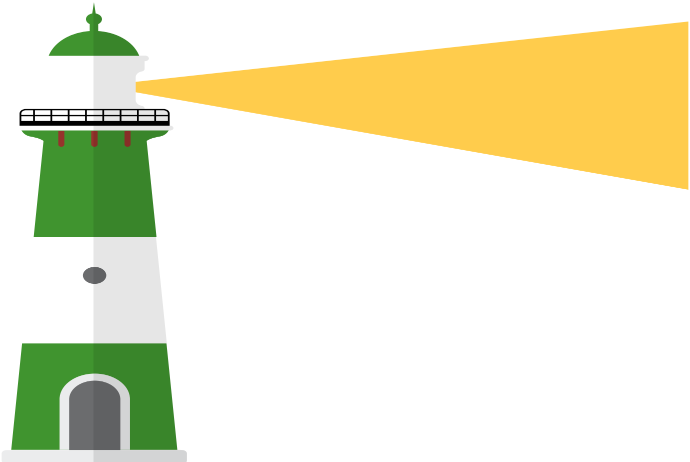
# Nutri2Cycle

Transition towards a more carbon and nutrient efficient agriculture in Europe

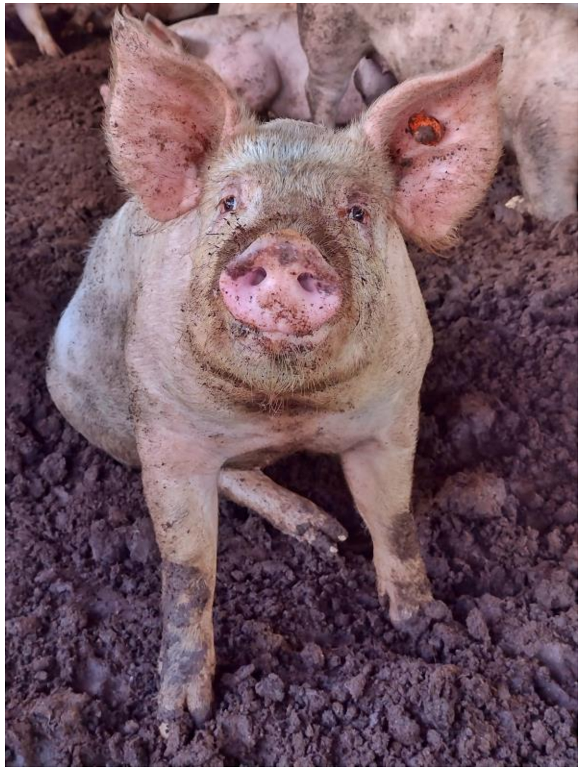


## Pig manure refinery into mineral fertilisers using a combination of techniques applicable at industrial pig farms.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773682.

# Introduction

Intensive livestock production → surpluses of nutrients



Animal manure can provide globally → over 115 million ton of N (2017).

- Surplus of slurry nutrients exceed the capacity of local surrounded crops.
- Environmental problems associated to N losses; Nitrates leaching, NH3, and CH4, and NOx emissions, eutrophication…
- Its management is the primary source of GHG emissions from pig farming, which in turn accounts for 18% of the total global GHG emissions from the livestock industry.

# Introduction

Solid-liquid separation

- Solid fraction → P and Organic Matter
- Liquid fraction → N, K and P

No high recovery efficiencies guarantee
Liquid fraction → Large volume → Transport costly

Membrane filtration → RO → technique from which water can be removed
(Volume reduction in 30 – 77% )

RENURE criteria
To safe use of processed manure materials in NVZ
e.g. Mineral nitrogen to total nitrogen ratio ≥ 90%.

