

01. Introduction



Agriculture currently relies on polyurethane (PU) microcapsules, which are effective but non-biodegradable. Their accumulation in soil and water causes long-term microplastic pollution. The upcoming EU regulation (2023/2055) plans to ban microplastics in 2031. To face these new challenges, Calyxia develops biodegradable alternatives to PU microcapsules. Biocontrol solutions are promising but limited by cost, efficiency, and stability in field conditions. Formulation through microencapsulation can be a decisive lever to enhance the performance and reliability of these natural actives,

02. Calyxia's Technology

Description of the technology : double emulsion process

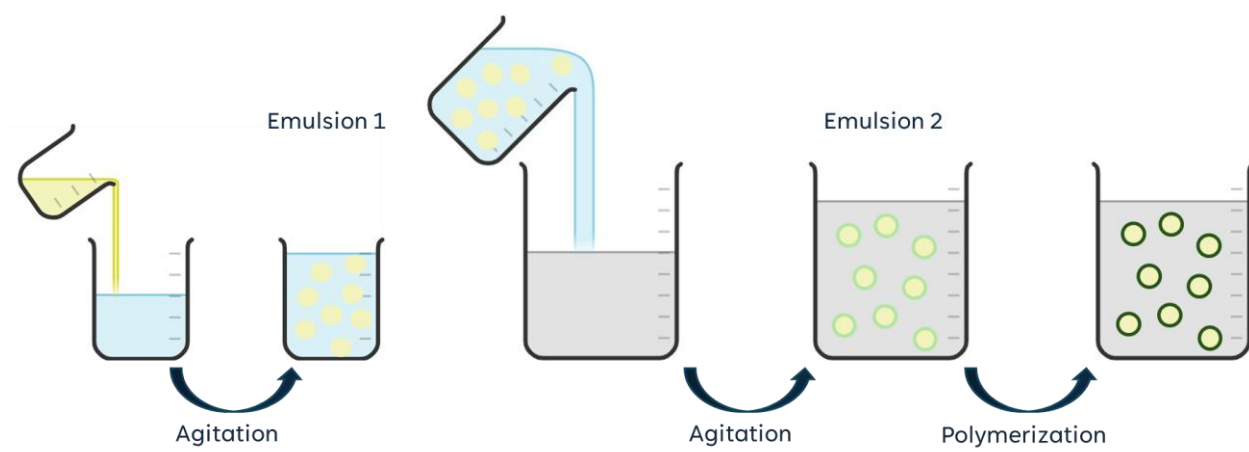


Figure 1 : Schematics of Calyxia's patented process

Development from lab-scale to industrial scale



03. Advantages of the technology

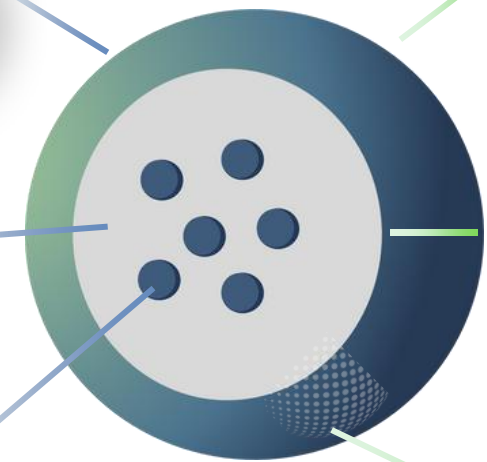
Microcapsules fully customizable to your needs

MICROCAPSULES SYSTEM

SHELL CHEMISTRY
Portfolio of different biodegradable chemistries

CORE FORMULATION
Adapted to each active ingredient and expected performance

ACTIVE FORM
Technology compatible with liquid, powders, dispersion...



