Data Acquisition and Field Support for Sanitation Projects

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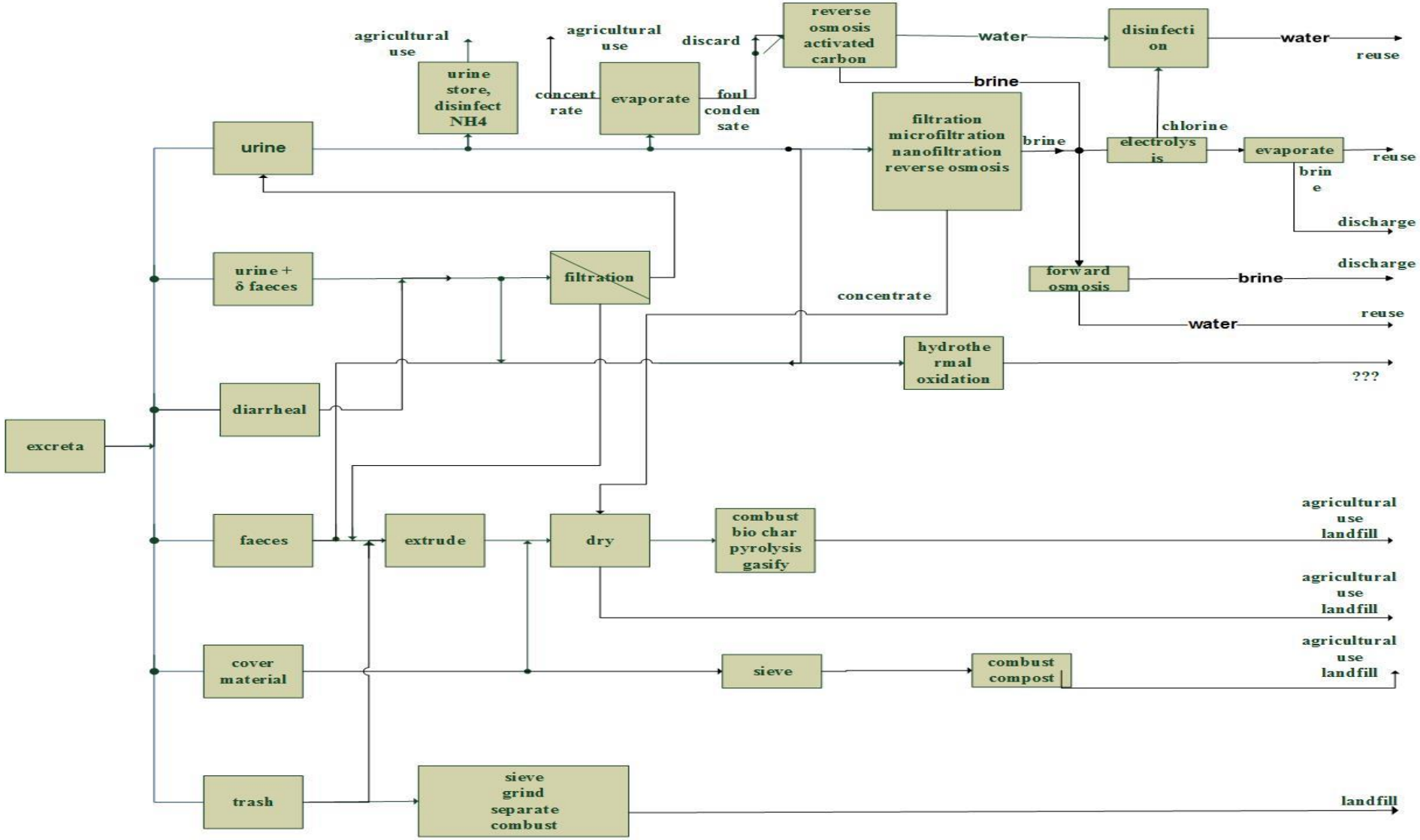
Overall Approach

