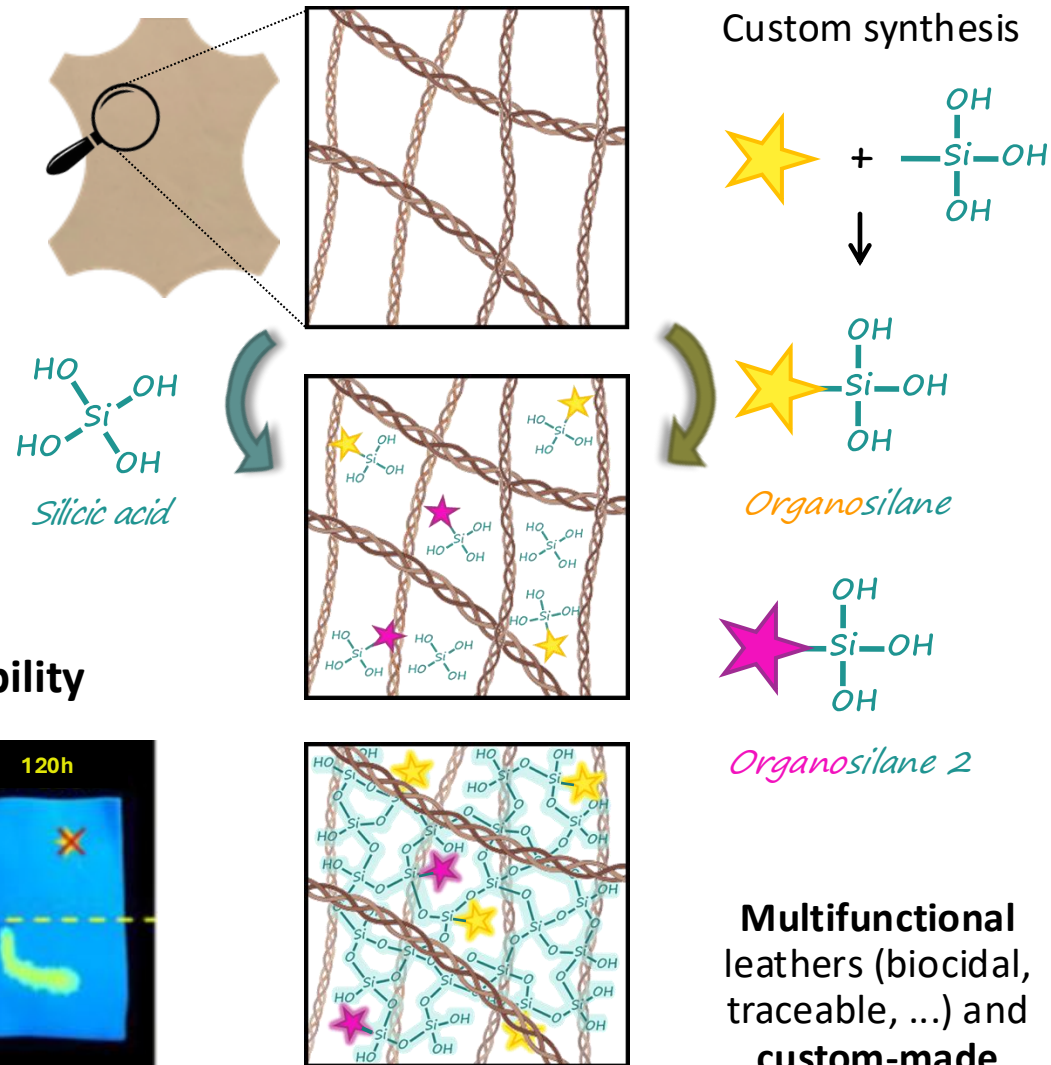
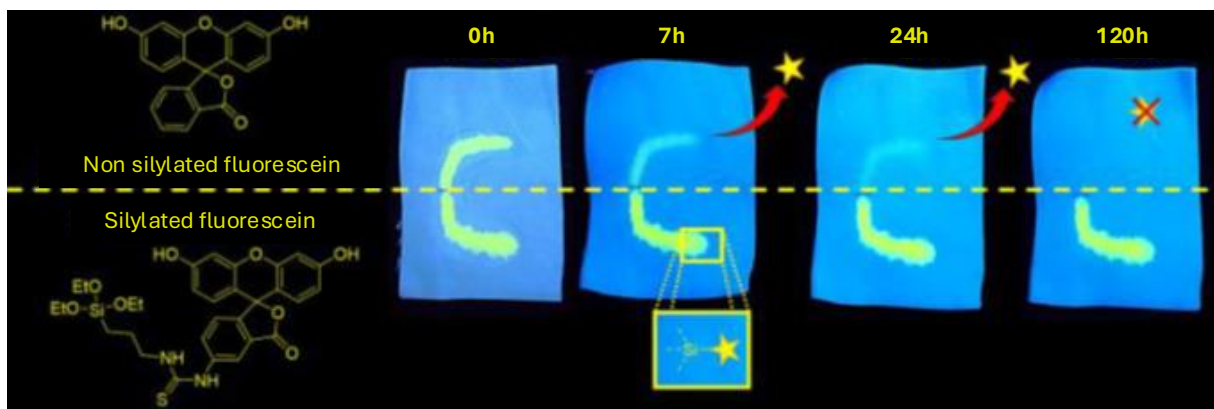
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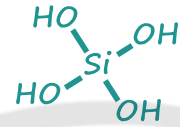
Post tanning