PROPERTIES

SIZE-CONTROLLED
Selected in a range from 1 to 30 µm

SHELL THICKNESS
Core-shell ratio adapted to application

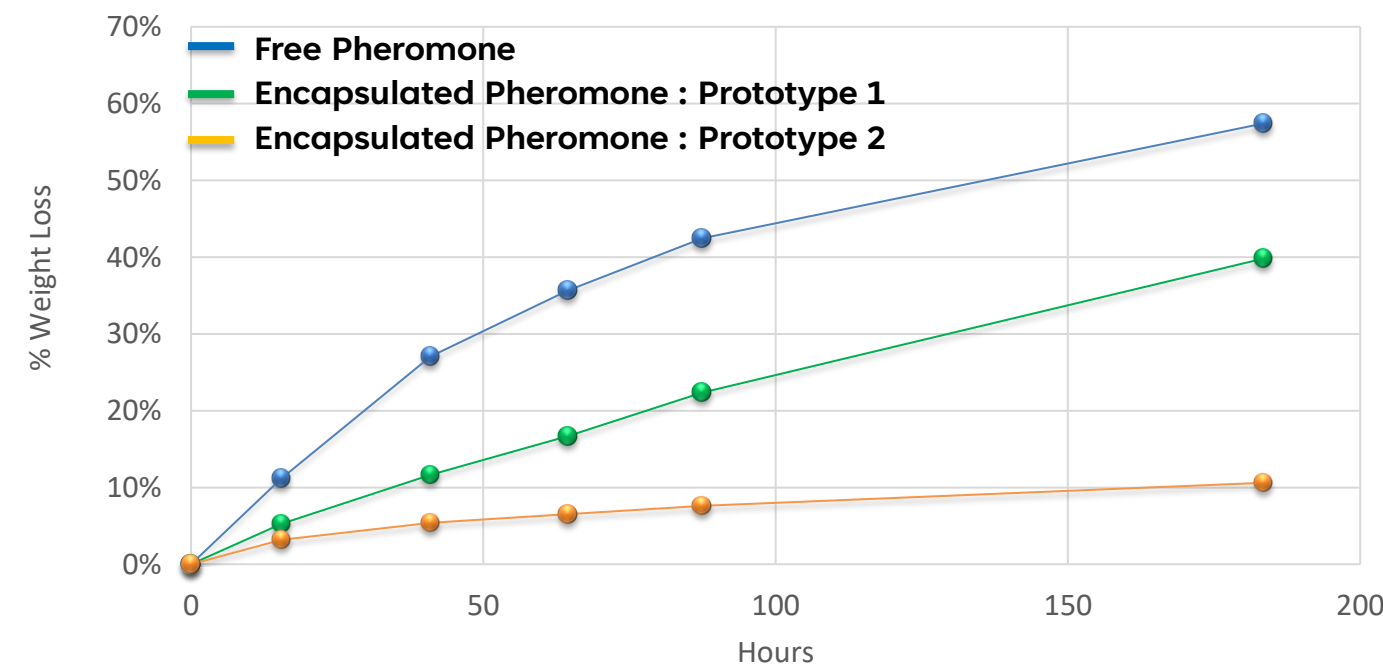
SHELL POROSITY
Non-porous or porosity-controlled shell

06. Case Study 1 : Pheromones

Protocol :

- A pheromone was encapsulated using Calyxia Naturacaps, creating toolbox of prototypes
- 0,100 g of free pheromone or 1 g of capsules containing the pheromone were poured on a petri dish and placed at 37°C in a climate chamber
- Weight measurements were made at 0,5 day, 1,5 days, 2,5 days, 3,5 days and 7,5 days
- Percentage of weight loss of pheromone was calculated and plotted over time

Figure 2 : % Weight Loss of Pheromone over time



✓ Reduction of volatility with biodegradable encapsulation

✓ Tunable release depending on application needs

Technology also compatible with: Plant extracts, Metabolites, ...

04 Benefits For Formulations

- Tunable Controlled Release
- Volatility Reduction
- Active Protection for Improved Stability
- Bioefficacy and Residual Activity
- Compatibility with Current AG Practices

05. Biodegradability assessment

Accelerated Tests



- Inherently Biodegradable** : 70% biodegraded in 14 days, **OCDE 302C**
- Readily biodegradable** : 60% biodegraded in 28 days, **OCDE 301B/301F**
- Biodegradable** : 60% biodegraded in 60 days, **OCDE 301B/301F**

