Technical Brief: What is Fecal Sludge?

Contents

1 Introduction

It is necessary to understand the characteristics and quantities of fecal sludge from on-site sanitation technologies, like a pit latrine or septic tank. This information is essential to plan and design appropriate fecal sludge management options.

The first step is to know what fecal sludge is. Where does it come from? What is it made of? How much is there? Fecal sludge from one on-site sanitation technology can be very different than sludge from another technology. It is highly variable in consistency, concentration, and quantity. The characteristics and quantities of fecal sludge depend on various technical, operational, and environmental factors.

Characterizing and quantifying fecal sludge is often overlooked because implementers are not aware of its importance. As well, fecal sludge is often still treated like wastewater despite differences in their characteristics. With more research and pilot projects, the sanitation sector will grow its capacities and knowledge on this topic. Guidelines or standards for characterizing and quantifying fecal sludge will also be developed.

This Technical Brief defines and explains the differences between excreta, fecal sludge and wastewater. It also explains the variability of fecal sludge characteristics and discusses the challenges in reliable fecal sludge characterization and quantification.

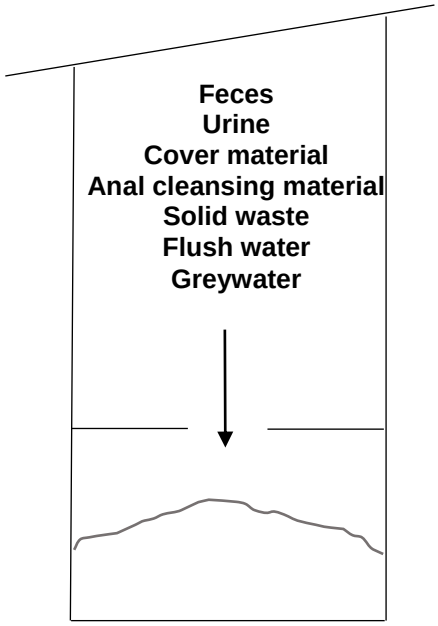
Fecal sludge collected in a pit latrine

CAWST focuses on the planning, design, and implementation of sanitation projects for low-income communities not connected to a sewered system. For such communities, household or decentralized sanitation offers a hygienic and affordable solution.

CAWST's free, open content resources and schedule of international training workshops can be found at: https://resources.cawst.org and www.cawst.org/services/training.

2 What is Fecal Sludge?

Fecal sludge is excreta from an on-site sanitation technology (like a pit latrine or septic tank) that may also contain used water (for example, flush water, greywater, anal cleansing water) and other anal cleansing materials (for example, paper). In a composting latrine, it will also include cover material (like ash or sawdust). As well, fecal sludge may have solid waste that is often disposed in a latrine.



Different components of fecal sludge

Excreta
= Urine + Feces

Fecal Sludge
= Excreta + Flush water + Anal cleansing material + Solid waste

↓

Collected in an on-site sanitation technology (like a pit latrine or septic tank)

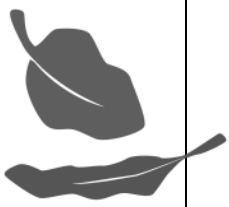
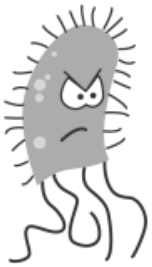
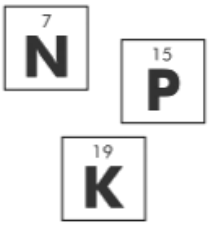
Wastewater
= Excreta + Flush water + Anal cleansing material

