PHARIO ®

High-quality PHBV from municipal wastewater

from pilot to successful demo: welcome to new applications

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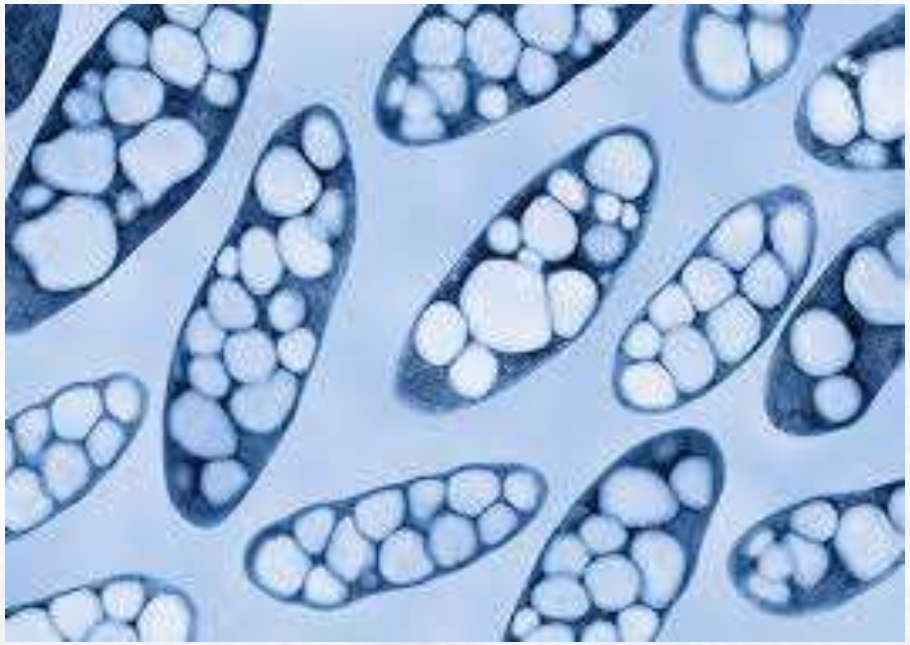
www.phario.eu

Biodegradability PHA general



PHA is a unique polymer compared to other biopolymers:
It can degrade to CO2 and H2O (truly) by its nature

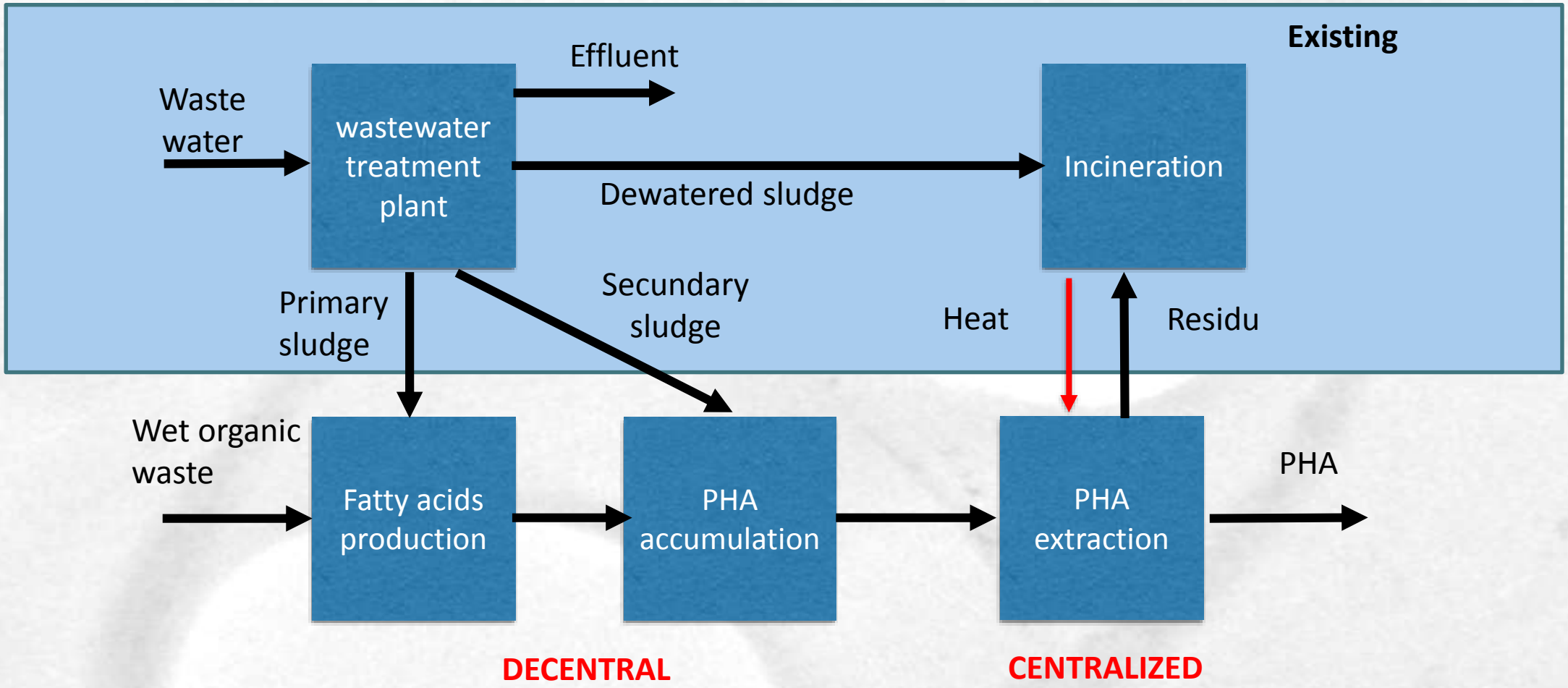
- **In marine environment**
- **In soil environment**
- **In industrial composting**
- **In home composting**
- **Mechanically recyclable**
- **Anaerobic digestion (CH4),or into new PHA**

