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Combined Phosphorus& Kaumera recovery from Aerobic Granular Sludge

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Motivation

NEREDA® Technology is an innovative biological wastewater treatment process based on granular sludge. It is characterized by a repeated batch wise operation (Fig 1) and low space requirement. Currently, the process is optimized for phosphorus removal through anaerobic/aerobic alternation, but it is desired that wastewater treatment processes in the future recover that phosphorus.

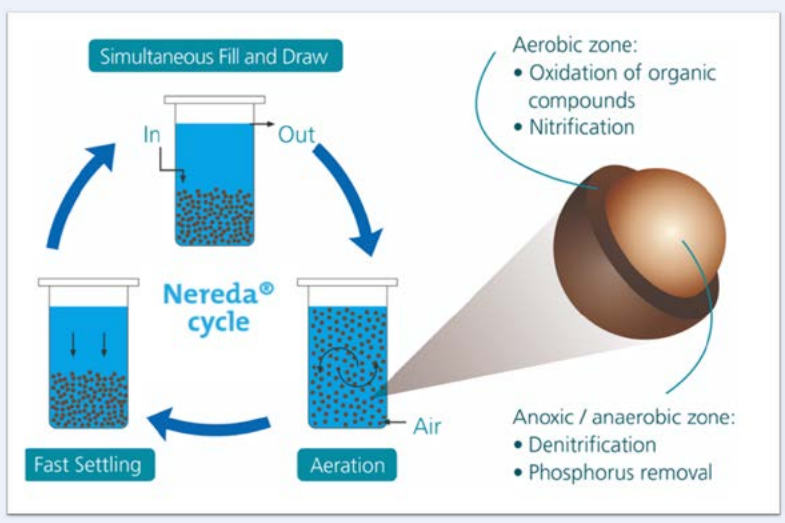

Fig 1: NEREDA® WWTPs cycle

NEREDA® waste sludge offers the opportunity for recovery of a new bio-based raw material extracted from the extracellular polymeric substances (EPS) (Fig 2). The commercial name for this bio-based material is Kaumera NEREDA® Gum, and a first demonstration extraction installation is in operation in Zutphen (Fig 3). Kaumera is a gel forming polyelectrolyte that can be used in many applications (Fig 4). The non-flammability properties of Kaumera are suggested to be related to the phosphorus co-extracted with the Kaumera polymers.

Fig 2: NEREDA® Kaumera Gum

Fig 3: Kaumera extraction installation in Zutphen

Fig 4: Kaumera applications (Flame retardant material- Dye binder)

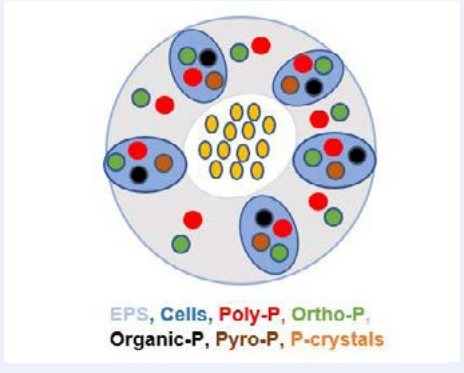

Fig 5: Illustration of phosphorus speciation in granules, (Huang et al., Bioresource Technology, 193, 2015)

In NEREDA® plants, phosphorus is removed by an enhanced biological phosphorus removal (EPBR) process. Phosphorus will be present in the sludge as polyphosphates, organic-phosphates and precipitates (Fig 5). Phosphorus recovery in NEREDA® and conventional plants is not economically competitive compared to phosphorus obtained from phosphate rock. Creating higher value and higher quality phosphorus materials instead of just fertilizers from alternative sources would boost the phosphorus recovery sector and open new markets.

Technological challenge

Currently, the interaction between biological phosphorus removal and co-occurring phosphorus precipitation is unknown. It has been reported that precipitates occur, but it is unclear to what extend this is pure chemically or biologically induced precipitation. Also, there are indications that the Kaumera polymers have phosphorus covalently attached.

Knowing the speciation of phosphorus and the background of how the speciation can be influenced is essential for developing phosphorus recovery strategies. The phosphorus recovery can be integrated in the NEREDA® process as well as in the Kaumera extraction process (Fig 6).

The aim of this project is to develop high value recovery options for phosphorus, especially focusing on understanding the influence of phosphorus on the Kaumera properties

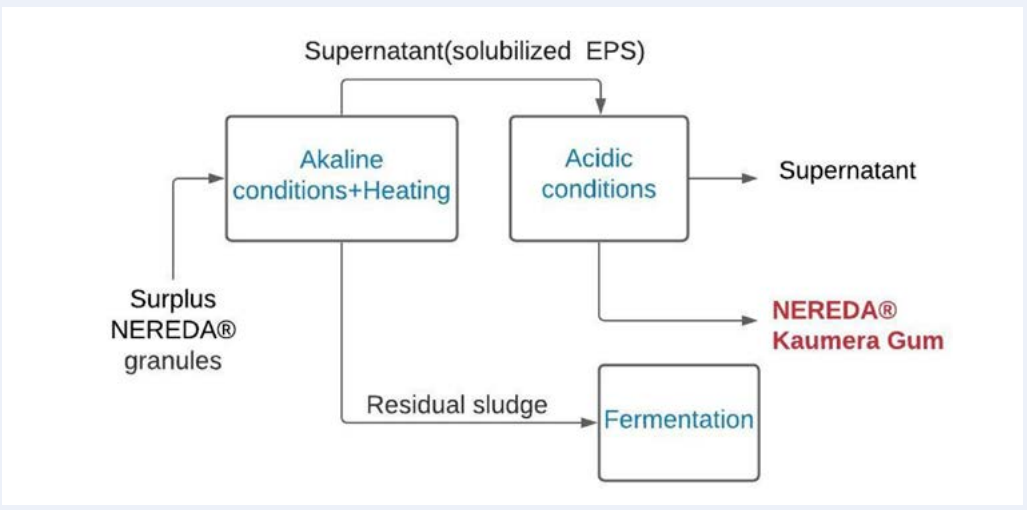

Fig 6: Kaumera extraction procedure from aerobic granules

Research goals

- Understand phosphorus immobilization and speciation in aerobic granular sludge
- Understand the fate of phosphorus in the Kaumera extraction process
- Understand the role of phosphorus in Kaumera properties such as fire retardancy, dewaterability, and gelling
- Develop a phosphorus recovery method integrated with the NEREDA® Technology or Kaumera extraction process

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