# SICLE.e

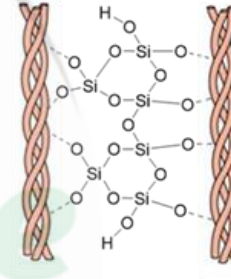


BIO-BASED  
MOLECULE

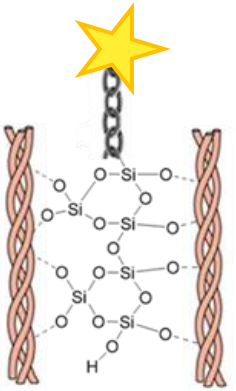


Silicic Acid

TANNING METHOD



INNOVATION



New materials



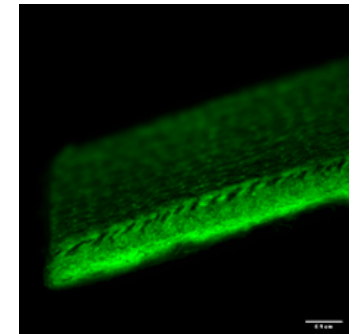
VALORIZATION



Detanning



Compostable



# Thank you for your kind attention !

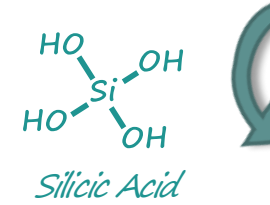
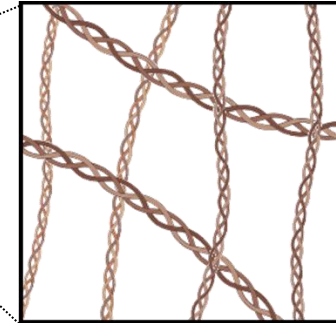
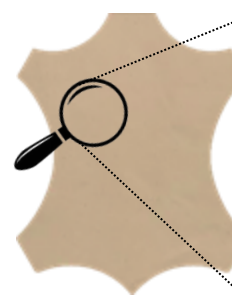
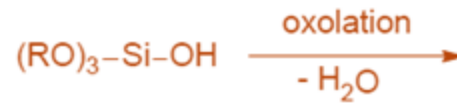
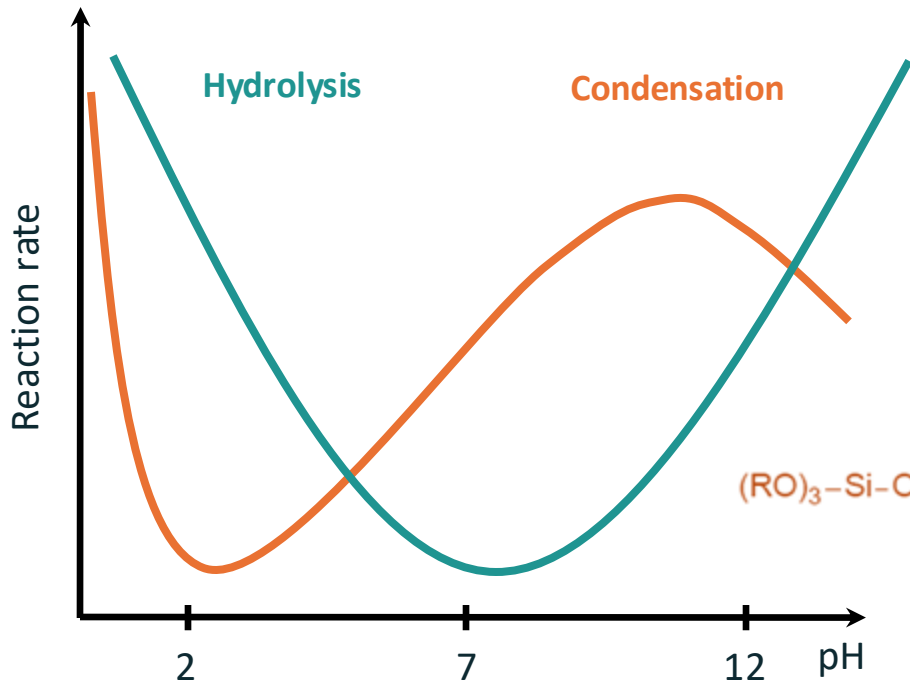