(will be tested to standards during PHARIO demo stage)

Overview of biobased plastics (thermoplastics)

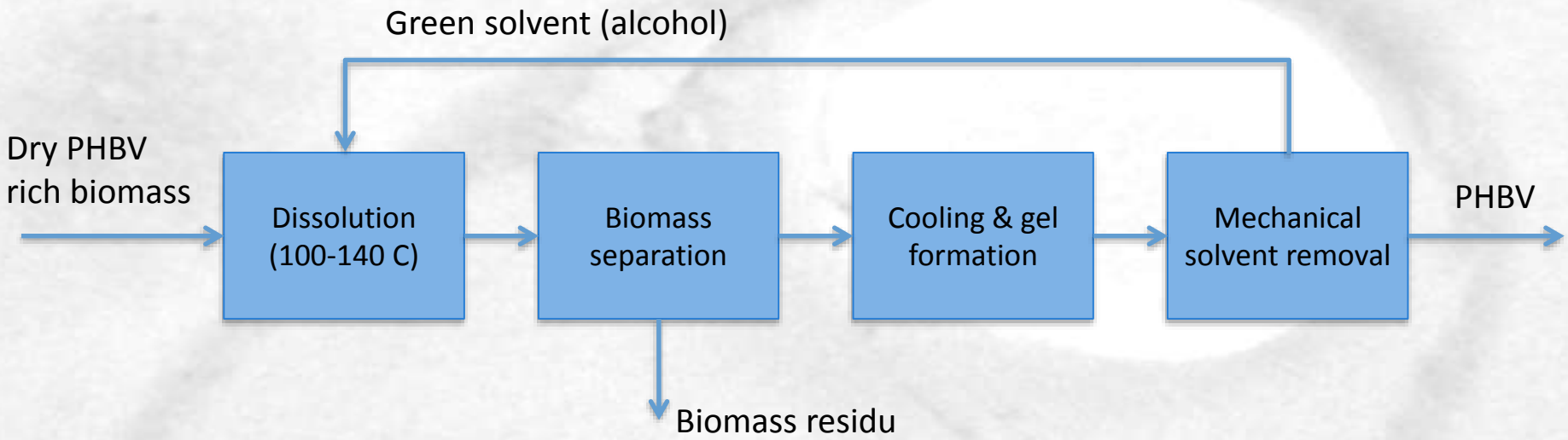
	Non-biodegradable	Biodegradable (in industrial composting installation)	Biodegradable (in water in nature)
On the market today	Bio-PE (drop-in) PA11, PA10.12, PA4.10	PLA (and *PLA/PHA blends*) PHA (and *PHA/TPS blends*)	PHA Regenerated cellulose
Under development (not on the market yet)	PEF Drop ins: Bio-PP , Bio-PVC, Bio-PET, Bio-PTT PBT PA6, PA6.10, PA66, PA12	Bio-PBS Cellulose Acetate PGA *PLA/TPS blends* *Bio-PBS/TPS blends*	

PHARIO®: a new value chain



- Municipal wastewater treatment “trains” bacteria for PHA production
- Added value by harvesting bacteria and use of organic residuals to make PHA bioplastic
- Extraction of the PHA rich biomass with green solvent
- Steerable and high quality PHA polymer

Unique solvent extraction



- **High purity and stable product from heterogenous waste**
- High and tuneable Mw
- Ability to homogeneously blend different HV batches

A scalable process

Pilot (10 month)

- **Biomass WWTP behaves consistent**
- **Feed quality determines PHA quality**
  (so not the influent/biomass)
- **Consistent quality PHA possible**
  (enough control options)
- **Quality PHARIO PHA: good and unique**

Scalability

- **In principle all WWTP's are suitable**
- **Commercial scale: 5000 ton PHA, 800.000 P.E.**
- **Potential Netherlands: 25.000 ton PHA (at least)**
- **Potential EU: 500.000 ton PHA**

Business case

Classic PHA 4-5 €/kg

- Large % of cost related to feed stock
- Volatility in feed costs
- Process relatively mature

PHARIO PHA® 2-3 €/kg 3-4 €/kg

- Feed stock is very cheap
- Long term, stable contracts for feed stock
- Costs based on extrapolation from pilot => much room for optimization

Value case:

- 70% lower than classic PHA production
- Potential to be a climate neutral plastic
- Tertiary feedstock: no food, no GMO

PHA2USE project 2019-2021

Demonstration PHA2USE

- PHA for Application development
- Technology upscaling

Two approaches:

- PHARIO® from sludge
- Paques/TU Delft rich culture

Investing partners

Research & Development

Dordrecht: wwtp & sludge incinerator

350 kg/day PHA rich biomass production

Pilot extraction facility

Extraction 100 kg batches for key application partners

Let’s demonstrate together

PHARIO PHBV capabilities

- Injection moulding, film extrusion: possible
- Other processing: in development
- Bio-degradability as a (controlled) and valued function or end-of-life: water, soil, home, industrial composting, anaerobic digestion
- Datasheet: available (three grades)

Target applications:

- Bio-degradable: For example: seed coatings, fertilizer coatings, horticulture, agriculture, weed protection, plastic bags, packaging (oxygen barrier properties), mulch foils,
- Other applications with added value (impact modifiers PLA and other bio based polymers)

Please share your ideas on application development?!

OPEN SPACE STILL FOR NEW APPLICATION PARTNERS

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