



# HIGH PERFORMANCE PHAS WITH LEVULINIC ACID

## KEY FEATURES

- > **Performance material** for the production of PHA co- and terpolymers, such as PHB3HV and PHB3HV4HV
- > **Co-nutrient** with metabolically-engineered strains (like *Ralstonia eutropha*, *Pseudomonas putida*, *Cupriavidus necator*) and wild marine strains for PHB3HV4HV production
- > **Yield improvement** and composition design for crystallinity and property control

## LEVULINIC ACID FROM GFBIOCHEMICALS

- > Patented and proven technology with feedstock flexibility
- > 10,000 MT/a production plant came online July 2015 in Caserta, Italy
- > Targets 25,000-50,000 MT/a industrial plant by 2019
- > First company to produce levulinic acid at commercial scale
- > Price estimate at maturity is €1/kg



## PHA MARKET

- > Global PHA market is expected to rapidly develop in the next five years
- > About 30 companies working to acquire market position
- > Multiple scl- and mcl-PHAs are being developed and introduced
- > Focus on PHAs with improved functionalities and property balances
- > Emphasis is on decreasing PHA manufacturing costs

## UNIQUE OFFERING

- > High purity (>99.5%) levulinic acid as additional raw material for PHA copolymer production
- > Builds in 3-hydroxyvalerate and 4-hydroxyvalerate units for PHBV product design
- > Can be used to replace propionic acid or other co-nutrients for PHBV manufacturing
- > Samples available for testing and for larger scale PHA manufacturing
- > Literature reference list available

## VALUE PROPOSITION

- > Levulinic acid is a cost-effective building block for production of PHB3HV4HV products for film, fiber, injection molding and extrusion applications
- > PHBV products have advantages compared to PHB:
  1. Improved fermentation yield
  2. Enhanced toughness and elongation properties
  3. Wider processing window due to lower melt temperature and crystallinity control



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