Properties of faecal sludge from different on-site sanitation facilities in Durban, South Africa

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FSM3

PRG pollution research group

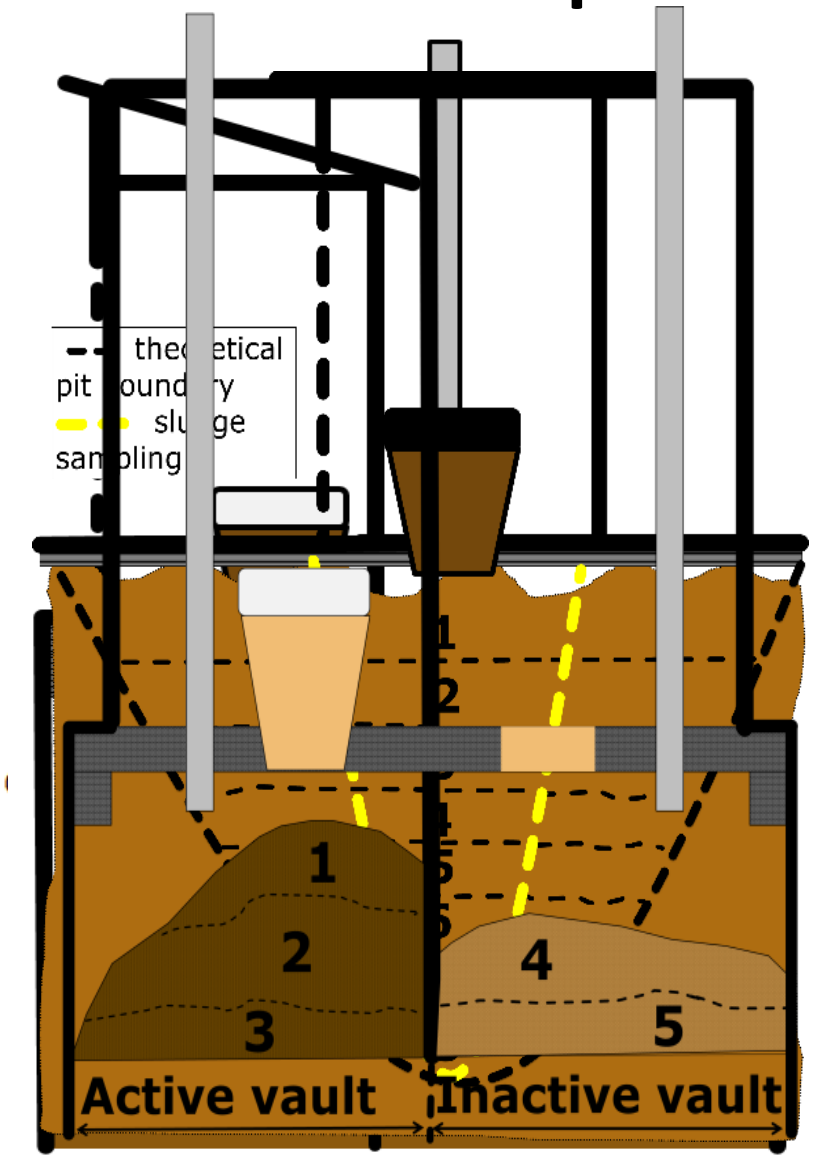
Objectives

- Generate first hand data on faecal sludge characteristics from on-site dry sanitation facilities
- Establish a correlation between facility usage and sludge quantity and quality.
- Provide data for improving of the design and sizing of pit-emptying devices, transport and processing systems for the sludge and the design of future on-site sanitation facilities

Pit emptying programme

Facility type	Characteristics	Usage level	Number of facilities sampled	Location
Household VIP latrine	Dry	Low use (<5 users/facility)	5	Besters
		High use (>5 users/facility)	5	
	Wet	Low use	5	Besters
		High use	5	
Household UDDT toilet		Low use	5	Mzinyathi
		High use	5	
Household unimproved pit latrine	Dry	Low to high use	2	Ocean Drive
Community ablution block VIP	Wet and dry	High use	9	Malacca Road
School VIP toilet block	Wet and dry	High use	4	Mzinyathi
Total			45	

