



UNLOCK NETWORKING EVENT: Advancing Circular Economy In Agriculture

TUESDAY 22 OCTOBER 2024 | 14:30-18:15 CET | BRUSSELS



This project has received funding from the Bio-based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101023306. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.





Technologies in Feather Processing and Upscaling

Jonna Almqvist



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Technologies in Feather Processing and Upscaling

Three treatment techniques



Feather sanitation and mechanical grinding



Cedrob is largest polish meat producer established in 1991

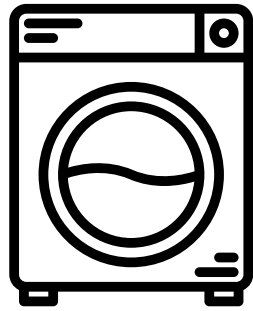
- **Production of 441 thousands tonnes of chicken meat in 2022**
- **In 4 poultry facilities produces approx. 50 tonnes of feathers daily - category 3 by-products which have to be rendered.**

As partner of the UNLOCK project Cedrob S.A. delivers appropriately prepared feathers by project and built of pilot plant.



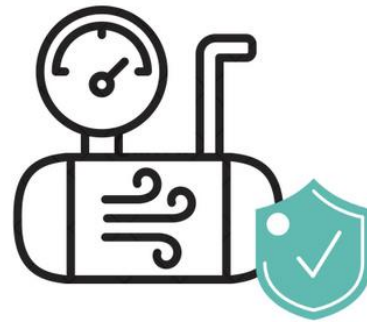
Feather sanitation and mechanical grinding

The goal of feather conditioning



- CLEAN

Washing to
remove dirt and
grease



- SAFE

Drying and thermal
treatment in
accordance to
regulations for
microbiology remove



- GROUND

To size allowing
usage by partners in
biodegradable
materials production

Feather sanitation and mechanical grinding

Feather grinding

Mechanical grinding is innovative process

Dry feathers are hard to grind in semi-industrial scale because of their properties - fibers are hard and flexible.

During process grinders blocked and overheated.

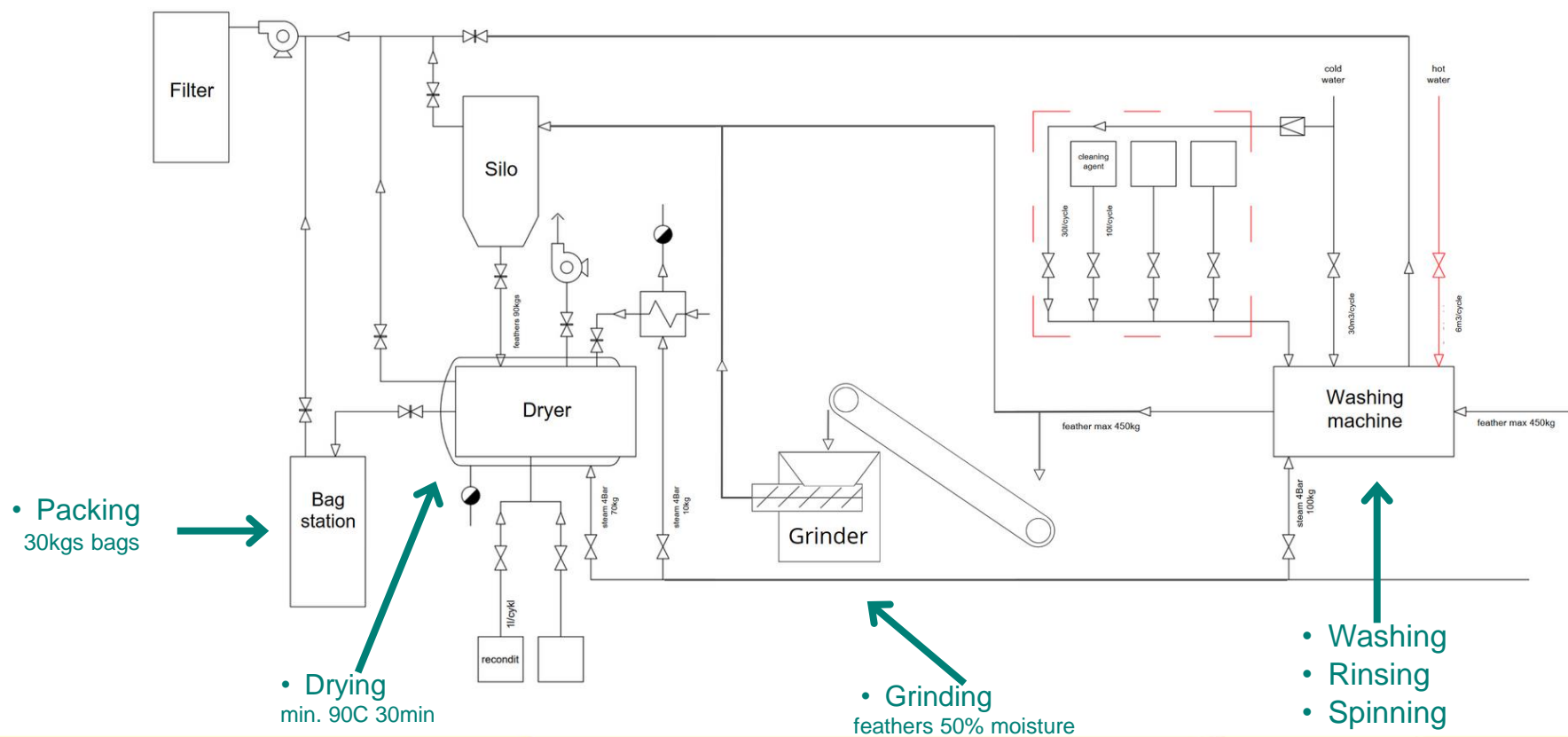
Washed wet feathers was tested and gave positive results. Wet feathers are more soft and easier to grind.