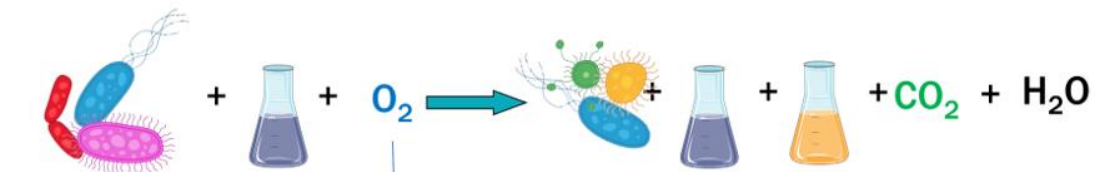


Figure 3 : Biodegradation Chemical Process

Internalization of OCDE 302C and 301F test at Calyxia :

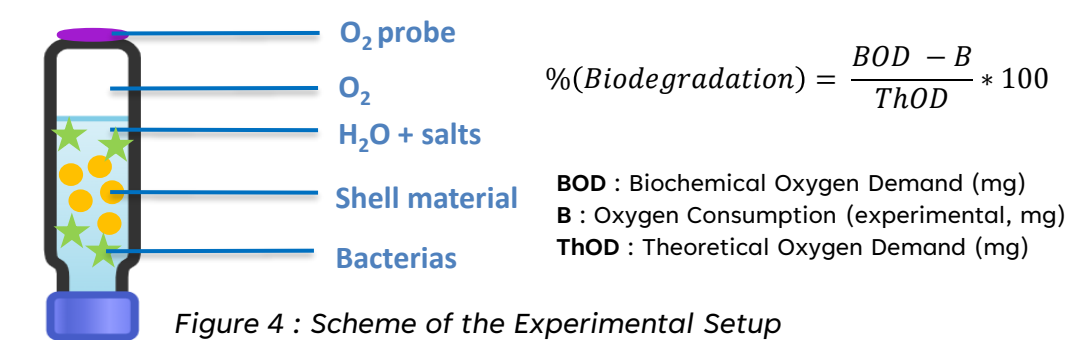


Figure 4 : Scheme of the Experimental Setup

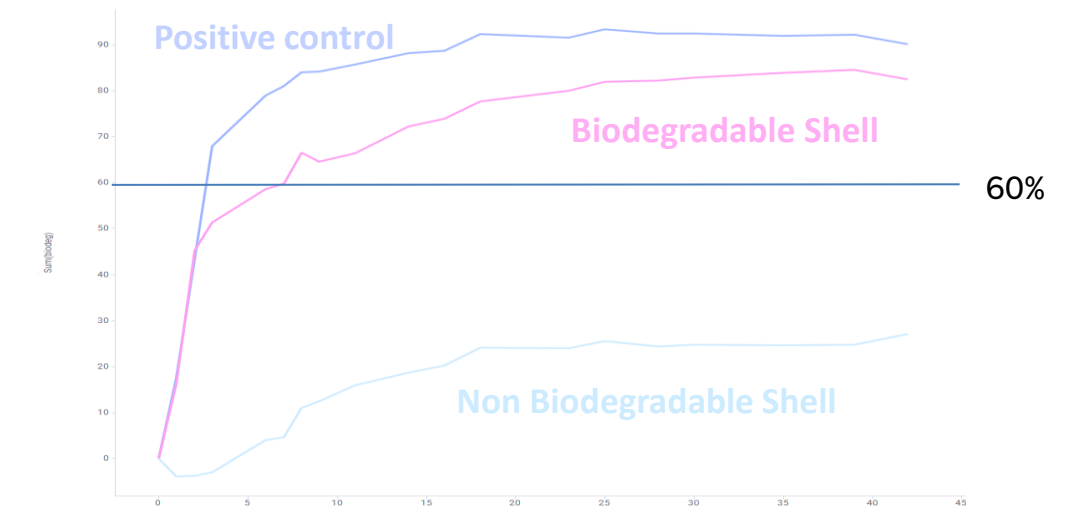


Figure 5 : Biodegradation vs Days of Experiment

- ✓ Screening of 90 chemistries every 6 weeks
- ✓ Creation of a portfolio of biodegradable chemistries
- ✓ Compatible and suitable for microencapsulation