Selection of analytical samples at different depth levels of pit



Non-faecal materials in pits

Paper

Hair / wig / braids

Plastic - light

Menstrual products

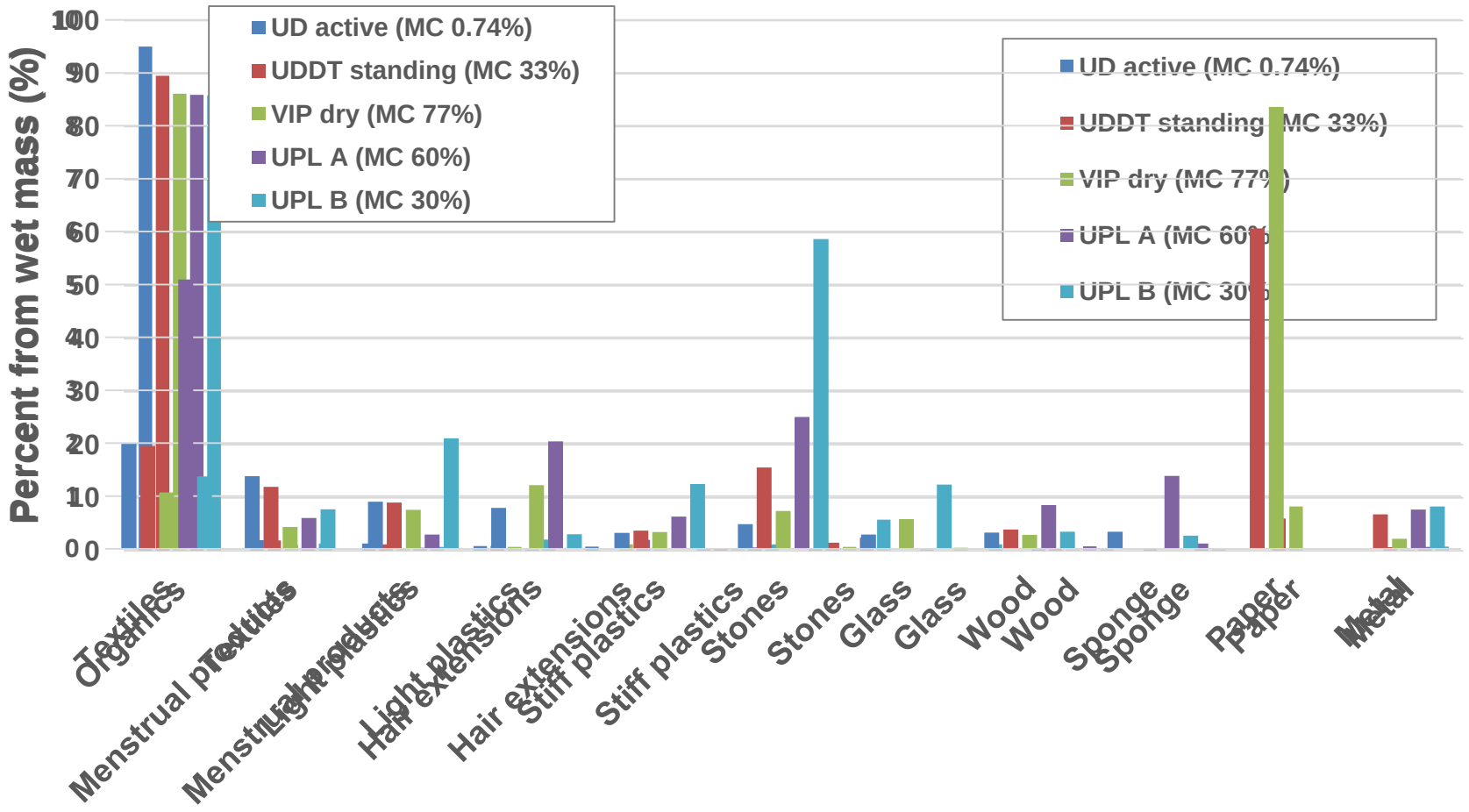
Textiles

Plastics - rigid

Glass

Metals

Material categories in pits from different on-site sanitation facilities



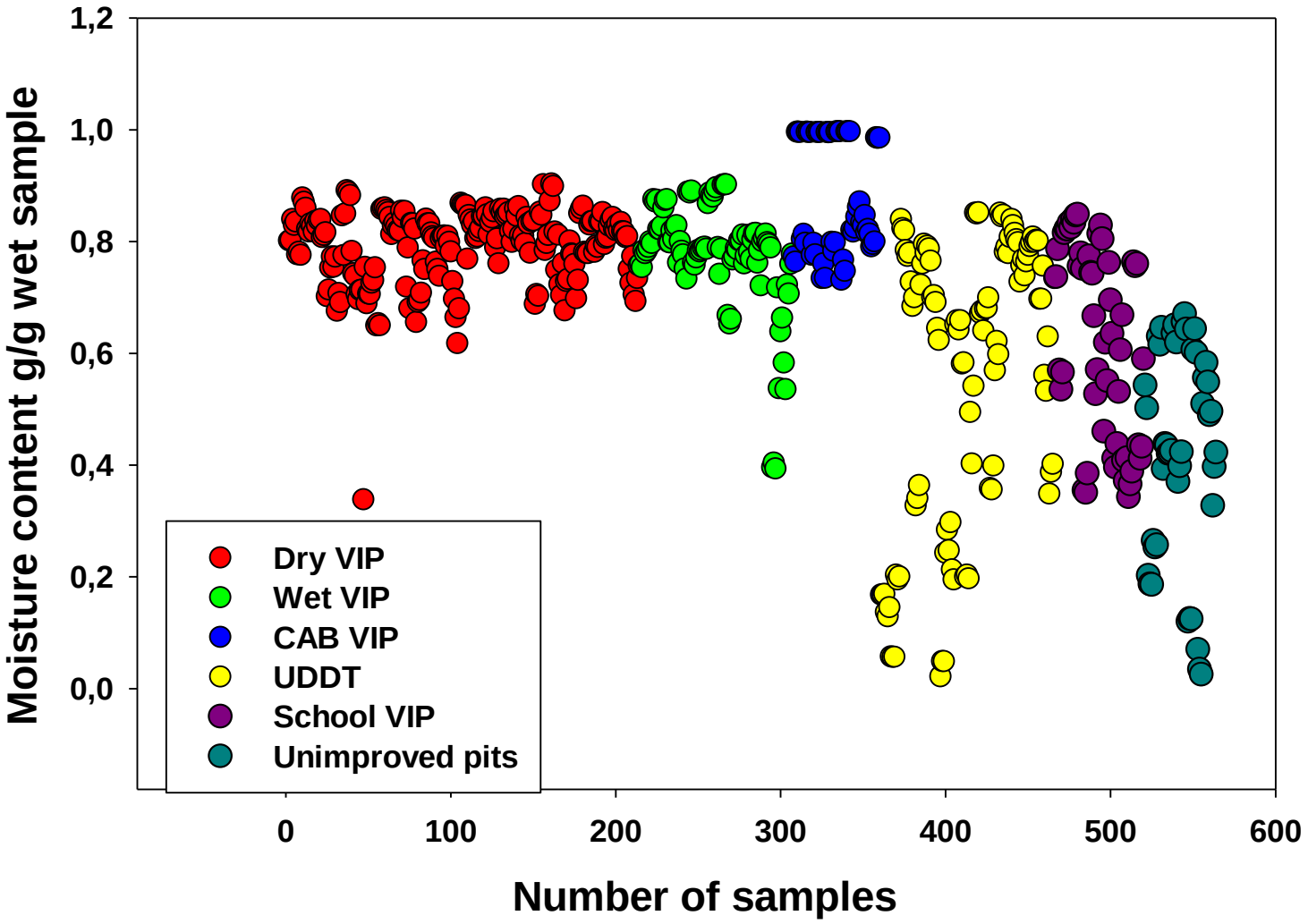
Analyses on faecal sludge

- Moisture content/ Total solids
- Ash/ Volatile solids
- Suspended solids
- TKN
- Ammonia
- COD
- pH
- Nitrates/Nitrites
- Potassium
- Orthophosphates/Total phosphates