Water reduces temperature of process.

Capacity of grinding:

- dry feathers 30kg/h
- wet feathers 200kg/h





Capacity of the process is up to 200kg/h of dry feathers.

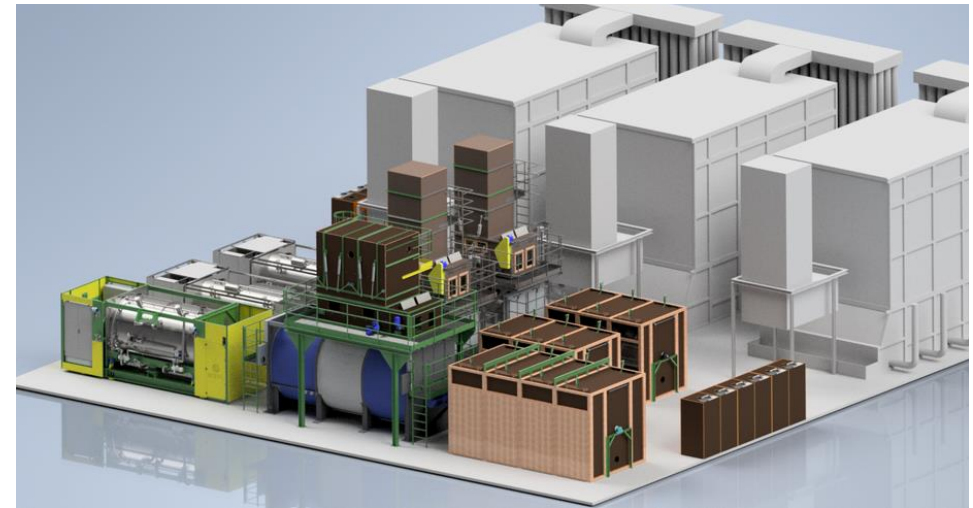
- The designed process is automated, what reduces quantity of employees needed.
- The automated washing machine eliminates time needed for manually loading and unloading centrifuge.
- Washed feathers are automatically transported and feed grinder. There is possibility to bypass whole feathers directly to dryer as emergency.
- Gentle drying with hot air in temperature 120OC is automatically controlled to set level of moisture (10%).
- Unloading dry feathers with vacuum transport occur separation of heavier foreign bodies, which stay at the bottom of the dryer and are removed later.