# System description – OB-Slurless

- Full scale – Lombardy, Bergamo
- Pre-assembled process plant
- Max. raw input 120 $m^3/d$, continuous process, any kind of manure
- Sequential separation and concentrations steps to:
    - Reduce volume by recovering of clean water and
    - Concentrate nutrients
    - Concentration of N, favoring its displacement in places where is required
- Monitored remotely

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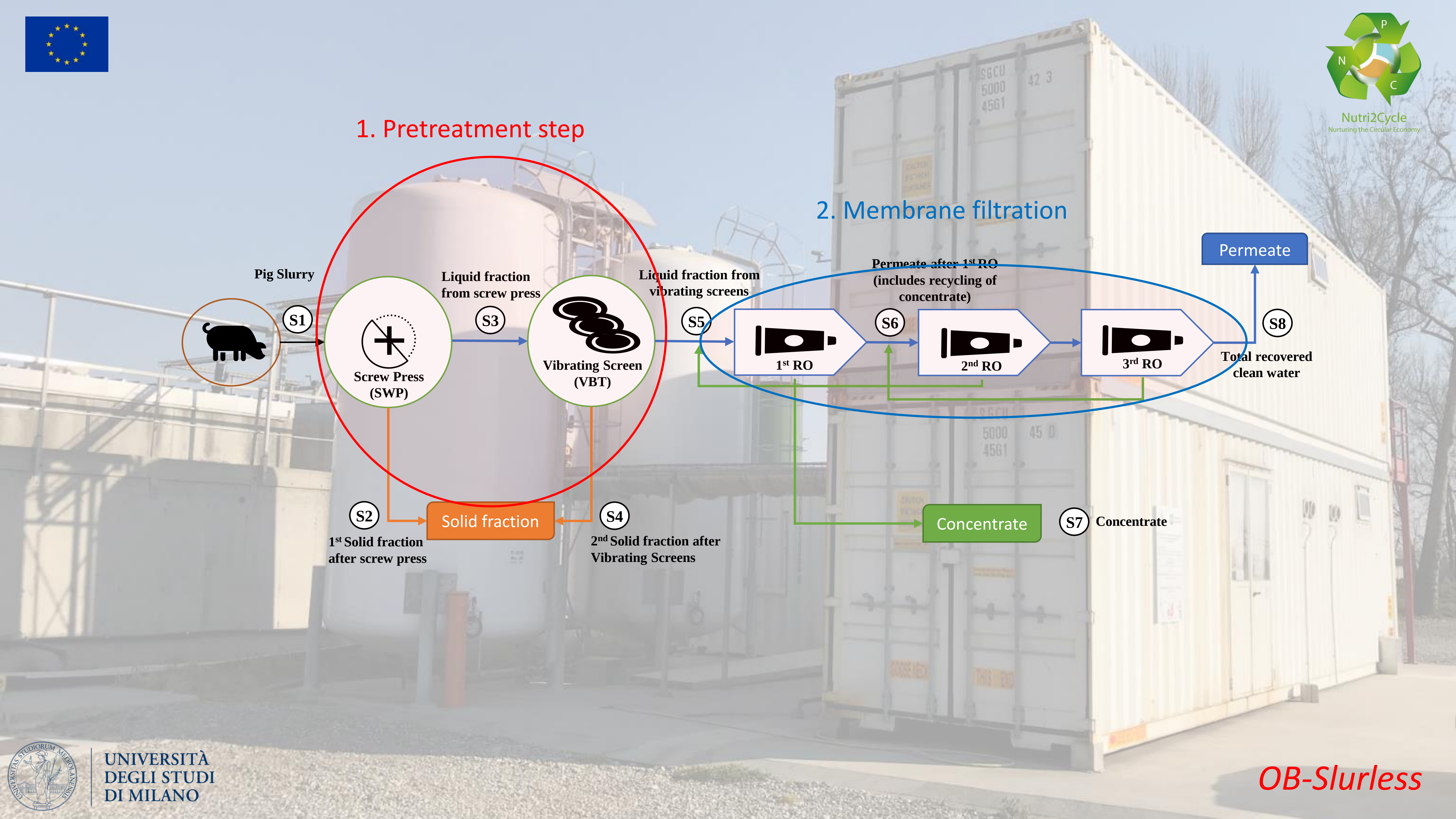
Nutri2Cycle
Nurturing the Circular Economy
1. Pretreatment step
2. Membrane filtration
Pig Slurry
S1
Screw Press (SWP)
Liquid fraction from screw press
S3
Vibrating Screen (VBT)
Liquid fraction from vibrating screens
S5
1st RO
Permeate after 1st RO (includes recycling of concentrate)
S6
2nd RO
3rd RO
Permeate
S8
Total recovered clean water
S2
1st Solid fraction after screw press
Solid fraction
S4
2nd Solid fraction after Vibrating Screens
Concentrate
S7
Concentrate
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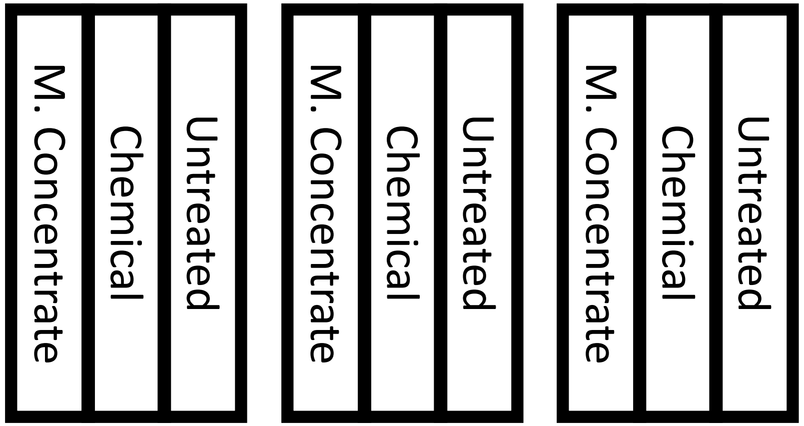
OB-Slurless