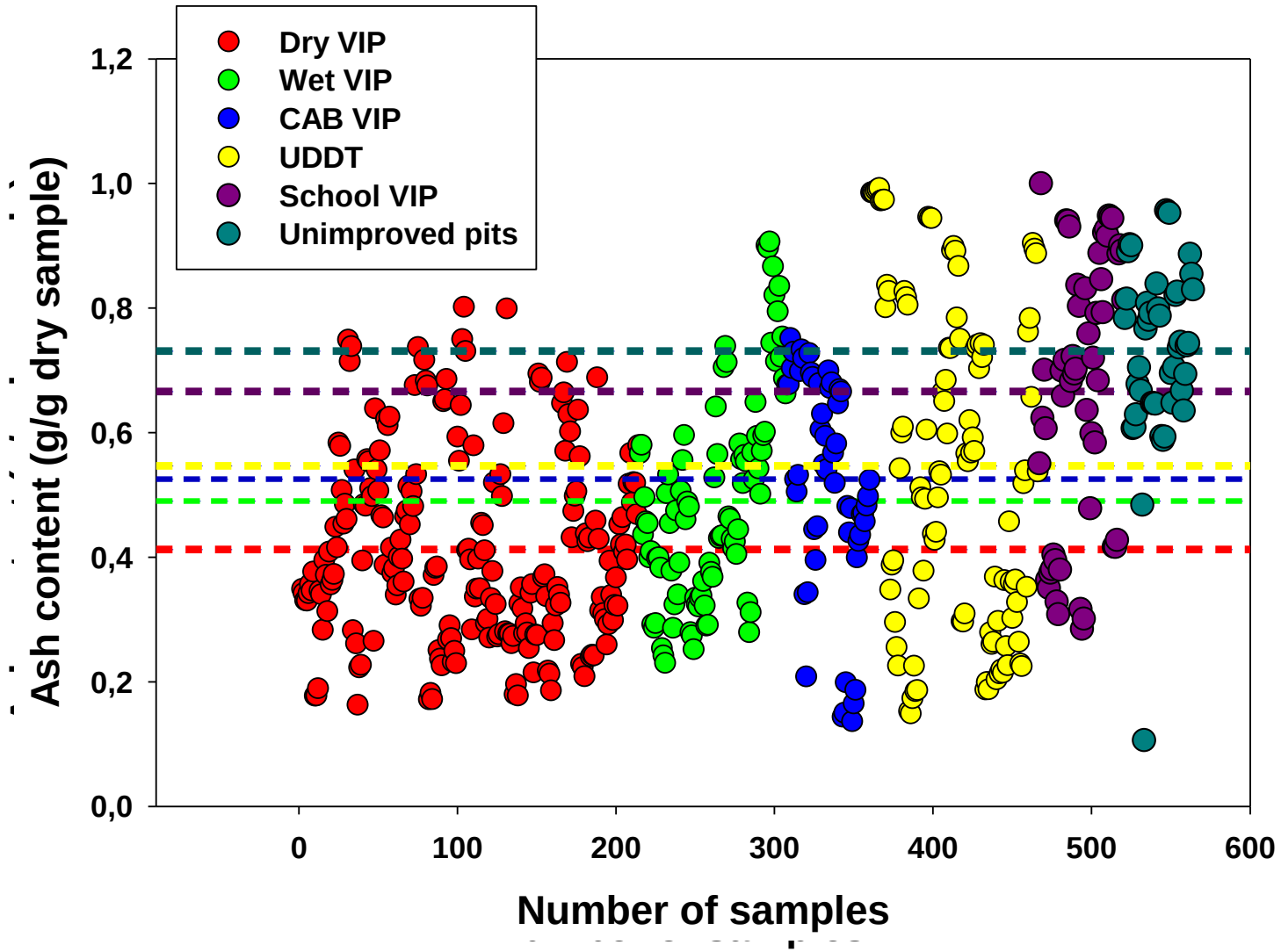
Analyses on faecal sludge

- Calorific value
- Specific heat
- Thermal conductivity
- Rheological properties (Viscosity)
- Plastic and liquid limits
- Density
- Sludge volume index
- Particle size distribution
- Ascaris/parasites content