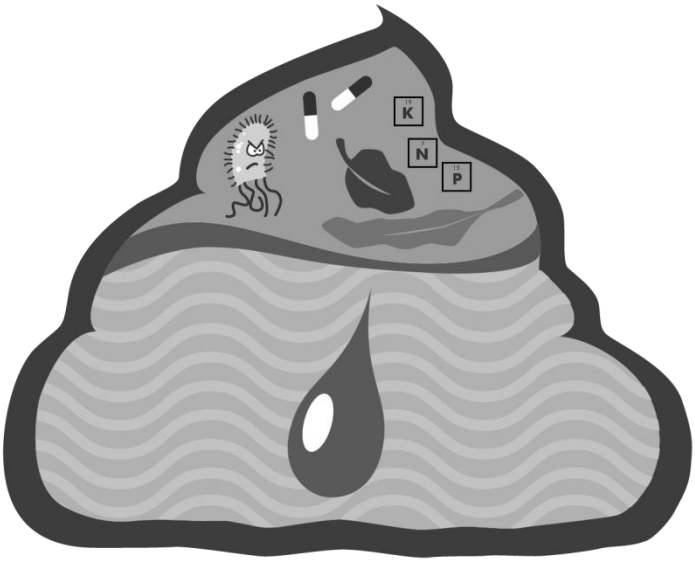
↓

Transported through a sewered system

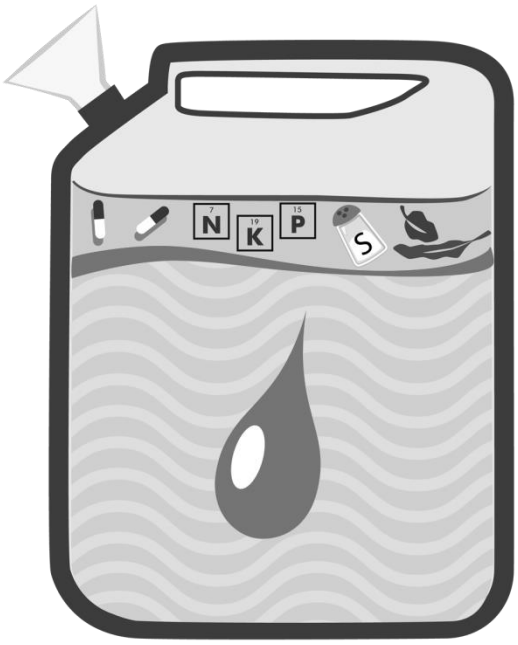
3 What is Excreta?

Excreta is made up of both feces and urine. The following are the main components of feces and urine:

Water	Organic Material	Pathogens	Nutrients	Trace Organics	Salt
					



Feces from a healthy person



Urine from a healthy person

3.1 Water

Both urine and feces are largely made of water. On average, 91-96 % of urine is water and 75% of feces are water (Rose, Parker, Jefferson & Cartmell, 2015). The amount of water excreted will mainly depend on how much liquid a person drinks, how much they sweat, their diet and age. The rest are solids.

3.2 Organic Material

Organic material comes from the remains of living organisms such as plants and animals. When we have a meal that contains vegetables and meat, we are eating organic material. This material goes through our digestive system. Some of the organic material is digested and is used as energy. The organic material that is not digested is excreted through feces and urine.

- 25% of feces are solids, of which 84-93% is organic material. This organic material includes undigested plants, nitrogen, fats, dead or live microorganisms and some carbohydrates. The rest of the solids are inorganic solids which include calcium phosphates, iron phosphates and other body fluids (Rose et al., 2015).
- 4-9 % of urine is dissolved and suspended solids, of which 65-85% is organic material. The main component of the organic material is urea (Rose et al., 2015).

How Much Organic Material is in Excreta?

Oxygen demand can be measured as an indicator of the amount of organic material in excreta. This is the amount of oxygen needed for microorganisms to digest all the organic material. This is known as biological oxygen demand (BOD) and it is measured in mg/L. The more organic material, the more oxygen microorganisms will need to fully digest it, and the higher the BOD. To measure BOD, a sample of excreta or urine is taken and tested using laboratory methods.

Pristine river:	1 mg/L (S.K. Gupta, 2011)
Moderately polluted river:	2 to 8 mg/L (S.K. Gupta, 2011)
Feces:	14,000 to 33,500 mg/L (Rose et al., 2015)
Fecal sludge from septic tanks:	840 to 2,600 mg/L (Koné & Strauss, 2004)
Fecal sludge from public toilets:	up to 7,600 mg/L (Koné & Strauss, 2004)

3.3 Nutrients

Nutrients are found in the food we eat. They go through our digestive system where some are used by our bodies and others are excreted through our urine and feces. Humans need nutrients to grow and stay healthy, particularly children. However, as an adult, our bodies excrete most nutrients. The main nutrients in fecal sludge are:

- Nitrogen (N)
- Phosphorous (P)
- Potassium (K)

Most of these nutrients are excreted through our urine, and only some are found in our feces. The following table shows the percentage of each nutrient that is excreted in urine and in feces.