- Undertaking analysis on request
- Develop Standard Operating Procedures (SOPs) for excreta
- Undertaking analysis according to different treatment technologies
  - Front-end
  - Back-end
  - Final product

Excreta material flow diagram



disinfection
evaporation
reverse osmosis
activated carbon
electrolysis
filtration
microfiltration
nanofiltration
reverse osmosis
electrolysis
electro dialysis

forward osmosis
adsorption
nanofiltration

oxidation
hydrothermal oxidation

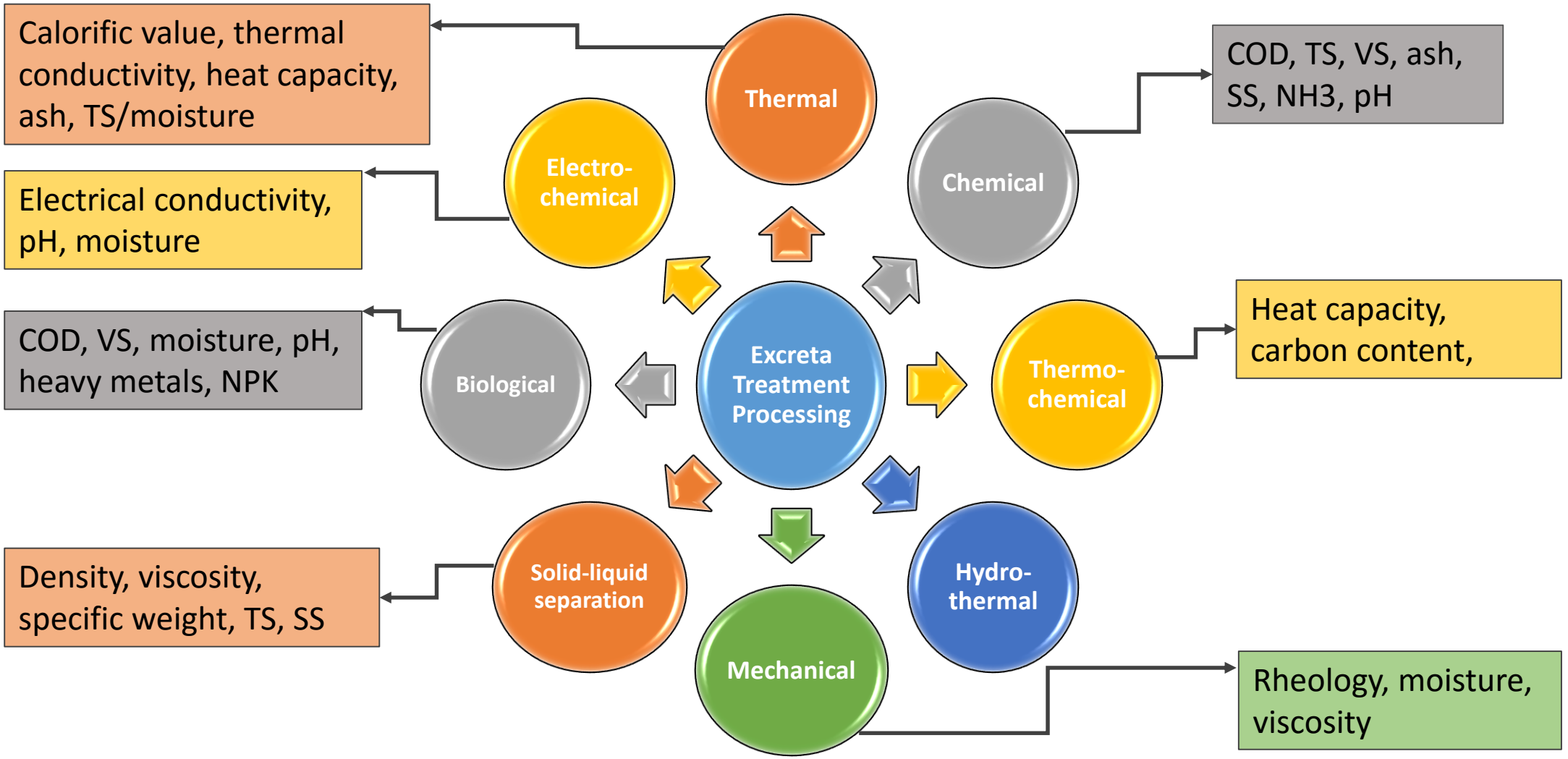
extrude
dry
combust
pyrolysis
gasify
super critical
plasma arc gasify
char
smoulder

sieve

grind

compost

What data is essential for each process?