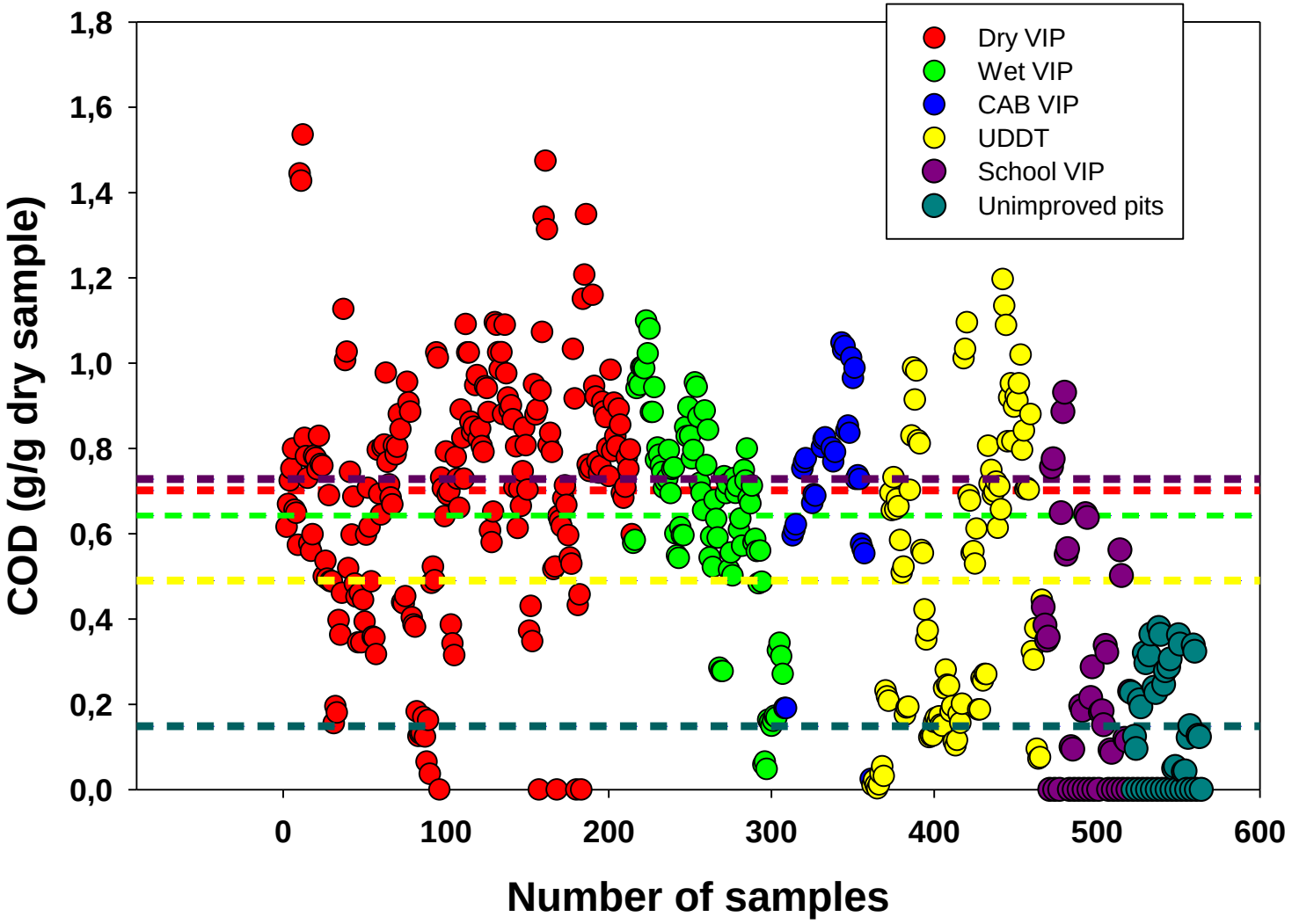
Moisture content



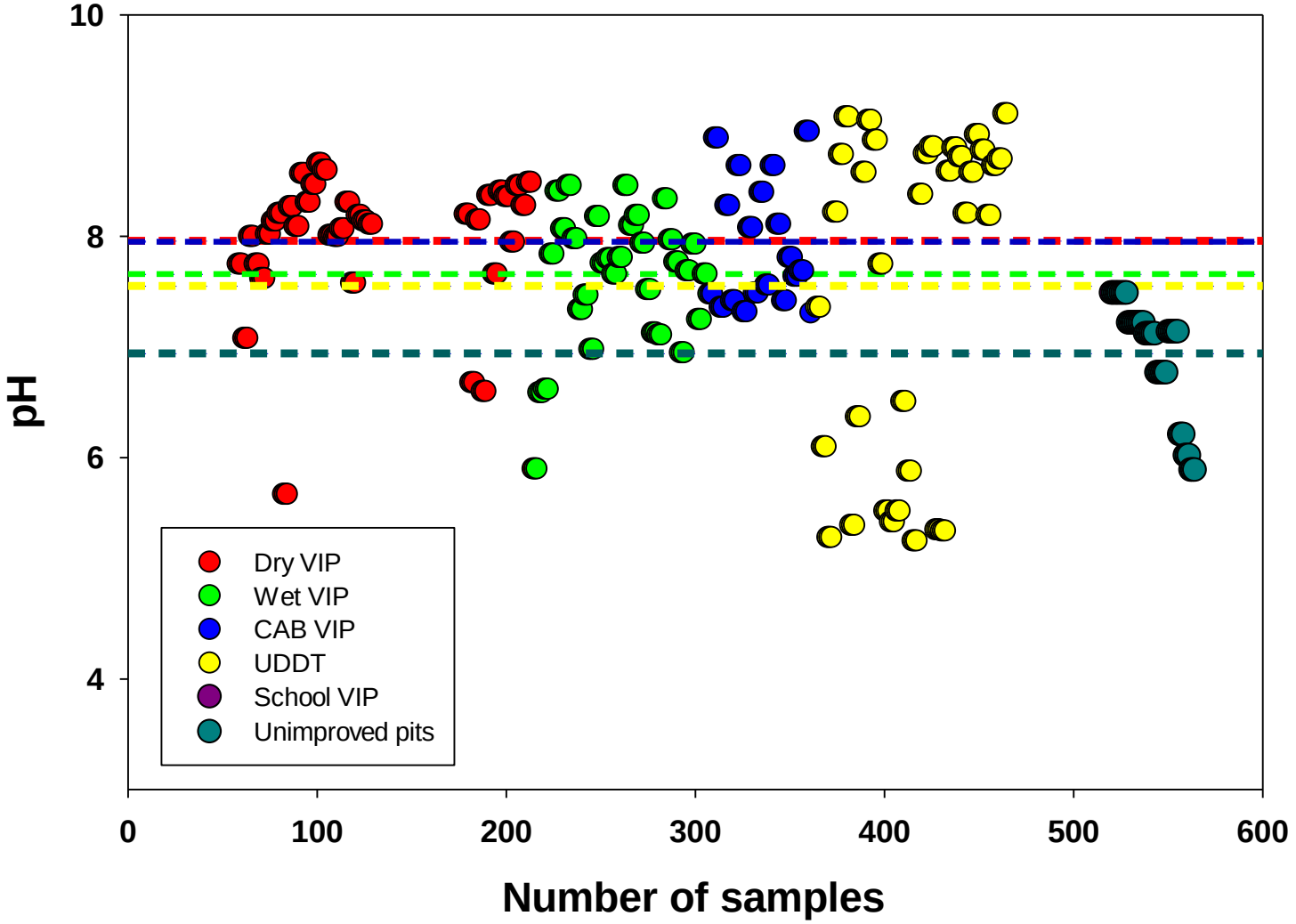
Ash content


Dry VIP
Wet VIP
CAB VIP
UDDT
School VIP
Unimproved pits
Ash content (g/g dry sample)
1,2
1,0
0,8
0,6
0,4
0,2
0,0
0
100
200
300
400
500
600
Number of samples

