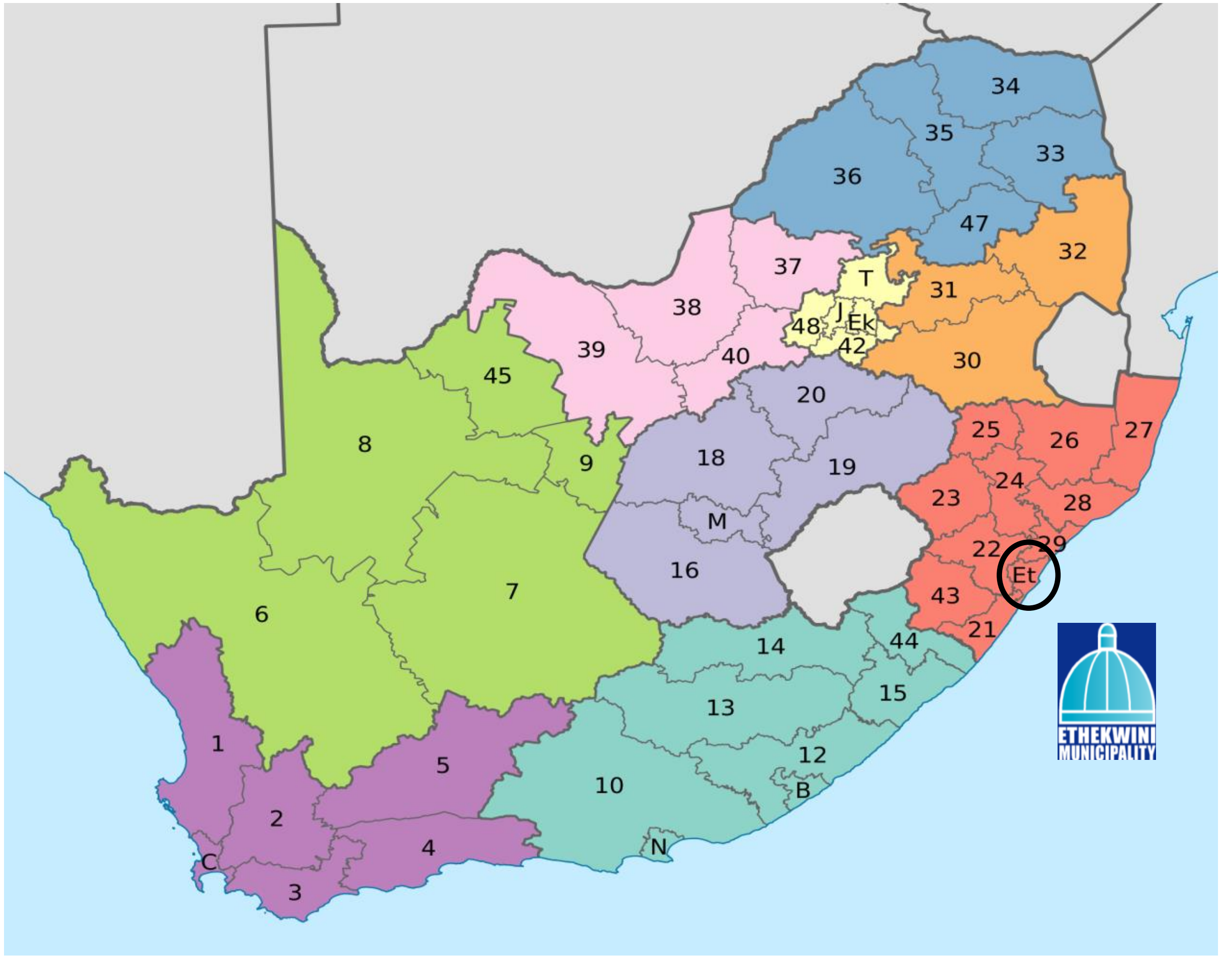
Study of LaDePa process for the treatment of feacal sludge from VIP latrines

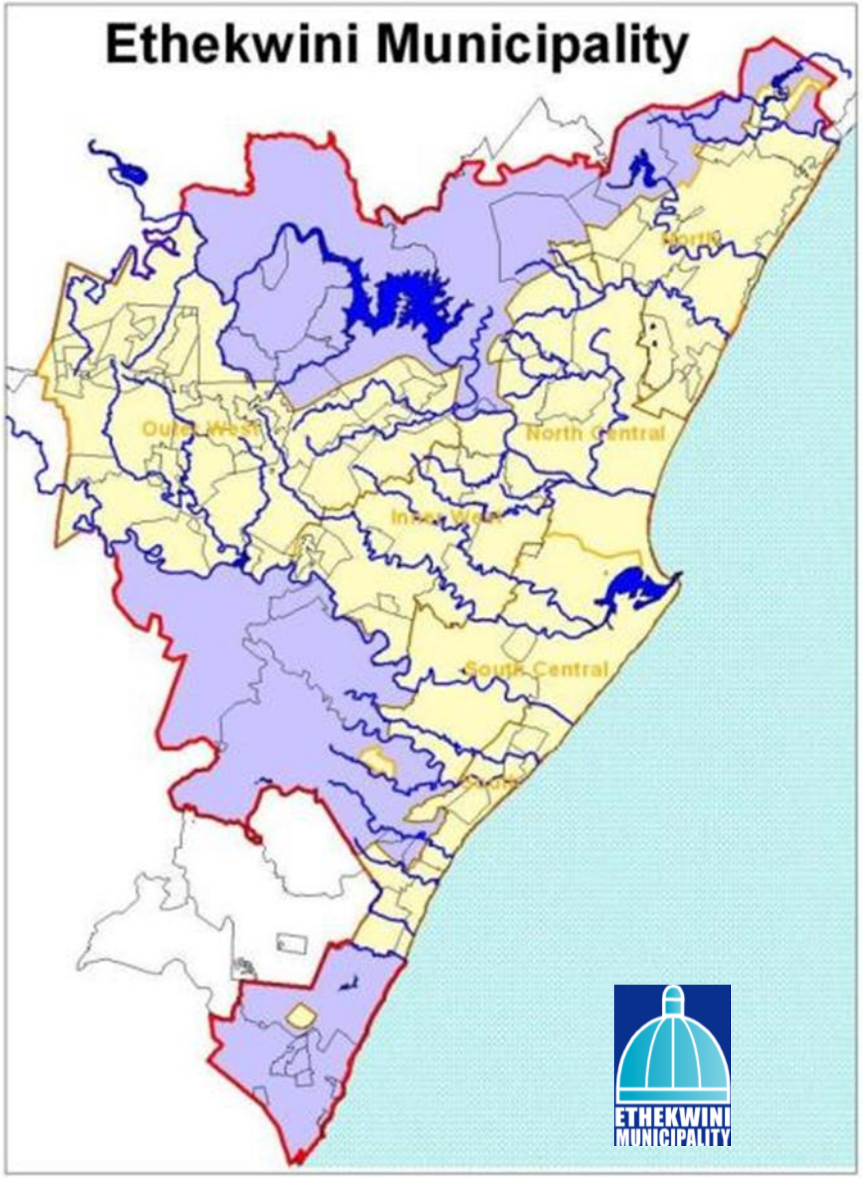
S. Septien, A. Singh, S.W. Mirara, L. Teba, K. Velkushanova, C. Buckley