Table: Percentage of Nutrients in Urine and Feces

Nutrient	Urine (%)	Feces (%)
Nitrogen	88	12
Phosphorous	67	33
Potassium	73	27

(Jonsson & Vinneras, 2004)

Nutrients: Fertilizer and Pollutant?

Nitrogen, phosphorous, and potassium are needed for plant growth. Farmers apply these nutrients onto their fields to increase crop yield. However, these nutrients can also infiltrate through the soil into the groundwater, or be transported by rainwater runoff to surface water bodies. They can contaminate both drinking water and the environment.

High concentrations of nutrients and organic material in surface water can damage the aquatic ecosystem and be disruptive to livelihoods (for example, fishing and tourism). Algae in the water feed on the nutrients and reproduce rapidly, called an algal bloom. The algae blocks the sunlight from penetrating the water, and other aquatic plants are unable to grow. When the algae dies and is eaten by other organisms, the oxygen in the water is used up and aquatic organisms (like fish) suffocate. This is known as eutrophication. In fresh water systems, phosphorous is the limiting nutrient whereas in salt water it is nitrogen.

Nutrients can also contaminate drinking water and impact our health. For example, nitrates (a form of nitrogen) in drinking water can cause methemoglobinemia, a condition which decreases the amount of oxygen transported through our blood. Infants who are bottle fed with formula prepared with nitrate contaminated drinking water are most at risk. See CAWST's Fact Sheets on the Chemical Parameters of Drinking Water Quality for more information about nitrogen.

3.4 Pathogens

Excreta naturally contains many living things. Some are harmless or even beneficial, but others can cause illness. Living things that cause disease are also known as pathogens. They are sometimes called other names, such as microorganisms, microbes or bugs, depending on the local language and country.

The number of pathogens in feces is generally much higher than in urine. Urine is normally sterile (contains no pathogens) when it leaves the human body. There are only a few pathogens, such as *Schistosoma haematobium* and *Salmonella typhi*, which can be excreted in urine. However, most pathogens found in urine are caused by fecal cross-contamination. This means the urine came into contact with feces. For example, the VUNA (Valorisation of Urine Nutrients in Africa) project, which aimed to recover nutrients from urine, found that urine collected from urine-diverting toilets was frequently cross-contaminated with feces (Etter, Udert & Gounden, 2015)

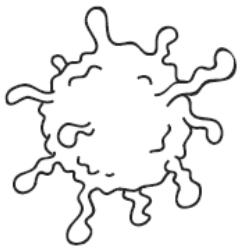
There are four different categories of pathogens: bacteria, viruses, protozoa, and helminths. Each will be discussed in the following sections.

Table: Examples of Fecal Pathogens, Illnesses and Symptoms

Pathogen Group	Illness	Symptoms
Bacteria	Cholera	Watery diarrhea, severe dehydration
	E. coli infection	Mild to severe diarrhea
	Typhoid fever	Headache, fever, nausea, vomiting, paralysis
Viruses	Hepatitis A and E	Fever, nausea, stomach pain, jaundice, anemia
	Rotavirus	Nausea, vomiting, diarrhea
Protozoa	Cryptosporidiosis	Watery diarrhea, stomach cramps and pain
	Giardiasis	Diarrhea, abdominal cramps, weight loss
Helminths	Ascariasis	Doesn't always have symptoms; sometimes abdominal pain, coughing
	Hookworm	Doesn't always have symptoms; sometimes stomach pain, anemia, local itching
	Schistosomiasis	Stunting and anemia in children, flu-like symptoms, painful urination, liver and intestinal pains

(Heymann, 2015)

3.4.1 Viruses



Viruses are the smallest microorganisms. Viruses are unable to reproduce by themselves and must use another living organism to make more viruses. Nonetheless, in the right conditions viruses can survive for months. Different viruses are more or less resistant to various environmental conditions. Even different strains of viruses have different levels of resistance which makes it difficult to monitor virus die-off.