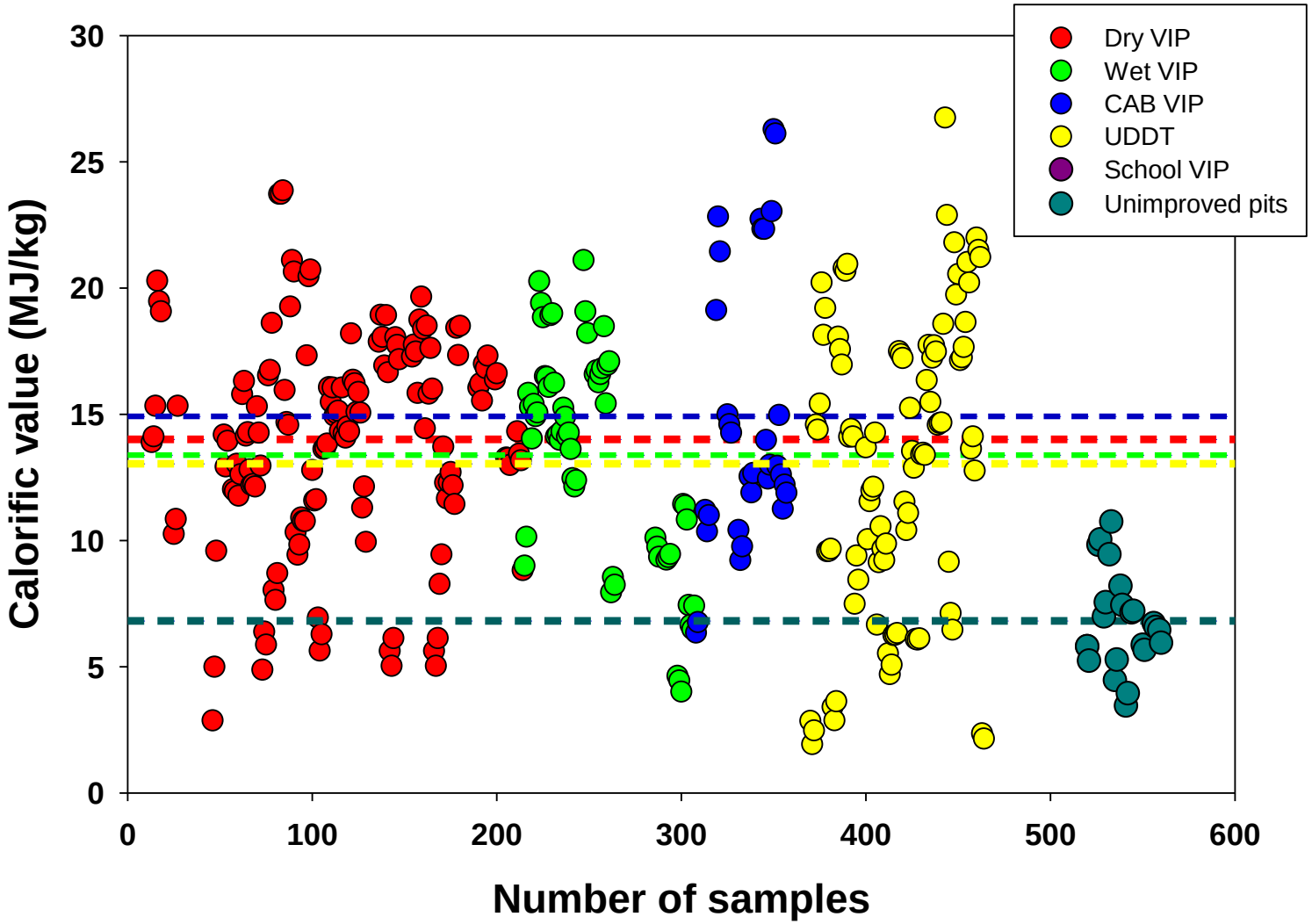
Total COD


Dry VIP
Wet VIP
CAB VIP
UDDT
School VIP
Unimproved pits
COD (g/g dry sample)
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
0
100
200
300
400
500
600
Number of samples