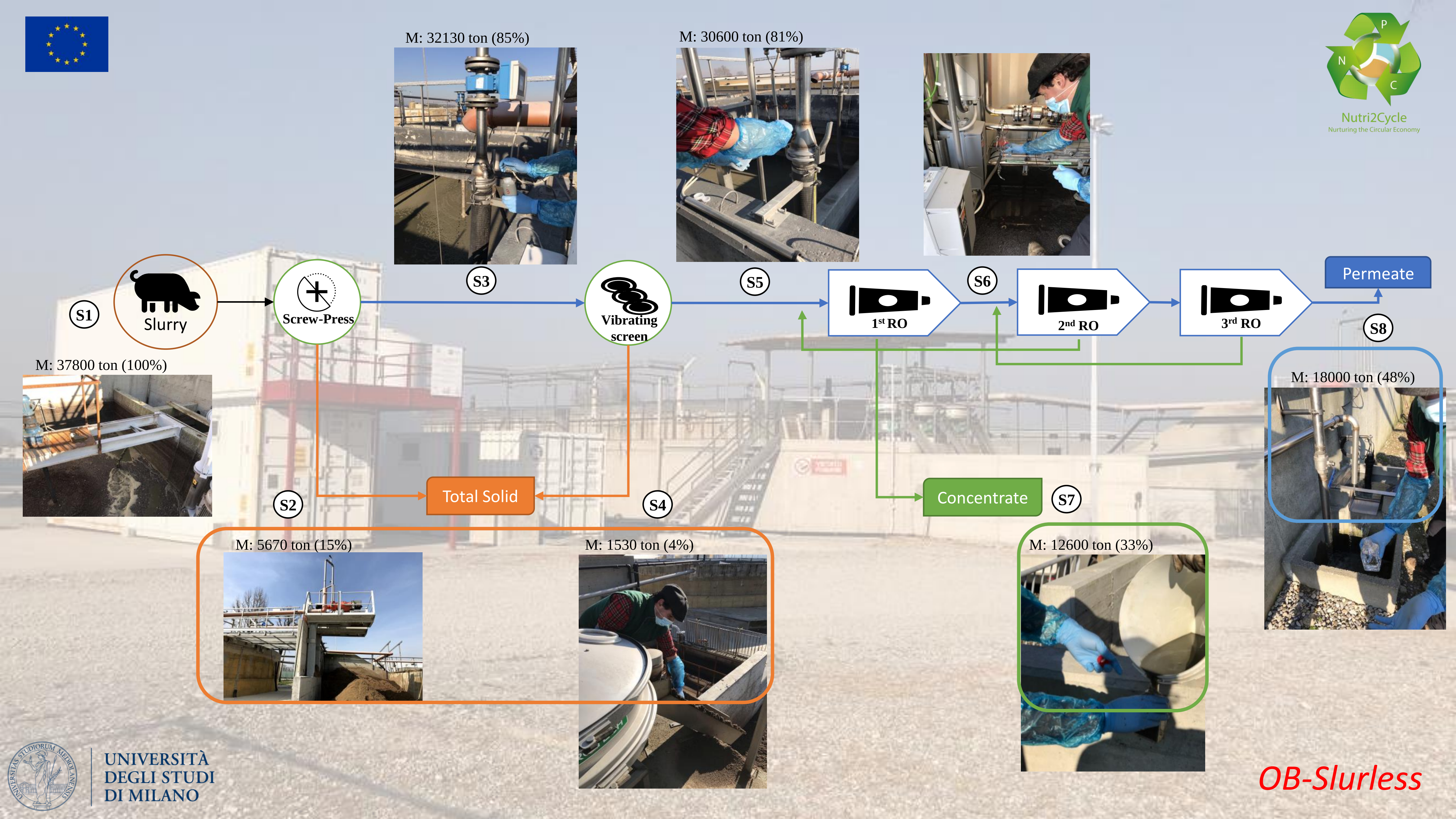
# Monitoring

Sampling: Jan - May - July – 2021. Samples were tested in triplicate.

Dry matter at 105 °C (DM 105 °C), dry matter at 600 °C (DM 600 °C). Total nitrogen (TKN), Ammonia-N (NH4-N) nutrients (P, K, Ca, Mg, Fe, Mo, Mn), heavy metals (Cd, Cr tot, Ni, Pb, Cu, Zn) and micro elements (Hg, As, Al, Co, Se, Na) the other elements (Ca, Mn, Mg, Fe, Mo, Al, Co, Na).