Pollution Research Group, University of KwaZulu-Natal, 4041 Durban, South Africa

Corresponding author: septiens@ukzn.ac.za

South Africa





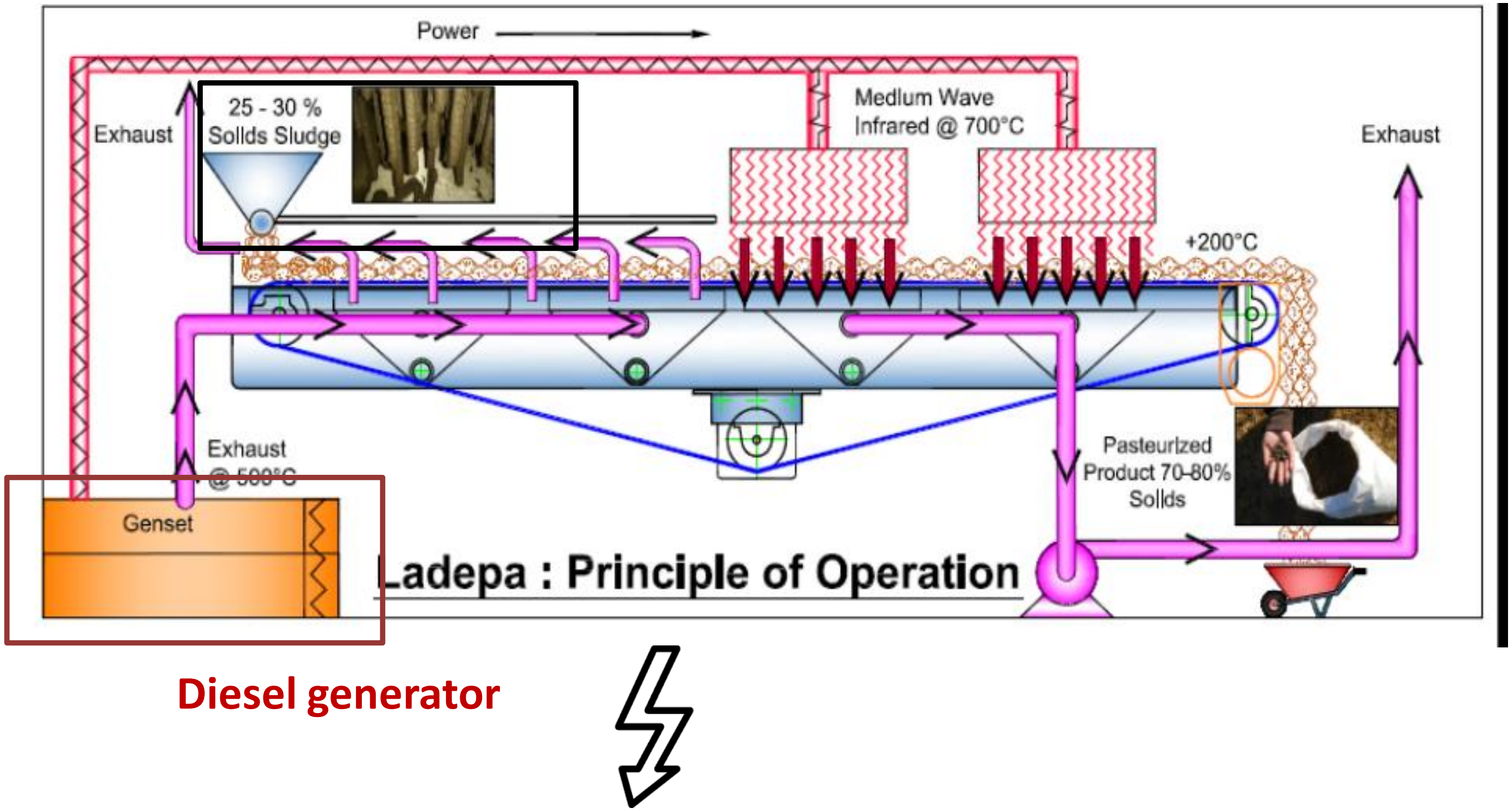
3.5 millions of inhabitants

1 millions of people in informal settlements

30,000 VIP latrines

Latrine Dehydration Pasteurization (LaDePa)