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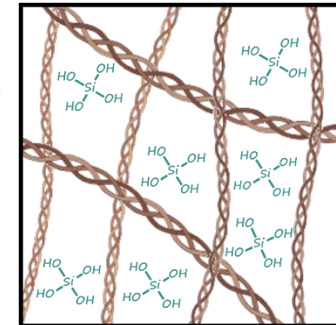


# Our tanning method

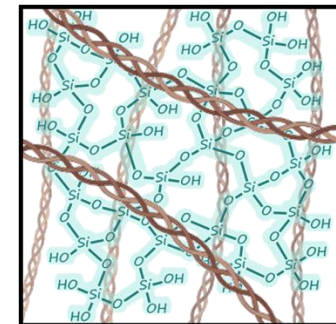
## The Sol-Gel Process



pH 1.5 - 2.0



pH 4.0 - 4.5

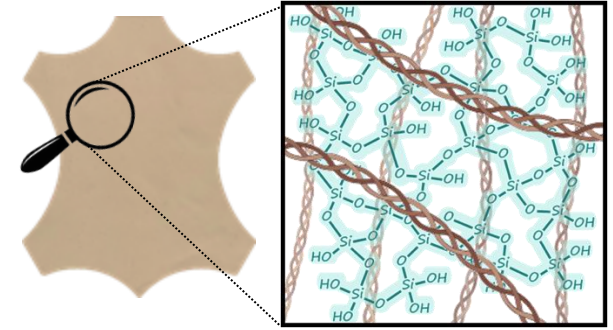
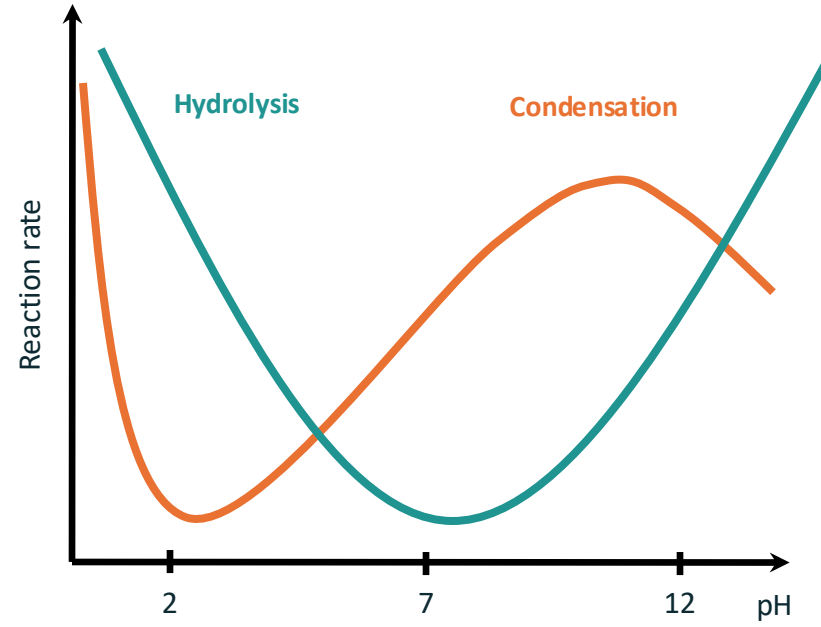


Collagen fiber cross-linking



# Valorization

## Detanning

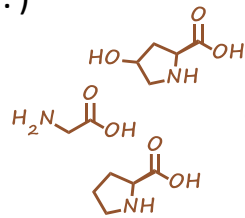


Detanning

# Valorization

## Detanning

Valorizations  
 (hydrogel, plant bio  
 stimulant,...)