Feather sanitation and mechanical grinding

Pilot plant location

Demo plant will be located in Zakład Drobiarski Cedrob S.A. located in Kutno in central Poland

- The plant will be installed in newly constructed facility



Feather sanitation and mechanical grinding

Characterisation of produced feathers

Parameter	Value
MICROBIOLOGY	Salmonella absent in 25g
	Enterobacteriaceae <10cfu/100g
CONDITION	Option 1 whole feathers washed and dried
	Option 2 washed, dried and cutted to approx. 10-15mm
COLOR	White
MOISTURE	<10%
FAT	<3%



Whole feathers



Ground feathers

Feather sanitation and mechanical grinding

Summary

- Alternative process to rendering which can be implemented in slaughterhouse.
- Feathers can be used as valuable material.
- CO2 reduction by minimizing transport to rendering facilities.
- Less energy compared to feather meal production.

Steam explosion



• Steam explosion

Thermo-mechanical process used to break down materials

- High pressure steam applied to feathers
- Rapid pressure release causes cell structure breakdown

Key parameters

- Temperature, pressure and duration

Benefits

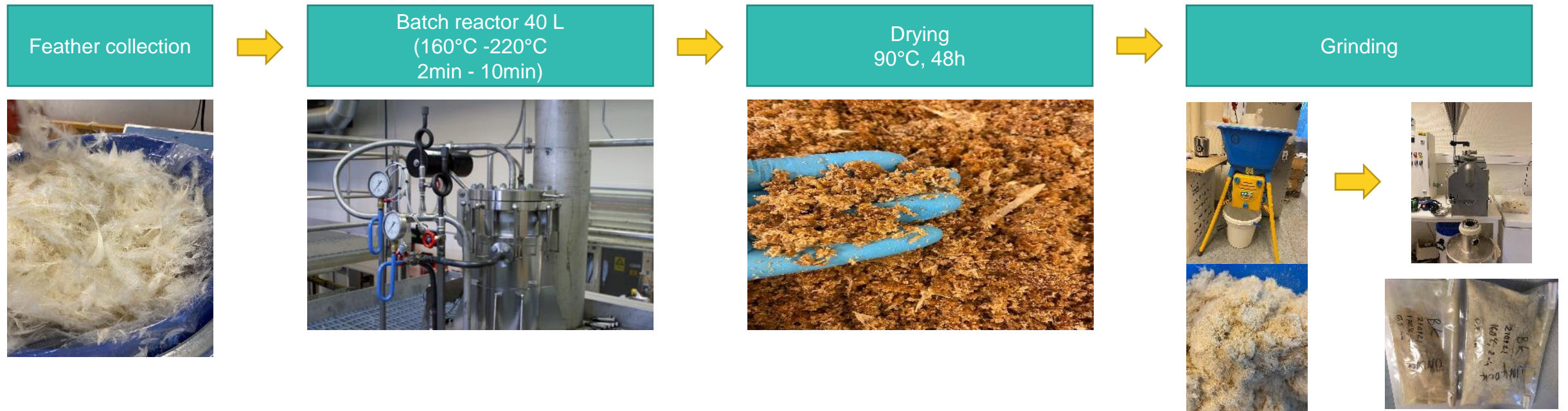
- Improved accessibility for further processing
- Enhanced conversion of feathers into valuable materials

Initial Experiments

- Small-scale testing of steam explosion on feather samples
- Optimization of process parameters

Results

- Successful breakdown of keratin structures
- Increased surface area for downstream applications



Steam explosion

A scalable technology:

-from batch reactor to demo plant

- TRL 4 to TRL 7

RISE Steam Explosion



Batch
40 L
2-3 kg
190°C
4 min



Sekab Biorefinery Demo Plant



Continuous
20 kg/h

Demo Trial:
500 kg feathers
195°C
10 min

Results and Learnings from the Pilot Scale

There were less problems than expected

- feeding, burning, dust etc.