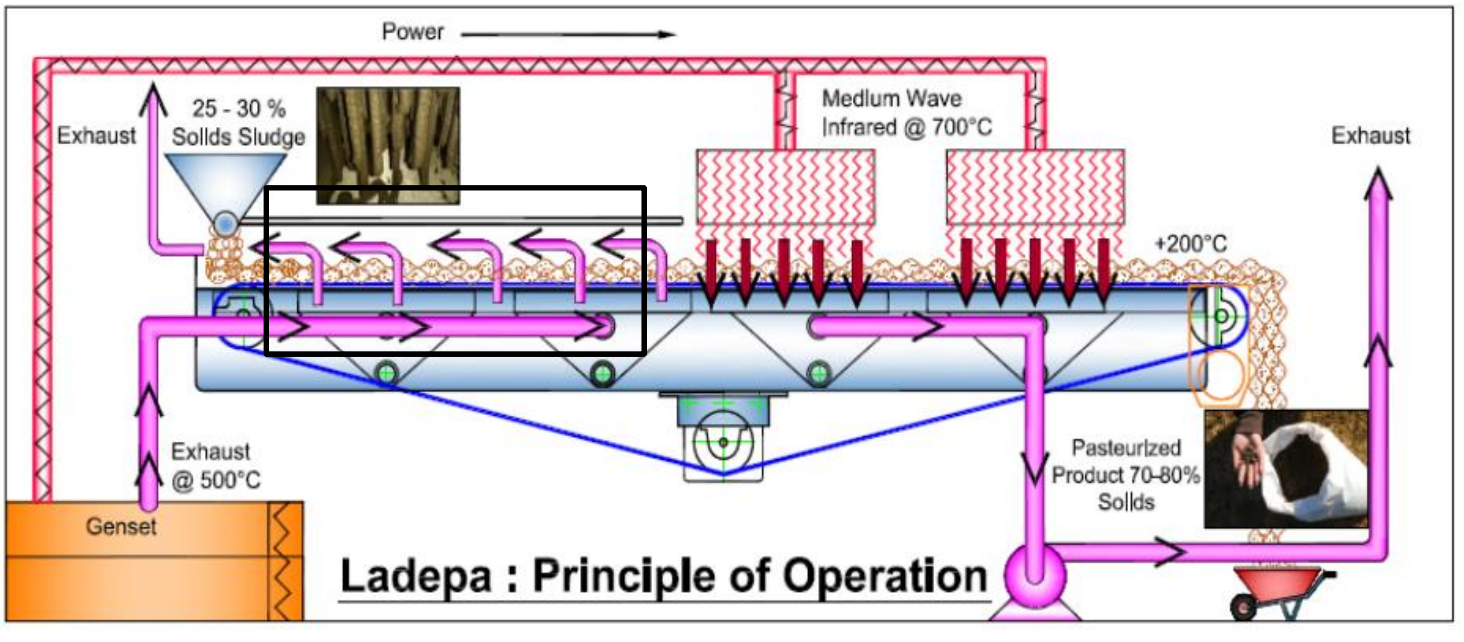
Pre-heating with hot air



Diesel generator

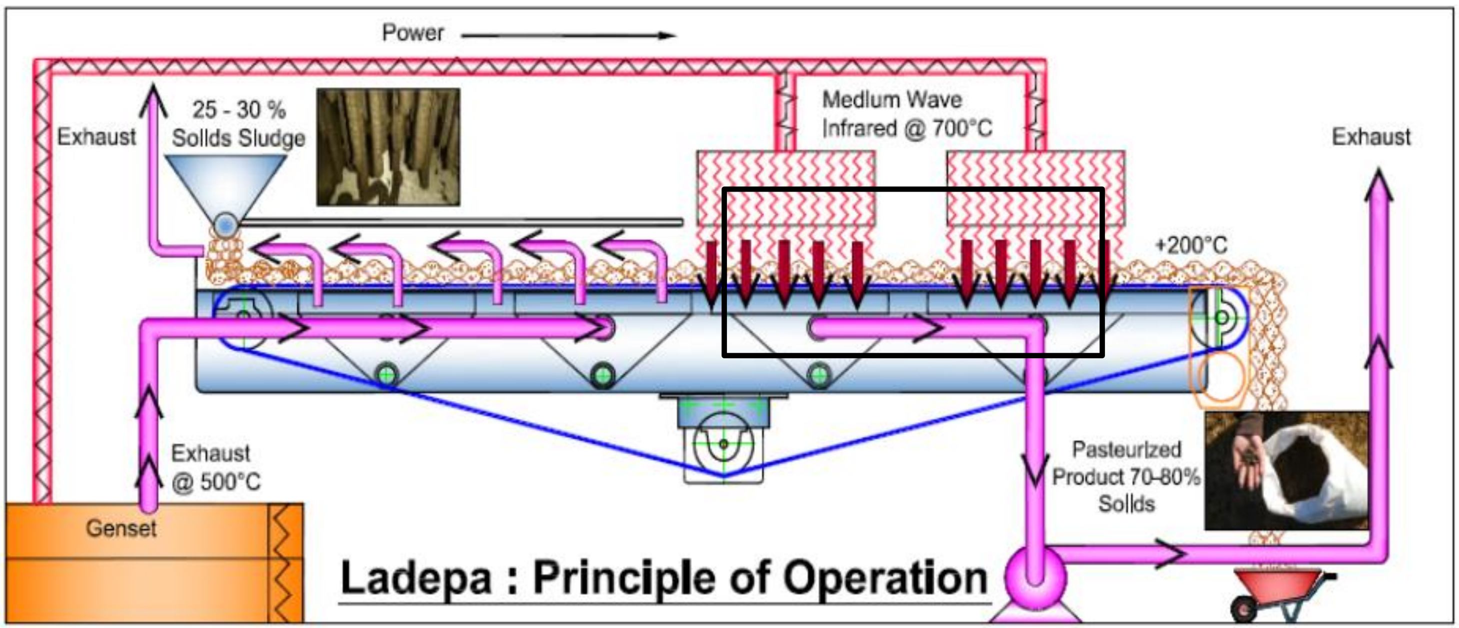
Latrine Dehydration Pasteurization (LaDePa)