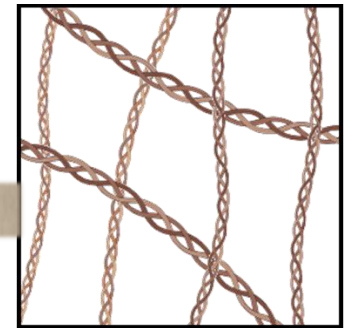
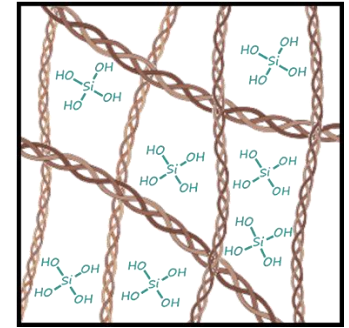
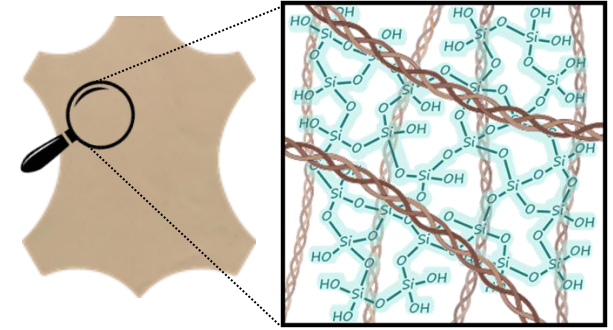
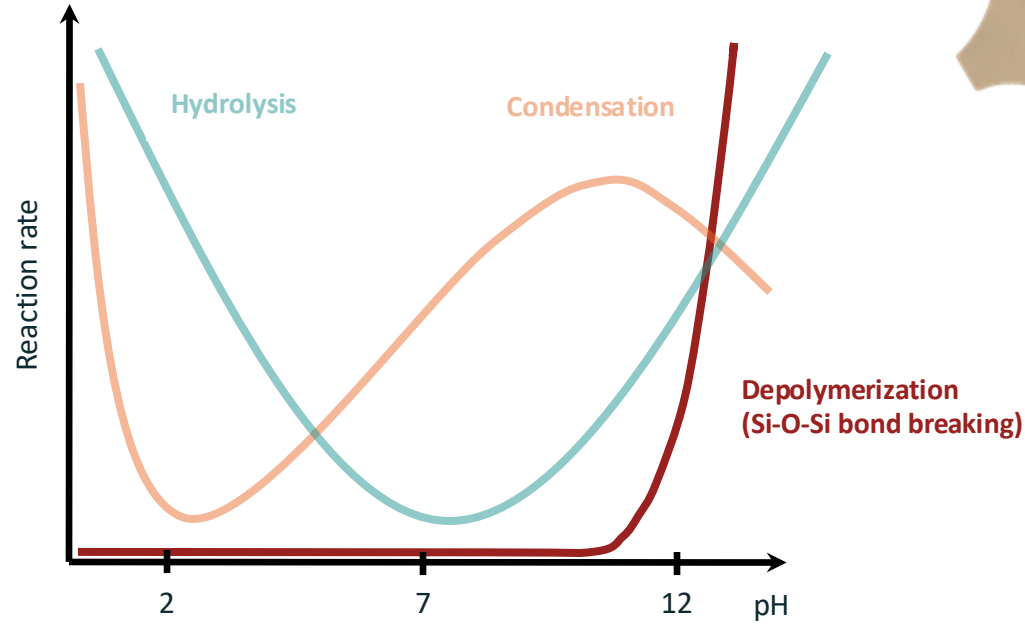


Amino acids

Peptides

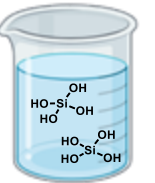
Collagen peptides

Gelatins



Detanning

Hydrolyzed silica +  
 (new tanning agent ?)



# SICLE.e