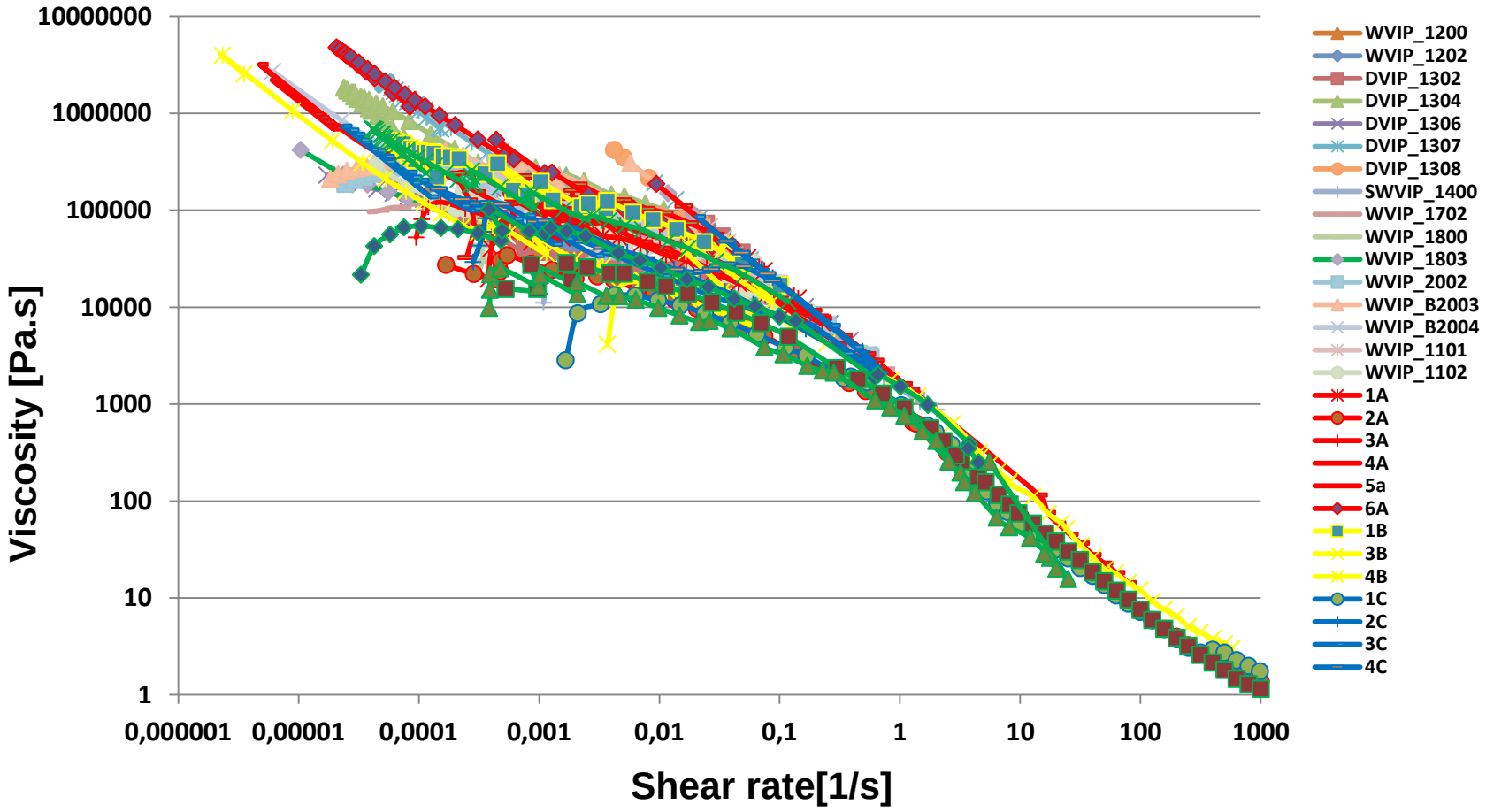
pH


10
8
6
4
pH
0
100
200
300
400
500
600
Number of samples
Dry VIP
Wet VIP
CAB VIP
UDDT
School VIP
Unimproved pits