Heating with medium IR emitters



Latrine Dehydration Pasteurization (LaDePa)

Safe reuse of the product



Agriculture

Biofuel

Objectives

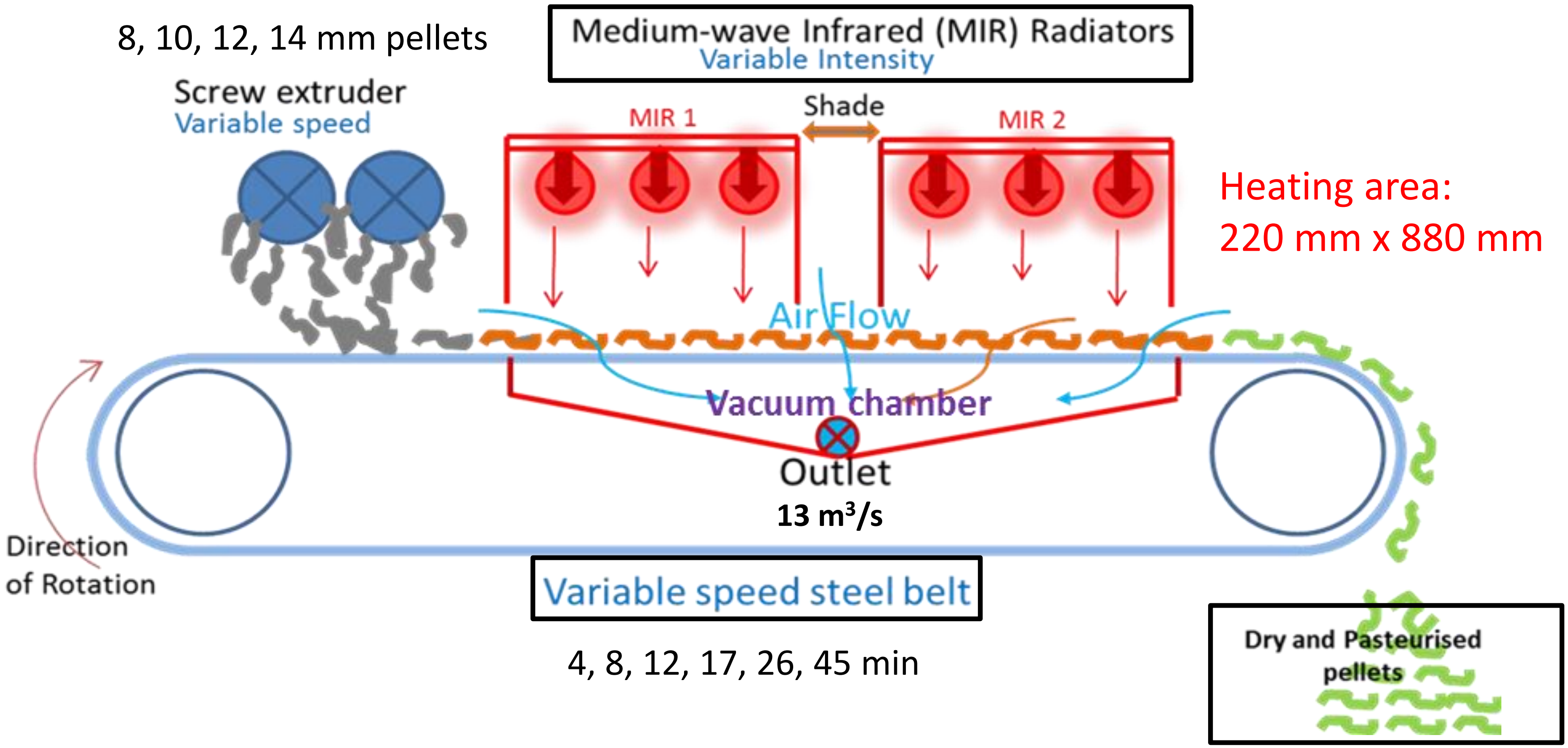
- **Characterize LaDePa process**
- **Evaluate the use of pellets in agriculture or as a biofuel**

Bench scale LaDePa to study the process

Experimental plan

3.0 kW (~90°C), 4.7 kW (~140°C), 6.5 kW (~215°C)