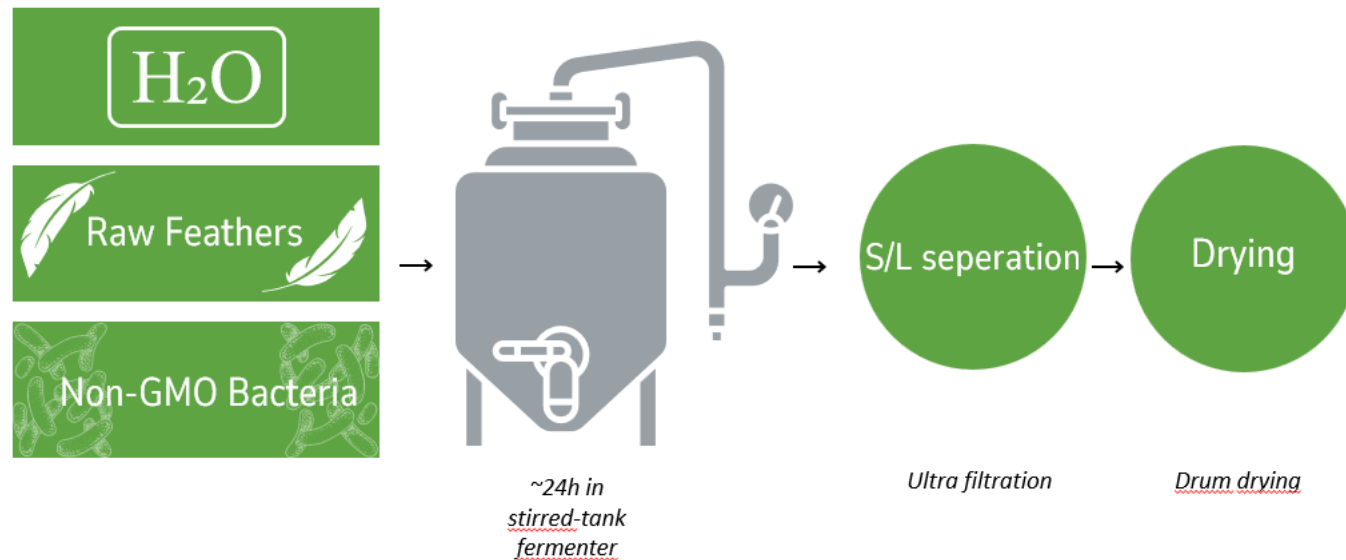
Advantages

- Minimal use of chemicals
- Lower energy consumption
- High yield
- Easy to scale



Challenges in dewatering
of large amounts of material

The process



- **Adding feather:** Introduce feathers into the fermenter as the main substrate.
- **Adding media:** Mix water and media to create a suitable environment for microbial activity.
- **Fermenter preparation and sterilization:** Achieving aseptic conditions of both the reactor and the feathers.
- **Inoculate with bacteria:** Introduce specific bacteria that can break down keratin in feathers.
- **Introduce air:** Provide aeration to support aerobic bacteria, enhancing decomposition and fermentation.
- **Harvest fiber:** After an appropriate fermentation period, collect the resulting fiber as the end product.



Feather before hydrolysis



Fiber broth



Dried fibers

The resulting fibers are...

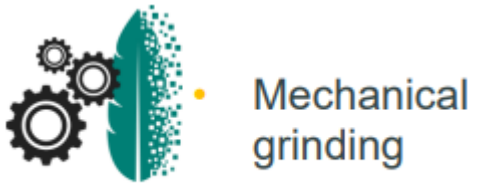
- Biodegradable
- Lightweight
- Non-toxic
- Water-retentive
- Insulating
- Effective as a structural reinforcement
- Nitrogen-rich



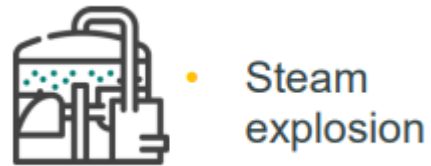
Has been validated in 500L fermenters

Technologies in Feather Processing and Upscaling

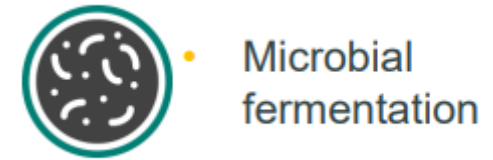
Summary



- + Easy technique
- + Cost-effective
- Energy intensive



- + Scalable
- Energy consumption



- Complex to scale
- + Low energy consumption



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