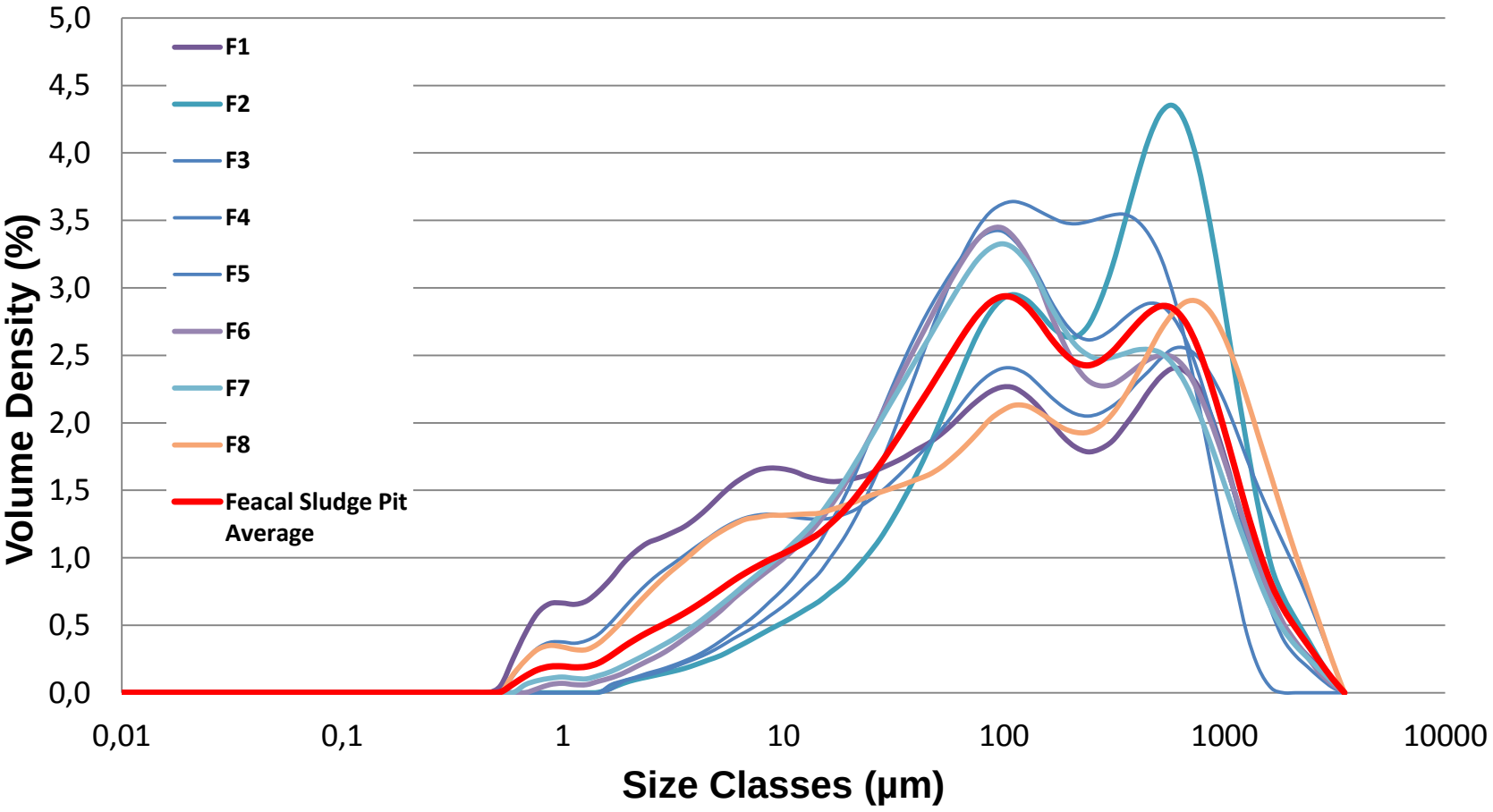
Calorific value



Rheological properties



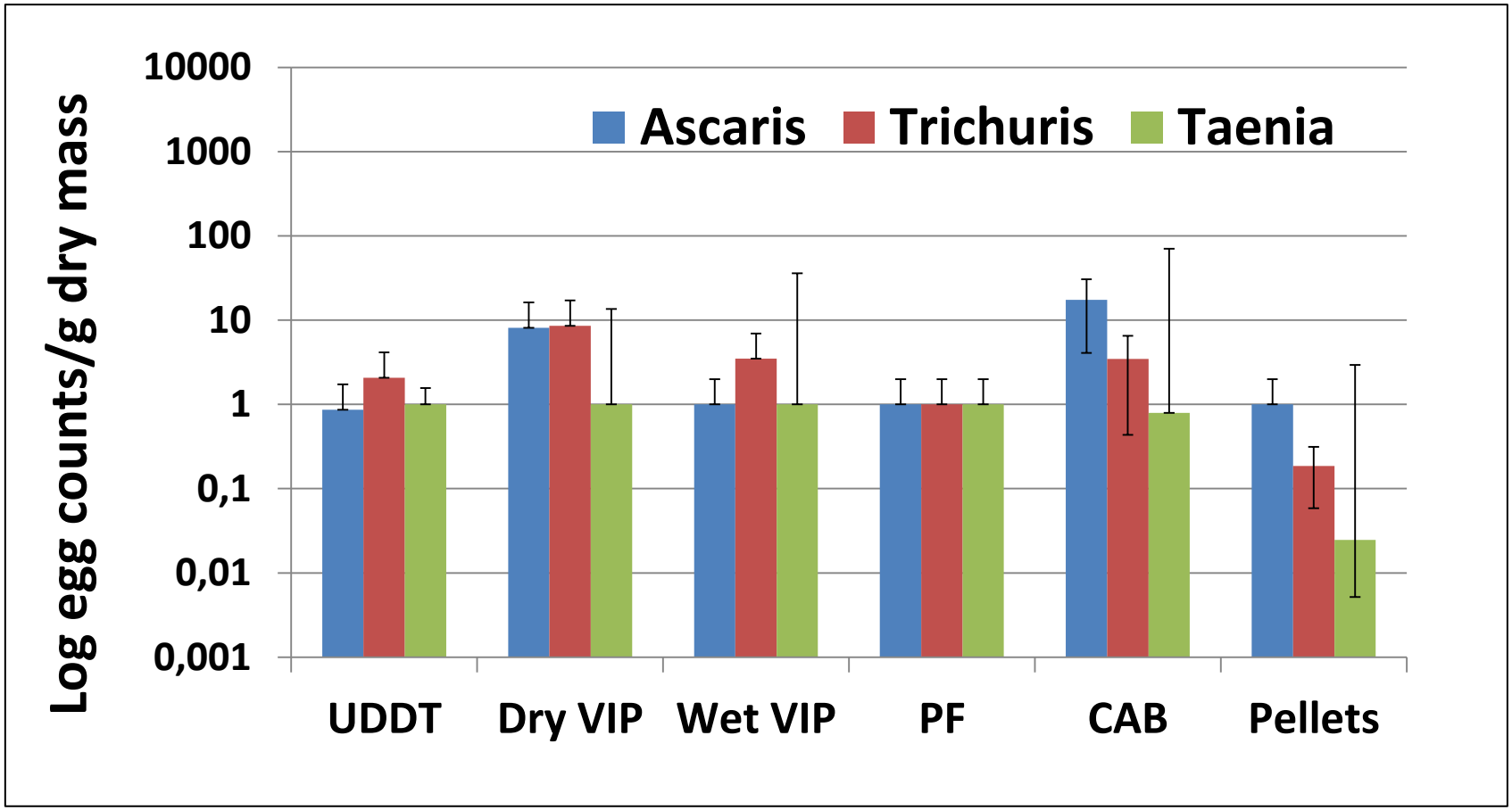
Particle size distribution



Helminth Eggs

Occurrence of Helminth Eggs in On-site Sanitation Systems in eThekwini Municipality, South Africa

N. Rodda*, C. Archer*, V. Kelly*, K. Velkushanova and C. Buckley****



Conclusions

- By material categorisation, the “organics” category was the most prevalent, between 85 and 95% from the total wet mass
- For VIP samples from different facilities, the average moisture content was between 75 and 85%. It was lower for UDDT samples - 61%
- The average ash content (% dry mass) for the VIPs was between 35 and 55% For the UDDTs and aged samples from the unimproved pit latrines, the ash content was higher - 58 to 66%
- The average COD was between 0.60 and 0.90 gCOD/g dry sample for the most of the VIP samples. For some UD and aged samples, it was much lower – 0.15-0.30 gCOD/g dry sample

Conclusions

- The average calorific value varied between 11 and 15 MJ/kg for the most of the analysed sanitation facilities, except for the unimproved pit latrines where the sludge was more aged at about 5 MJ/kg.
- In terms of rheological properties, the overall tendency is shear thinning which is expected to ease the pit emptying processes with applied increasing shear stress
- The sludge from all sanitation facilities showed higher helminth content than the limit of <1 helminth egg/g TS set by WHO (2006)

Outcomes

- Development of faecal sludge sampling methods and techniques
- Development of laboratory Standard Operational Procedures for analyses on faecal sludge
- Crucial support information required by partner organisations, pit emptiers and designers
- Baseline for further similar studies in other regions

INTERACTIONS WITH OTHER RESEARCH PROJECTS

Data from other research projects provide input into the RTTC Phase II project. This includes:

- Water Research Commission funded projects awarded to UKZN
- Gates foundation funded projects awarded to UKZN

INTERACTIONS WITH OTHER ORGANISATIONS

Interactions with international and other African organisations through provision of data, hosting of visitors, assistance on research projects, testing of prototypes and exchange of information.