Yield trial experiment during the season 2021 to compare mineral concentrate vs. urea in corn production.




S1
Slurry
M: 37800 ton (100%)
Screw-Press
S3
M: 32130 ton (85%)
Vibrating screen
S5
M: 30600 ton (81%)
1st RO
S6
2nd RO
3rd RO
Permeate
S8
M: 18000 ton (48%)
S2
Total Solid
S4
M: 5670 ton (15%)
M: 1530 ton (4%)
Concentrate
S7
M: 12600 ton (33%)
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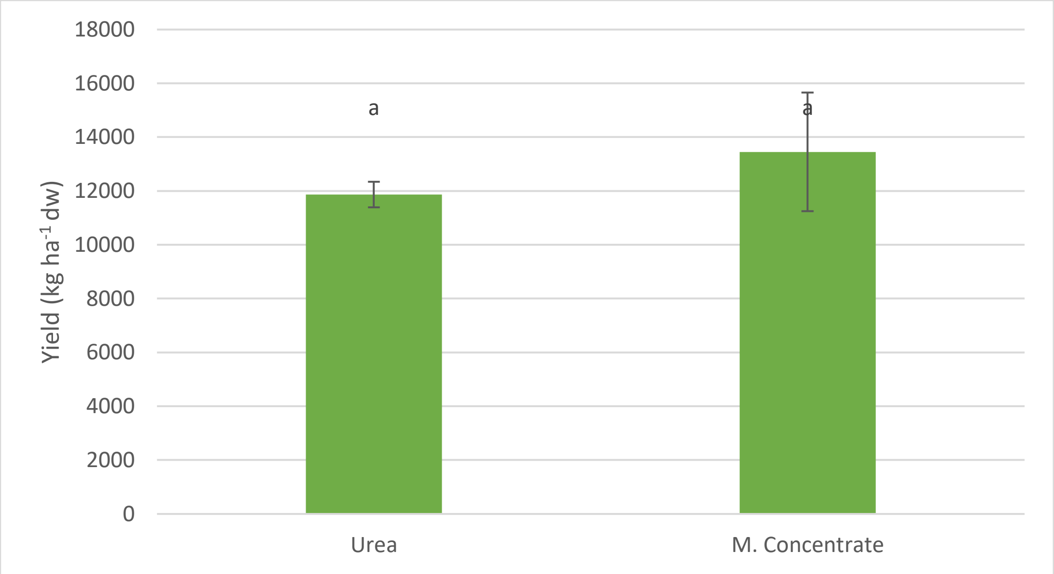
OB-Slurless