The Hepatitis A and E viruses are transmitted mainly through fecal contamination of food and drinking water. Every year there are an estimated 20 million Hepatitis E infections and 56, 600 Hepatitis E-related deaths (WHO, 2015a). Hepatitis A occurs sporadically and in epidemics worldwide. It is one of the most frequent causes of foodborne infection. Almost everyone recovers fully from Hepatitis A (WHO, 2015b).

Is HIV Transmitted in Excreta?

HIV (human immunodeficiency virus) is not transmitted by feces and urine (Fan, Conner & Villarreal, 2011). However, HIV can be transmitted if feces and urine contain blood. Blood can be found in excreta when there is internal bleeding, menstruation or cuts.

Is the Ebola Virus in Excreta?

Ebola is a virus that spreads through person-to-person transmission through direct contact of broken skin and mucous membranes with blood and other body fluids, such as feces and urine. Transmission can occur through direct contact with these body fluids, or through touching fomites (inanimate objects such as the floor, utensils, and bed linens) that have recently been contaminated with infected body fluids.

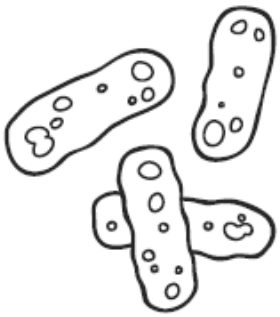
The characteristics of the Ebola virus suggest that it is likely to be relatively fragile in the environment. The virus is unlikely to survive for extended periods outside of the body. Nonetheless, excreta from an infected individual should be treated as a biohazard.

The World Health Organization provides specific recommendations for managing excreta from Ebola infected communities. Of particular importance are the following actions:

1. Keeping excreta separated from drinking water sources
2. Handwashing with soap
3. Containing excreta so that it is effectively separated from human contact

(World Health Organization, 2014a)

3.4.2 Bacteria



Bacteria are very small single-celled organisms that are present everywhere and are the most common living things found in human and animal feces.

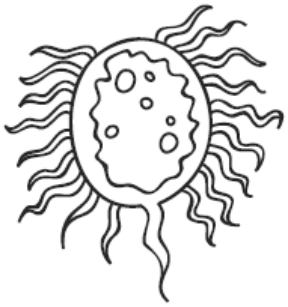
Diarrhea is a major symptom of the most common water-related diseases caused by pathogenic bacteria. These diseases include cholera, *E. coli* infection and typhoid fever. About 361,000 children die every year from diarrheal diseases linked to poor WASH (Prüss-Ustün et al., 2014). That's about 1,000 children under five every day.

Cholera is an acute diarrheal disease that can kill within hours if left untreated. It is no longer an issue in countries that have basic water, hygiene and sanitation standards. However, it is still a problem where access to safe drinking water and adequate sanitation practices are limited. Researchers have estimated that there are 1.4 to 4.3 million cases, and 28,000 to 142,000 deaths worldwide due to cholera every year (WHO, 2015c).

Escherichia coli (E. coli) is a group of bacteria, some of which are pathogenic and cause disease. Enterotoxigenic strains (ETEC) of *E. coli* are among the most important pathogens causing dehydrating diarrhea in infants and children under the age of four in developing countries (Heymann, 2015).

Typhoid fever is a waterborne disease that is caused by a bacteria called *Salmonella typhi*. Typhoid fever is found worldwide. It causes about 27 million cases and 210,000 deaths each year (Heymann, 2015).

3.4.3 Protozoa



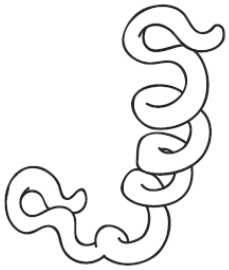
Protozoa are larger than bacteria and viruses. Some protozoa are parasites that need a living host to survive. They weaken the host by using up the host's food and energy, damaging its internal organs or causing immune reactions.

Amoeba, cryptosporidium and giardia are some of the pathogenic protozoa found in water that can cause diarrhea. They are found mainly in tropical countries.

Some protozoa like cryptosporidium are able to form cysts which allow them to stay alive without a living host and to survive in harsh environments. The protozoa cysts become active once the environmental conditions are optimal for their development.

3.4.4 Helminths

Helminths are worms. Helminths include nematodes (roundworms), cestodes (flat worms), and trematodes (flukes). Many helminths can live for several years in the human body.