Methods tested/ data provided

Groups of properties	Property / analytical test	Equipment / method	Reason/ importance
Chemical properties	**Moisture content** **Total dry solids**	Oven 105 ^{o}C	• Mechanical behaviour – mixing, drying, flowing, viscosity, combusting • Migration of pathogens • Biodegradation potential
	Total volatile solids **Ash content (fixed solids)**	Furnace - 550 ^{o}C	• Show the ratio of organic to inorganic solids that will change over time; combustion potential; biodegradability potential
	Total suspended solids	Filter, dry	• Pit emptying and processing – indicating potential settling, clogging
	COD total	Closed reflux titrimetric method, microwave	• Indicate the organic content and the biodegradability rate of the sludge contents
	pH	pH probe	• pH affects the rate of degradation of the faecal sludge and the sanitising effects of ammonia. • Indicates the corrosive effect on pit emptying and sludge treatment devices.
	Ammonia	Distillation	• Nutrient recovery; disinfection
	TKN (Total Kjeldahl Nitrogen)	Digestion and distillation	• Nutrient recovery
	K (Potassium)	Spectroquant Tests	• Nutrient recovery
	Total phosphate	Spectroquant Tests	• Nutrient recovery
	Orthophosphate		

Methods tested/ data provided 2

Group of properties	Property / analytical test	Equipment / method	Reason/ importance
Physical and mechanical	**Density (solids, dry, bulk)**	Mass balance & volume measurement (liquid volume displacement by solids)	• Pit emptying equipment & mechanical process design
	Particle size distribution (>5mm)	Wet sieving rig; Sieve shaker Set of sieves for dry and wet sieving.	• Pit emptying equipment & mechanical process design
	Particle size distribution (<5mm)	Malvern particle size analyser	• Pit emptying equipment & mechanical process design
	Sludge volume index (SVI)	30 minute settling test	• To estimate settling characteristics of sludge; pit emptying and processing
	Osmotic pressure	Osmometer	• Vapour pressure, membrane processing
	Rheological properties	Parr rheometer	• Design parameters for pit emptying equipment; extruders and mechanical treatment
	Sludge penetration resistance	Penetrometer – lab and field scale	• Design parameters for pit emptying equipment; extruders and mechanical treatment

Methods tested/ data provided 3

Group of properties	Property / analytical test	Equipment / method	Reason/ importance
Thermal properties	**Thermal conductivity**	Thermal conductivity analyser	• Drying, combusting, heating potential, thermal treatment design
	Specific heat		
	Calorific value	Calorimeter	• Combustion, heating potential
Biological properties	**Parasites content (e.g. Ascaris)**	External laboratory, microscope	• Identify the potential biohazard; Identify the need of pre-treatment before potential reuse
	Pathogens (e.g. E.*coli*)	Microscope, petri dish	• Identify the potential biohazard; Identify the need of pre-treatment before potential reuse

What else is missing?

- Stoichiometry of different excreta?
- What could be improved?
- How?

Highlighted Challenges

- **Extreme heterogeneity of faecal sludges and their characteristics**
  - Geography and climate
  - Local diet
  - Toilet use
    - Frequency
    - “Wipers” vs “washers”
    - Wet vs dry
    - Number of users
    - Frequency of use
    - Frequency of sludge collection/ emptying
    - Disposal of other materials – trash (detritus), grey water, chemical additives
- **Difficulties in sampling – highly heterogeneous; need for uniform method of collection and preparation**
- **How can we provide a data set that is useful for all grantees?**