These Include:

International Organisations

- Asian Institute of Technology
- Climate Foundation
- Sanergy
- Delft University of Technology
- Duke University
- Research Triangle Institute
- University of the West of England, Bristol
- Loughborough University
- Synapse
- Swedish Environmental Institute
- London School of Hygiene and Tropical Medicine
- University of Maryland
- University of Colorado Bolder
- Santec
- Beaumont Design
- E3Energy Partners
- UNESCO-IHE
- Kansas State University
- Swiss Federal Institute of Aquatic Science and Technology (EAWAG)
- Cranfield University
- University of Toronto
- Oklahoma State University
- Plymouth Marine Laboratory
- University College, London
- North Carolina State University
- Swedish University of Agricultural Sciences
- Janicki Industries
- Wageningen University
- Reckitt Benckiser
- AgriProtein
- Boston Consulting
- Path
- Firmenich
- Mott MacDonald
- ETH Zurich
- University of Laval, Montreal
- Unilever
- Bear Valley Ventures
- Bremen Overseas Research and Development Association (BORDA)
- Hering International (and South Africa)

African Organisations

- Khanyisa Projects
- Partners in Development (PID)
- **African Municipalities**
  - Kitwe Municipality
  - Kabwe Municipality
  - Botswana Government

SANITATION RESEARCH FUND FOR AFRICA PROJECT

Pit Characterisation

- Jimma University, Ethiopia
- Egerton University, Kenya
- Makerere University, Uganda
- University, of Malawi, Malawi
- University of Zambia, Zambia
- University of Botswana, Botswana

Developing Innovative Tools for Desludging and Beneficiation

- Water for People, Uganda
- Mzuzu University, Malawi
- Chinhoyi University, Zimbabwe
- North-West Uni., RSA
- ATL-Hydro, RSA
- Rhodes University, RSA

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- Water Research Commission, SA
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Thank you!

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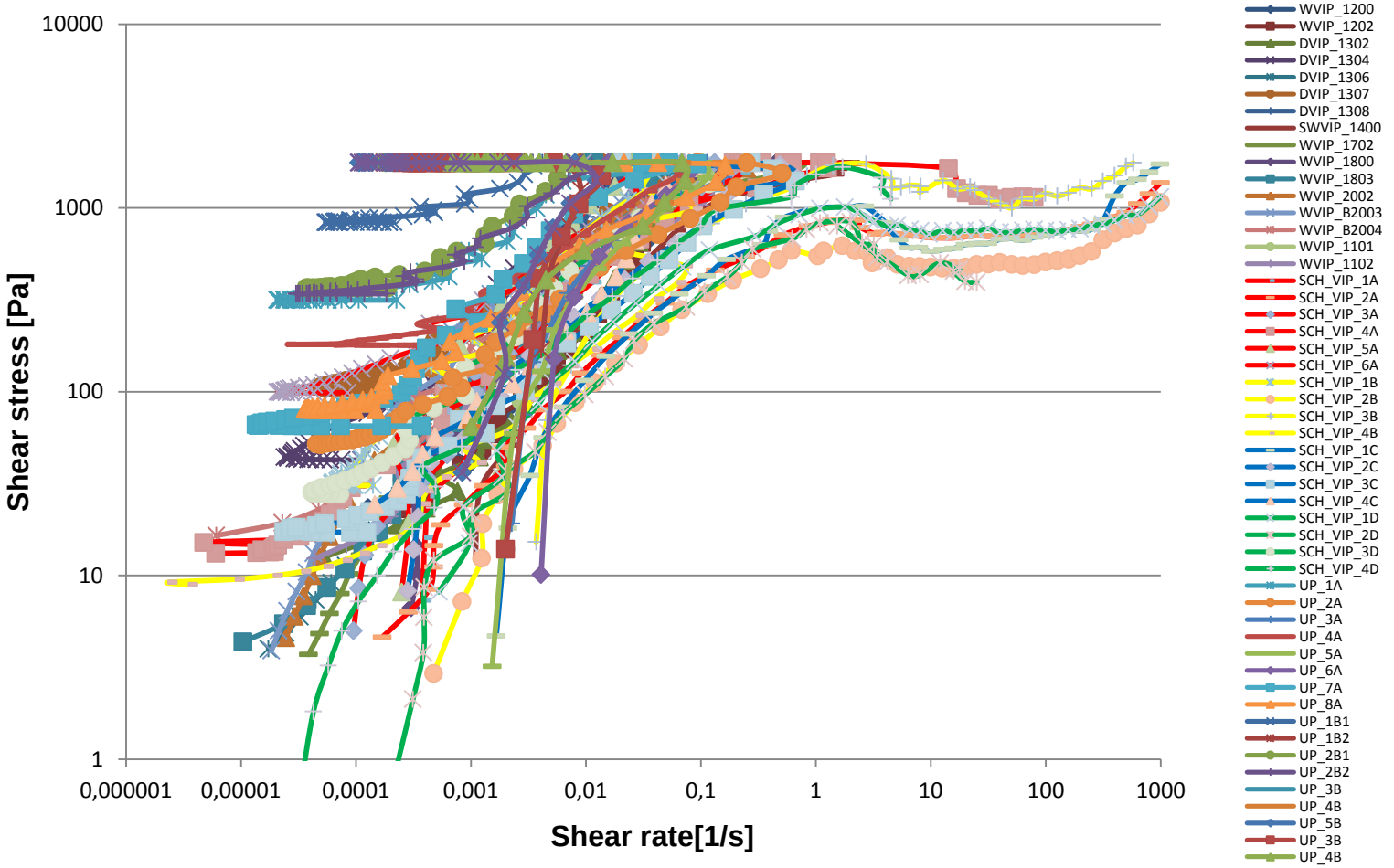
10000
1000
100
10
1
Shear stress [Pa]
0,000001
0,00001
0,0001
0,001
0,01
0,1
1
10
100
1000
Shear rate[1/s]
WVIP_1200
WVIP_1202
DVIP_1302
DVIP_1304
DVIP_1306
DVIP_1307
DVIP_1308
SWVIP_1400
WVIP_1702
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WVIP_1803
WVIP_2002
WVIP_B2003
WVIP_B2004
WVIP_1101
WVIP_1102
SCH_VIP_1A
SCH_VIP_2A
SCH_VIP_3A
SCH_VIP_4A
SCH_VIP_5A
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SCH_VIP_2D
SCH_VIP_3D
SCH_VIP_4D
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UP_3A
UP_4A
UP_5A
UP_6A
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UP_4B