Some helminth infections are transmitted by eggs present in human and animal feces, which in turn contaminate soil in areas where sanitation is poor. Soil-transmitted helminth infections are among the most common infections worldwide and affect the poorest communities. More than 1.5 billion people, or 24% of the world's population, have soil-transmitted helminth infections (WHO, 2016). The main soil-transmitted helminth species that infect people are roundworms (*Ascaris lumbricoides*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*).

Schistosomiasis, also called bilharzia, is a water-based disease transmitted through urine and caused by a group of helminths called *Schistosoma*. It is common in tropical and sub-tropical areas, affecting almost 240 million people worldwide (WHO, 2014b). According to USAID, “Schistosomiasis is considered second only to malaria as the most devastating parasitic disease in tropical countries (USAID, 2014).”

What is *Ascaris*?

When talking about sanitation, you will often hear about *Ascaris lumbricoides*, a type of roundworm that infects people. *Ascaris* is the most commonly used indicator for whether or not fecal sludge is safe after treatment. *Ascaris* eggs are one of the pathogens most resistant to inactivation in treatment processes and can survive in fecal sludge and soil for months or years. They can also be identified relatively easily in a laboratory (Strande et al., 2014).

Many people around the world are infected with *Ascaris*, especially in tropical and subtropical regions, and in any areas with poor sanitation. Ascariasis is caused by accidentally swallowing eggs found in human and animal feces. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth. Or, if feces with eggs is used to fertilize crops, the eggs may be eaten by people if the food has not been carefully cooked, washed or peeled. Good sanitation and hygiene are key to preventing Ascariasis infections (CDC, 2013).

3.5 Salt

Urine also contains high concentrations of salt. The concentration depends on what a person eats and how much they drink. One study suggested we have on average 8.8 grams of salt per litre of urine (Ganrot, Dave, & Nilsson, 2007). Salt in urine is not a public health issue, but it can be damaging to soils and plants when urine is used as a fertilizer in agriculture.

3.6 Trace Organics

Trace organics such as natural hormones, synthetic hormones and pharmaceuticals can be passed through urine and feces and still be biologically active. Researchers have only recently begun to study whether and how trace organics affect living things in the environment and what this means for public health.

Most trace organics that are excreted by the human body pass through urine. Due to the high prevalence of HIV infections in some countries, high concentrations of pharmaceuticals in urine is expected (Etter, Udert & Gounden, 2015).

3.7 Heavy Metals

Heavy metals are not usually a concern in domestic fecal sludge. These compounds typically come from industrial sources. Some contamination can occur from domestic sources, if for example, batteries are disposed in the latrine. Heavy metals are not removed during fecal sludge treatment, so it is important to avoid contamination in the first place (Strande, Ronteltap & Brdjanovic, 2014).

4 Characterizing and Quantifying Fecal Sludge

It is important to know the characteristics and quantities of fecal sludge to plan and design appropriate management options. The key fecal sludge characteristics include the following:

- **Water content:** The more water there is in fecal sludge, the more volume it takes up and the heavier it is. It is easier to empty watery sludge, but it is more expensive to transport.
- **Solid waste content:** Users often add garbage to their latrine. Various waste products commonly found in latrines include menstrual hygiene products, baby diapers, plastics, textiles, glass, metals, household contaminants, stones, sand and food waste (Strande et al., 2014; Velkushanova, 2015). It should be assumed that fecal sludge will contain at least a small portion of solid waste.
- **Stability of organic material:** Fecal sludge varies from fresh to stabilized (or stable). Fresh sludge has not had time to degrade. Organic material is not broken down. Older sludge has undergone degradation (for example, anaerobic or aerobic digestion) and the organic material is broken down. This process is known as stabilization.

