Chitosan IG in PLA: Recommended commercialization path

Executive route selection for antimicrobial and functional PLA products.

RECOMMENDATION 01

Start with Surface Coating, scale through Masterbatch Addition, and reserve Bulk Compounding for products where monolithic, full-thickness function is essential.

Rationale · Low MW, high charge chitosan is best supported by literature in interfacial / compatibilized use; bulk routes carry the highest risk without reactive compatibilization.

ROUTE COMPARISON

01 Surface Coating

▸ PREFERRED FIRST

Aqueous dispersion · post-form retrofit

STARTING LOADING
0.25–1.0 wt% in water · 0.2–1.0 g/m² dry

BEST FOR
Antimicrobial surface · O_2-barrier boost · fastest retrofit

GAINS
Strong surface activity · minimal resin change · fastest pilot

FAILURE MODES
Poor wetting · tack/blocking · abrasion loss · moisture sensitivity

COMPLEXITY ●●○○○ Low–Medium

02 Masterbatch Addition

SCALE NEXT

Pre-compounded carrier · let-down at extrusion

FINAL USE LOADING
0.10–1.0 phr in PLA after let-down

BEST FOR
Easy dosing · scalable plant implementation

GAINS
Dispersion control · lot consistency · flexible SKU creation

FAILURE MODES
Poor let-down · agglomerates · moisture pickup · added cost

COMPLEXITY ●●●○○ Medium

03 Bulk Compounding

RESERVED USE

Direct melt blend · monolithic part

STARTING LOADING
0.10–1.0 phr · stress-test to 2.0 phr

BEST FOR
Monolithic resin · full-thickness function · rigid parts

GAINS *if compatibilized*
Crystallization · barrier · compostability · bulk function

FAILURE MODES
Aggregation · haze · brittleness · ↑WVTR · thermal degradation · crack initiation

COMPLEXITY ●●●●● High

COMPATIBILIZER DEFAULT Masterbatch & bulk routes — **ADR-type epoxy chain extender** first; **MA-g-PLA** second.

NEXT STEPS Pilot Surface Coating · run **ASTM D1003, D3985, F1927, E96, E2180/E2149** · on success, develop compatibilized masterbatch.

Sources · pmc.ncbi.nlm.nih.gov/articles/PMC11209879 · nature.com/articles/s41598-018-22281-1 · real.mtak.hu/234348/1/EPL-0013374_article.pdf · frontiersin.org/journals/nutrition/articles/10.3389/fnut.2022.880520/full