8, 10, 12, 14 mm pellets



4, 8, 12, 17, 26, 45 min

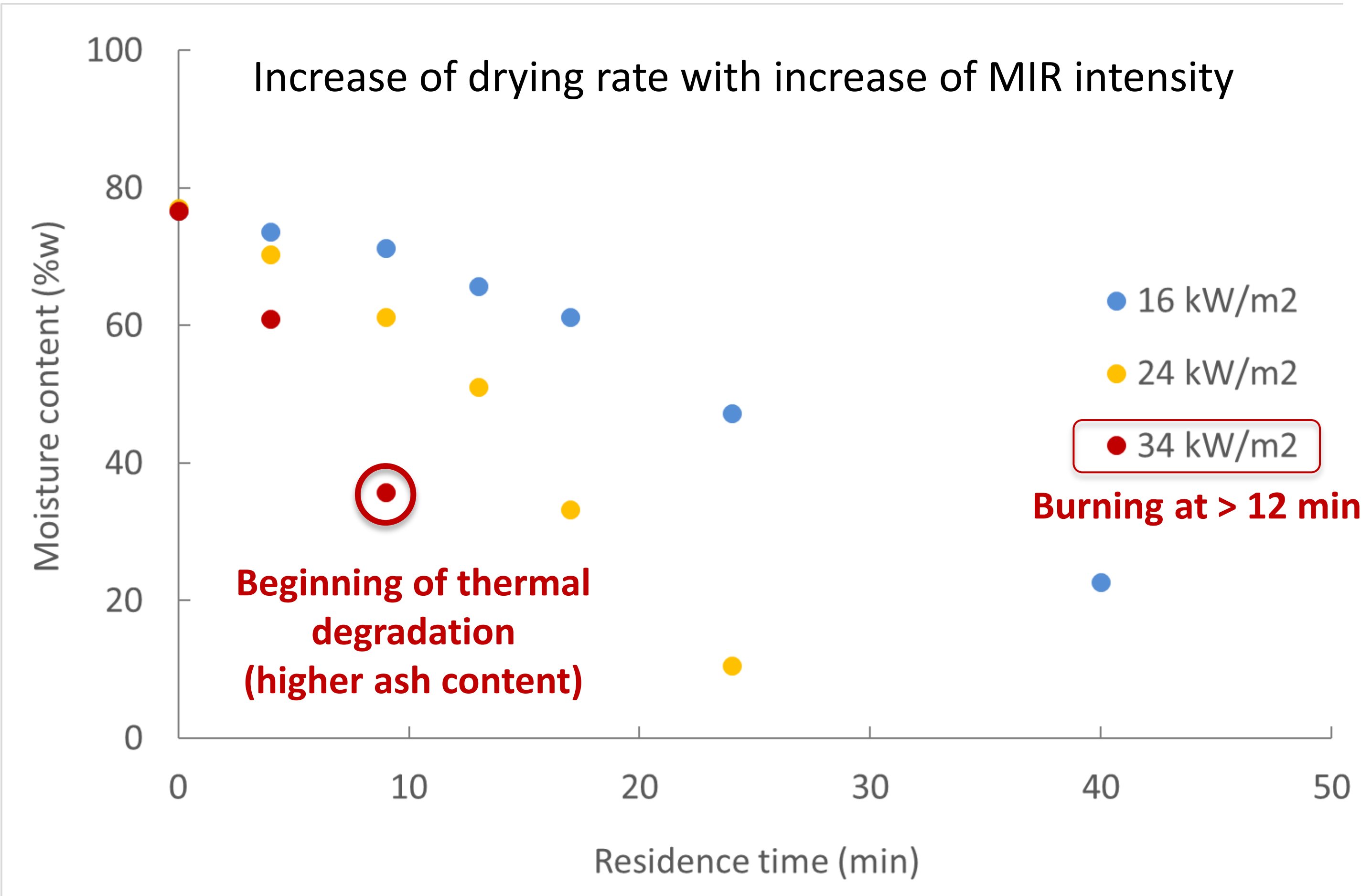
Characterization

Characterization of pellets

Drying performance Moisture content analysis	**Thermal degradation** Ash content analysis
Pasteurization L. Ascaris egg concentration	**Nutrient content** C, N, P, K, Mg, Ca Extractible PO_3^{-4}, NH_4^+, NO_3^-, NO_2^-
Energy content Calorific value	**Thermal properties** Heat capacity, thermal conductivity, Thermal diffusivity