Fecal sludge from one latrine can be very different than sludge from another latrine. The composition of fecal sludge (what's in it) as well as its consistency (how liquid or solid it is) will depend on various factors:

- **Variety of on-site sanitation technologies**: Septic tank, pit latrine, dry latrine
- **Storage duration**: Fecal sludge will be more or less stabilized depending on how long it is stored.
- **Infiltration**: Fecal sludge will be more or less viscous (thick) if there is a high infiltration rate into or out of the containment.
- **Amount of greywater**: Fecal sludge will be more or less dilute depending on the different types of used water going into the on-site sanitation technology (for example, water from bathing, dishwashing, laundry, and cleaning).
- **Emptying method**: Water could be added to help liquefy fecal sludge for pumping. Some emptying methods can only remove part of the contents, for example, fecal sludge at the bottom of a containment technology that is very thick. Other methods can remove the entire contents, for example manual emptying. Sometimes the household can only afford to get part of the contents removed.
- **Climate**: During rainy seasons, on-site sanitation technologies can fill up with runoff and overflow. Warmer temperatures increase degradation rates.
- **Solid waste**: Quantities of solid waste (garbage) disposed in the on-site sanitation technology, depending on access to solid waste management and awareness.

Table: How Fecal Sludge Characteristics Affect Sanitation System Components

Fecal Sludge Characteristic	Sanitation System Component	Common Challenges	Examples
Water content	Emptying	Thick sludge is difficult to empty.	A pump cannot be used to empty a dry latrine pit. Water will need to be added.
	Transport	Watery sludge is heavy and takes up a lot of space.	Wet sludge from a septic tank is easier to pump out with a vacuum truck.
	Treatment	Watery sludge will usually need to be dewatered before focusing on pathogen inactivation.	Sludge from septic tanks will need to be dewatered before composting.
	Use and disposal	Watery sludge has a higher risk of contaminating groundwater if it is to be buried.	Sludge from septic tanks will need to be dewatered before safely burying.
Solid waste content	Emptying and transport	Increases the quantity of sludge.	Owners need to pay higher costs to empty and transport the extra solid waste that is disposed in a pit latrine.
		Solid waste can break emptying technologies and clog pipes and pumps.	Solid waste disposed in a pit latrine will break a motorized pump used to empty the pit contents.
	Treatment	Solid waste can break treatment technologies or stop them from working properly.	Sludge with solid waste should be removed before it is discharged into an anaerobic reactor. The solid waste could damage the reactor and disrupt anaerobic digestion.
	Use and disposal	Solid waste affects the quality of the treated product.	No one will want to use compost that has pieces of garbage in it.
Stability of organic material	Treatment	Fresh sludge contains unstabilized organic material and is difficult to dewater.	Sludge from public toilets will be difficult to dewater as it has not had time to degrade.

Despite its importance, reliable data and accepted methods for characterizing and quantifying and do not yet exist. As well, data from characterization studies also focus on the household level, whereas significant amounts of fecal sludge are generated at public toilets, commercial entities, restaurants and hotels (Strande et al., 2014).

Researchers at Eawag-Sandec are in the process of developing an affordable and simple methodology that can be used to quantify and characterize fecal sludge on a citywide scale, and fill the present knowledge gap. They have hypothesized that demographic data could be used to develop citywide characterization and quantification plans. The methodology is being tested in Kampala, Uganda and Hanoi, Vietnam. More information can be found on the Eawag-Sandec website at: www.eawag.ch/en/department/sandec/projects/ewm/faq-faecal-sludge-quantification-and-characterisation/

Even though it is difficult to characterize and quantify fecal sludge, it shouldn't prevent us from doing the best that we can with the information that we have available. Information on the on-site sanitation technology and how it is operated can indicate some of the sludge characteristics, such as water content. The following sections describe some things that you can do to better understand the characteristics and amounts of fecal sludge that you are dealing with.

4.1 Characterization

The actual latrine itself can provide a lot of information about the fecal sludge characteristics. Key information includes the excreta containment technology, type of user interface, and how long the sludge has been stored. You can better understand the following sludge characteristics by observing the on-site technology and having discussions with the users, emptiers and maintenance staff:

- **Water content:** You can describe how watery the sludge is by understanding the following: type of latrine (for example, wet or dry toilet), excreta storage technology (for example, pit with infiltration to the soil), number of latrine users, amount of water going into system, type of soil, groundwater level, how the sludge is emptied (for example, with or without adding water), and how frequently it is emptied. For example, septic tanks are commonly operated with a greater amount of water and therefore tend to have a greater water content then pit latrines.
- **Solid waste content:** Ask the household if they use the latrine for waste disposal. People may be reluctant to admit what they put in their latrine. A pronged fork can be inserted inside the pit. The volume of solid waste retrieved can give you a better understanding of the quantity and types of solid waste in the fecal sludge.
- **Stability of organic material:** Ask the owner how frequently the latrine is emptied. The storage time will give you a better understanding of the stability of the sludge. For example, the sludge from a public toilet, will tend to be relatively fresh because it requires frequent emptying and was stored for a short period of time.