| Thesis | Period | Fertilizer | N ($kg_N$/ha) |
|---|---|---|---|
| I. M. concentrate | Pre sowing | Effluent as such | 170 |
| | | Concentrate | 83 |
| | Topdressing | Concentrate | 115 |
| | | | |
| II. Urea | Pre sowing | Effluent as such | 170 |
| | | Urea | 83 |
| | Topdressing | Urea | 115 |

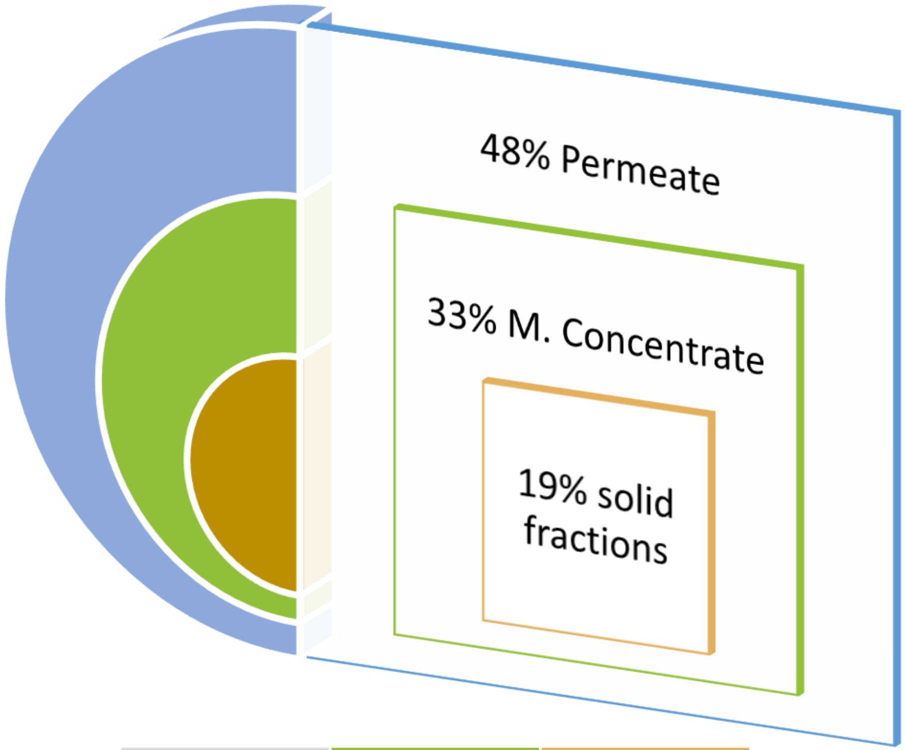




*OB-Slurless*

# Discussion

Advantages

- High quality recovered clean water, ready to be released safely into the environment.
- Solid fractions retained TS (84%), source of P and organic matter.
- The concentrate was characterized by a high N ratio content of $NH_4$-N in 91 % ✓, and K found in double concentration compared to the initial slurry.
  - Copper (Cu) 271 mg/kg (DM) ✓ **RENURE**
  - Zinc (Zn) 770 mg/kg (DM) ✓ **RENURE**




| Slurry | M. Concentrate (Exportable) | Solid fractions |
|---|---|---|
| N (100%) | 52 - 60% | 31 - 35% |
| P (100%) | 40 - 45% | 48 - 52% |
| K (100%) | 65 - 70% | 20 - 25% |

# Discussion

Drawbacks

- Relatively high energy consumption that carries membrane technology. Though input resources are minimal, chemicals for pH adjusting and membrane cleaning.
- Energy consumption is also a factor that could affect economic performance.
- Membrane fouling should be accompanied by prevention and mitigation practices.

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# Thank you very much

**www.nutri2cycle.eu**

**Twitter: #Nutri2Cycle**

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