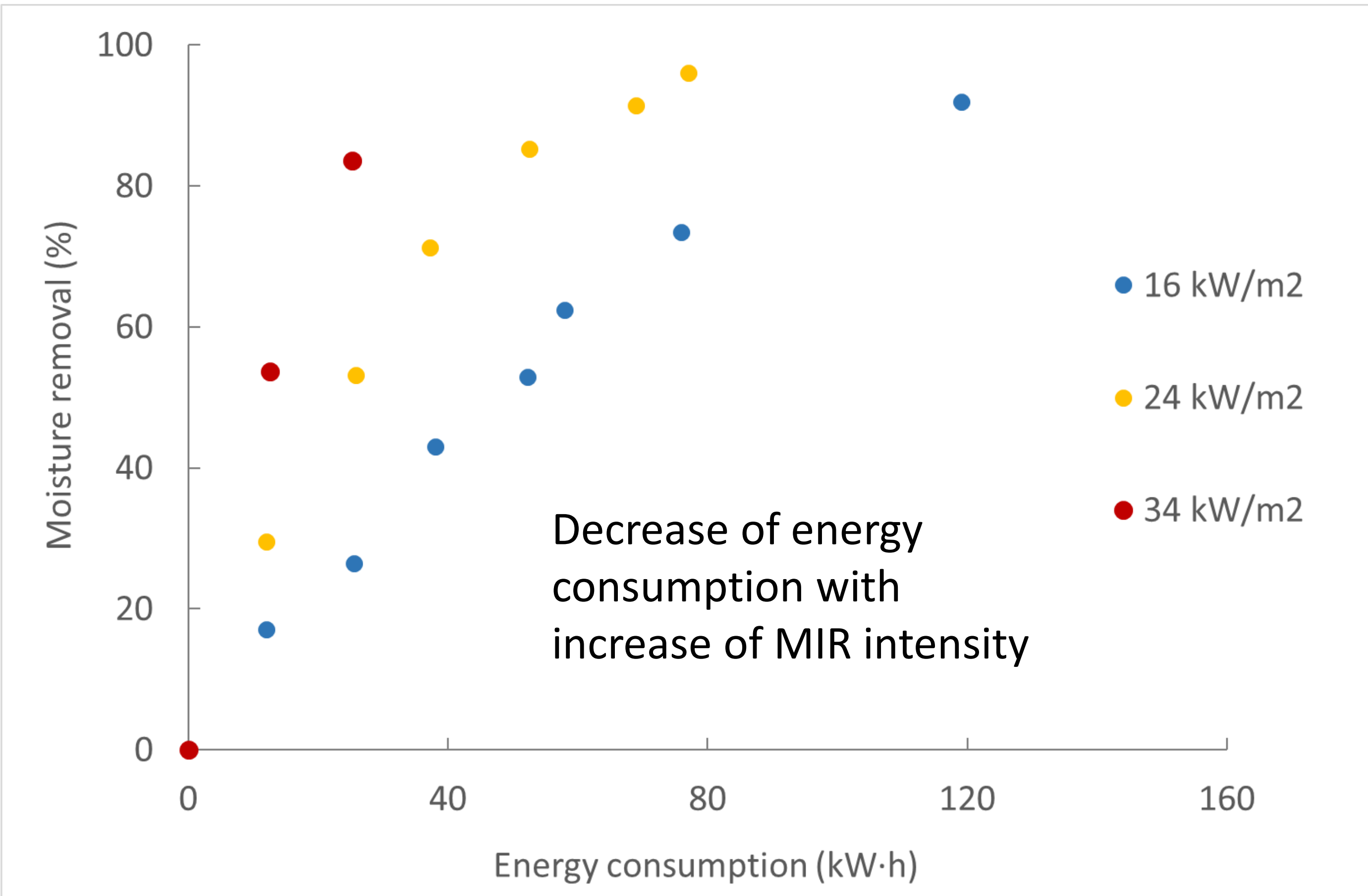
Drying curves

8 mm pellets



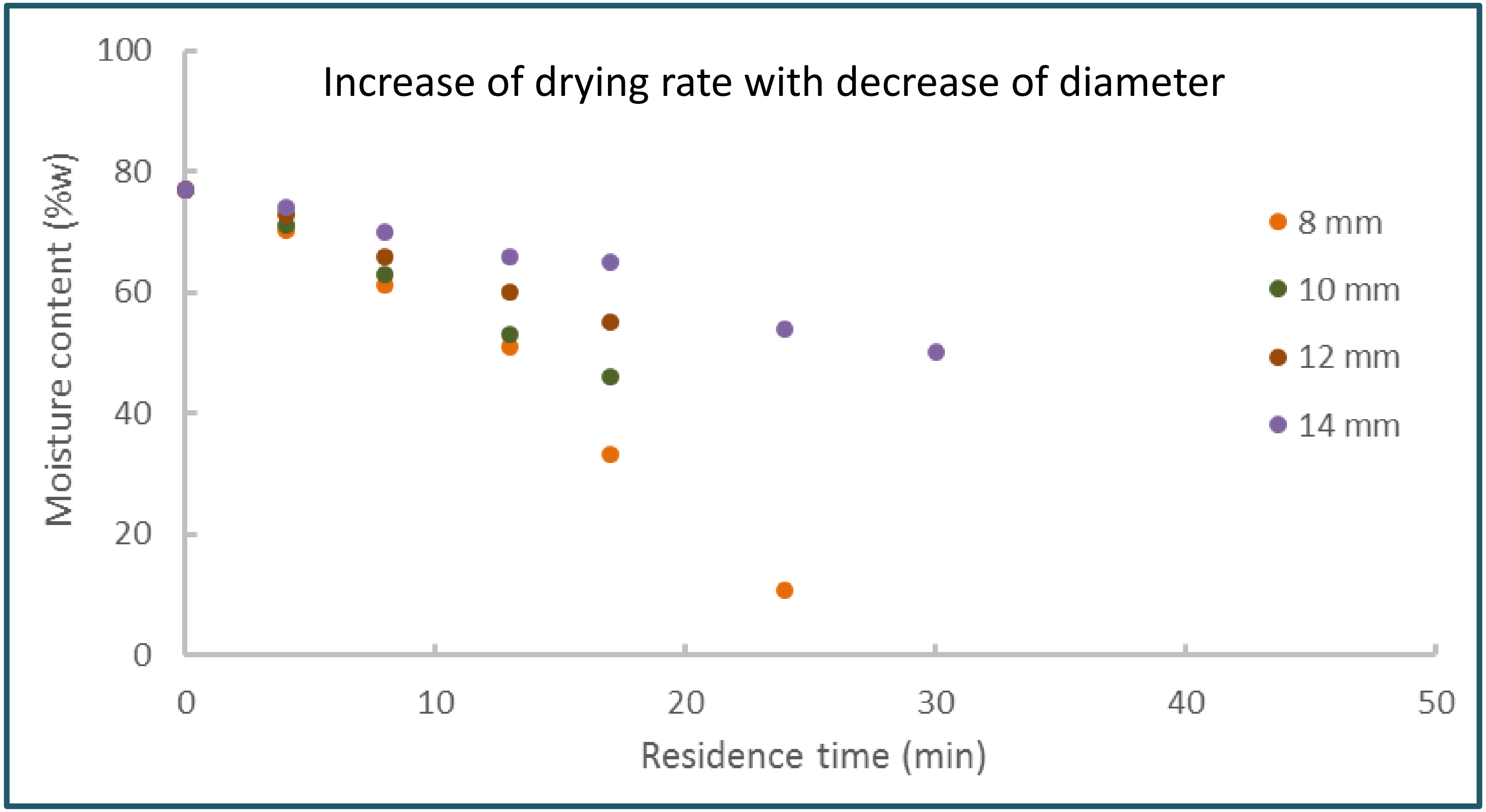
Drying performance

8 mm pellets



Drying curves

24 kW/m²



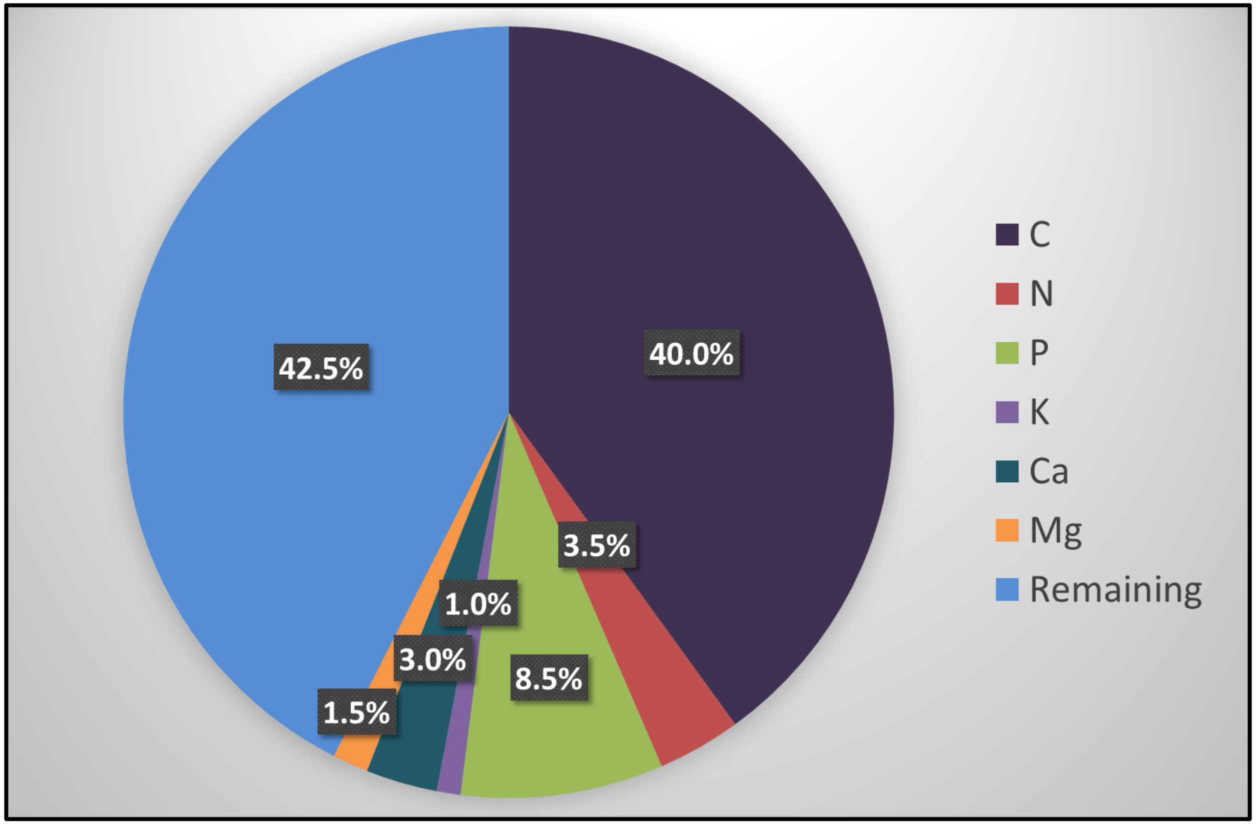
Ascaris viable eggs

Sample	Power density (kW/m²)	Residence time (min)	Ascaris eggs / g total solid
			Potentially viable
Faecal sludge	N.A.	N.A.	135
Pellets 8 mm	30	4	18*
