

GROWTH OF BIOLOGICALS IS LIMITED BY FORMULATION AND DELIVERY CHALLENGES

To maximize the market potential of biologicals and more effectively replace legacy pesticide and fertilizer options, products must address formulation and delivery challenges.

Biologicals Need to:



Increase shelf-stability and product viability over time



Extend periods of product efficacy and spray intervals



Enable tank-mixing and combination products



Facilitate new product concepts

As the industry advances, biological product manufacturers need reliable solutions to improve their products, prompting the question: *Is there a way to enhance biological delivery methods?*

MILLIKEN BRINGS WORLD-CLASS BIODEGRADABLE ENCAPSULATION CAPABILITIES TO AGRICULTURE THROUGH ENCAPSYS®

As the largest independent microencapsulation manufacturer, Milliken delivers a wide array of microencapsulation options, including biodegradable offerings.

The intersection of chemistry and process drives novel solutions for our customers.

Chemistry Innovations:

- Melamine formaldehyde
- Acrylic
- Polyurea/Polyurethane
- Polyester/Polyamide
- Biodegradable

Process Improvements:

- Coacervation
- Interfacial polymerization
- In-situ polymerization
- O/W and W/O emulsions
- Solid-phase encapsulation

Milliken's History in Microencapsulation:

As the original inventors of chemical microencapsulation, we hold more than 100 active patents and bring decades of expertise to the field. Our track record includes co-developing breakthrough technologies and providing manufacturing support for leading Fortune 50 brands.

IMPROVED PERFORMANCE OF BIOLOGICALS THROUGH ENCAPSULATION

CASE STUDY 1

Increasing Efficacy through Encapsulation

The Technical Challenge:

Can advanced formulation improve yield impacts of a multiple-strain microbial biostimulant product?

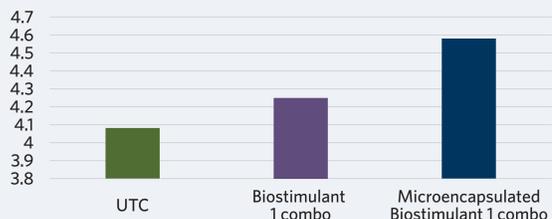
Milliken's Technical Approach:

- Balance structure, diffusion and environmental triggers to create a responsive system.
- Develop a delivery matrix that provides chemical and physical protection to microbial strains.
- Preserve activity and release timing.

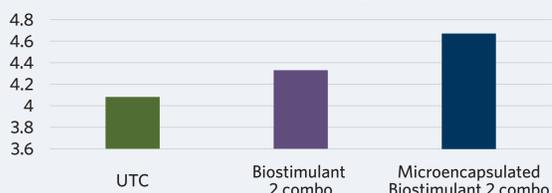
Product Results:

Field-proven increases in growth and yield effect across multiple years and geographies.

Corn Growth Rating (1-5)



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CASE STUDY 2

Extending The Period of Efficacy Through Controlled-Release Capsules

The Technical Challenge:

A volatile active ingredient required controlled release to maintain performance over an extended period in the end-use environment.

Milliken's Technical Approach:

We used our microencapsulation expertise to stabilize essential oils for consumer and industrial applications. Our polymeric capsule designs were tailored for integration into formulations, coatings and surface treatments.

- Techniques designed to minimize premature release during storage and handling.
- Capsule stability maintained through additional customer formulation steps.
- Customized encapsulation based on customer-specified actives such as botanical oils.

Product Results:

Our encapsulation solutions are formulated into customer products targeting enhanced surface properties like repellency or preservation. Testing has focused on leakage reduction and integration robustness, with additional performance validation by downstream partners.



CASE STUDY 3

Enabling New Product Concepts

The Technical Challenge:

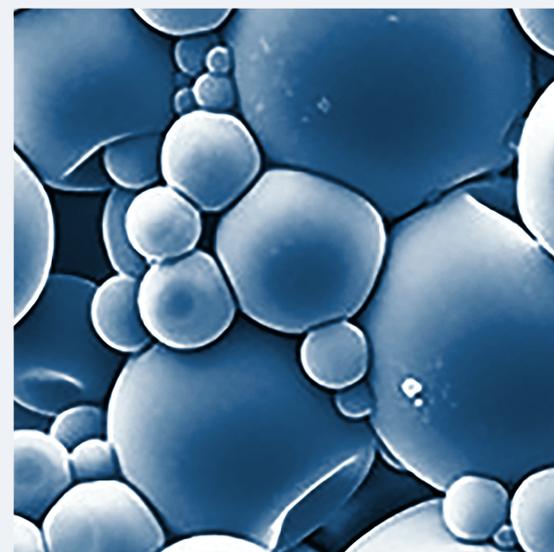
With rising weed resistance, farmers need additional tools. Can microencapsulation enable a pre-emergent herbicide to be safely used over crops, expanding its market?

Milliken's Technical Approach:

- Design a microencapsulated formulation that balances porosity to optimize active ingredient performance while shielding the treated crop from phytotoxic effects.
- Leverage novel encapsulation technologies from adjacent markets outside ag.
- Create a new encapsulation approach in agriculture.

Product Results:

Developed and tested a novel formulation ensuring crop safety at a new post-emergent herbicide timing without affecting pre-emergent weed control, opening a new application window for legacy herbicides.



Seeking better performance from your biological products?
Connect with Us.