		8	13*
		17	<1
		25	<1
	50	4	5*
		8	3*
		17	<1
		25	<1
	80	4	<1
		8	<1

* Intermediary between potentially viable and dead eggs

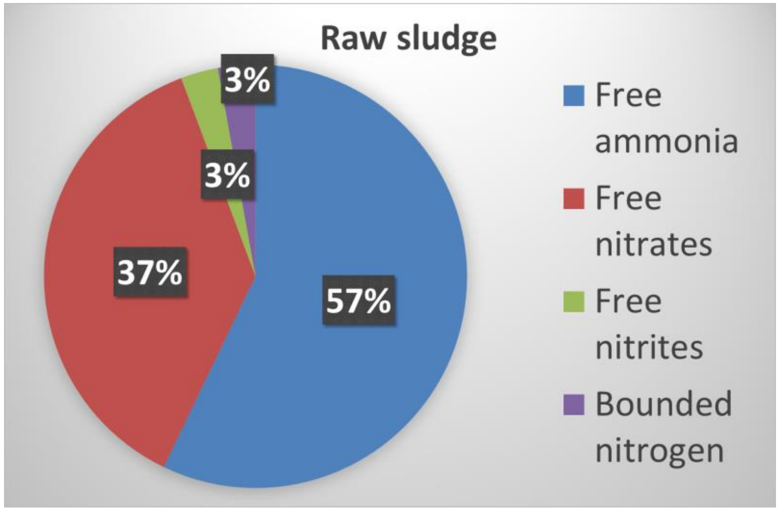
Nutrient analysis

Composition of nutrients of the dry-bone does not change during drying and with operating conditions

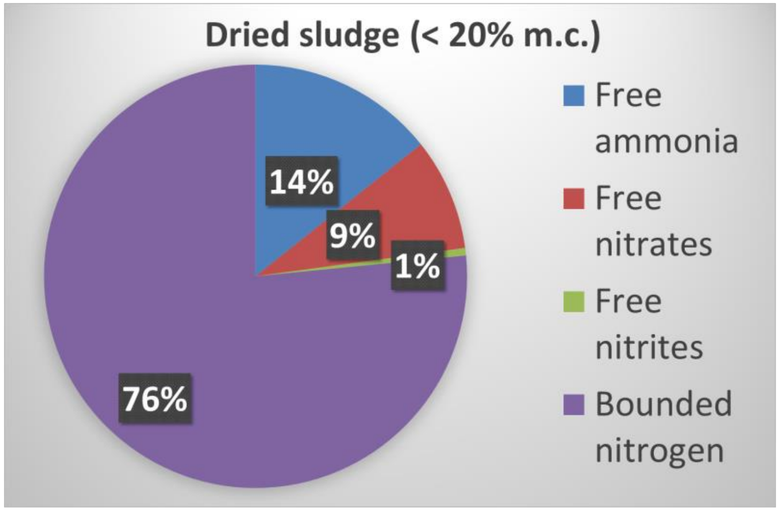


Nutrient analysis

Nitrogen (variation during drying)

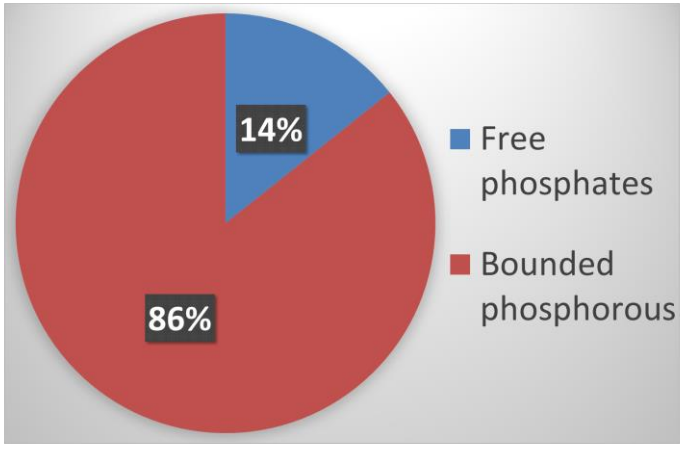


Fast release



Slow release

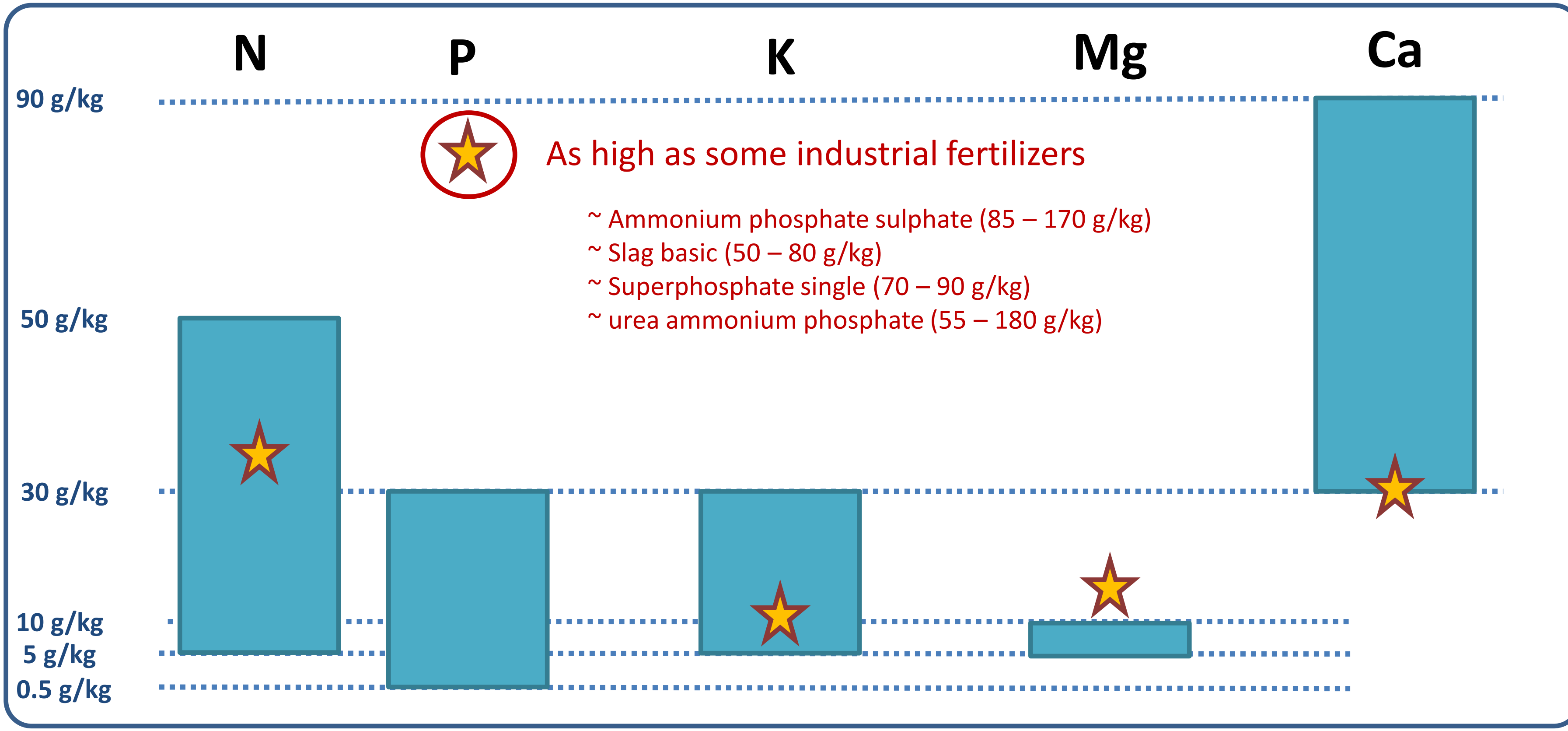
Phosphorous (no variation)



Slow release

Nutrient analysis

HOME COMPOST & MANURE



Calorific value / thermal properties

Propertie	Raw sludge		Dried sludge (<20% m.c.)	
Calorific value (kJ/kg dry)	18	=	18	As wood
Heat capacity (kJ/kg/K)	4.6	>	0.4	Low
Thermal conductivity (W/m/K)	0.5	>	0.06	Insulating
Density (kg/m^3)	1100	>	800	
Thermal diffusivity (m^2/s)	1.0×10^{-7}	<	1.8×10^{-7}	Range of common fuels

*Thermal diffusivity = thermal conductivity / (density * heat capacity)*

As water

Conclusions

- At higher MIR intensities: faster drying and pasteurization, lower energy consumption for drying
  But: risk of thermal degradation at too high radiation intensities
- No variation of nutrient content and calorific value along drying
  But: modification of chemical form for nitrogen during drying, changing its fertilizer properties (→ slow realease)
- Variation of thermal properties along drying → better heat transfer in dried material
- Potential use of feacal sludge in agriculture or as biofuel

Thanks

septiens@ukzn.ac.za

http://prg.ukzn.ac.za

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

PRG pollution research group

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