4.2 Quantification

Quantifying fecal sludge is an approximate science. The following information is needed to estimate the quantity of fecal sludge produced in a community:

- Number of users
- Location
- Types of on-site sanitation technologies
- Number of on-site sanitation technologies
- Fecal sludge accumulation rates

This information is rarely available and time-consuming to collect.

There is currently no proven method to quantify fecal sludge. There are different methods that exist to quantify fecal sludge, but their assessments are based on different factors, resulting in widely variable values.

These methods include determining:

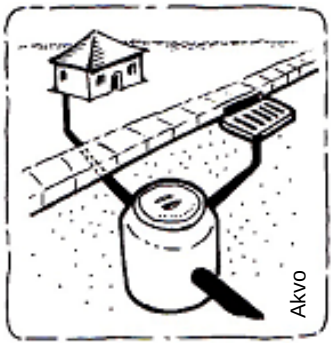
- Fecal sludge accumulation rates in on-site sanitation technologies
- Fecal sludge production based on actual and hypothetical desludging intervals
- Fecal sludge collection rates of service emptying providers

A vacuum truck counting study is an example of determining fecal sludge collection rates. It estimates the amount of fecal sludge currently delivered to a discharge location. In this study, the number of vacuum trucks and their discharge volume is recorded. The study should be implemented over at least one week and should be repeated a few times at different times of the year. This should ensure that the weekly and annual variability of fecal sludge collection is considered. For example, less fecal sludge is commonly discharged on Sundays or during the year when major investments (such as school fees) are due. A vacuum truck counting study does not quantify all of the fecal sludge generated in a community, nor can it predict future developments. As well, it can only be done in cities where fecal sludge discharge locations exist.

5 What is Wastewater?

Wastewater (also called sewage) is a combination of excreta and toilet flush water that is transported directly from the home through a system of pipes (called sewers) to a wastewater treatment facility. Sometimes the wastewater is discharged without treatment. Wastewater may also contain used water from other household activities (also known as greywater).

People often confuse fecal sludge and wastewater. Fecal sludge comes from an on-site sanitation technology, whereas wastewater is transported through a sewered system.



Conventional sewered system

There are also differences between the characteristics of fecal sludge and wastewater. The two main differences are the following:

1. **Variability:** Fecal sludge is highly variable in consistency, concentration and quantity because it comes from different types of on-site sanitation technologies, different uses, different households, and different management styles. Wastewater is more homogenous and consistent because it is mixed as it is transported through the sewers. It is therefore easier to manage because its characteristics are more predictable and we can make generalizations about the averages.
2. **Stability:** Wastewater is transported directly from the home to the wastewater treatment facility through a sewered system. Whereas fecal sludge is stored for a certain period of time in a containment technology (like a latrine pit or septic tank). Depending on the length of storage, fecal sludge can be more degraded and stabilized than wastewater.

Wastewater treatment technologies are not appropriate for fecal sludge treatment. Using a wastewater treatment technology to treat fecal sludge always results in failure (Strande et al., 2014). It is a common misconception that all wastewater technologies can be simply transferred to fecal sludge.

6 Glossary

Characterization: Describing the biological, chemical, and physical properties of fecal sludge.

Excreta: Urine and feces not mixed with any flush water.

Fecal bacteria: Bacteria found in the feces of humans or warm-blooded animals.

Fecal sludge: Also called sludge. Excreta from an on-site sanitation technology (like a pit latrine or septic tank) that may also contain used water, anal cleansing materials, and solid waste.

Greywater: Used water from household activities, such as laundry, dishwashing, bathing, and cleaning. It does not include toilet flush water.

Helminth: Also called worm or fluke. Large, multicellular organisms that are generally visible to the naked eye in their adult stages. Helminths can be either free-living or parasitic in nature. In their adult form, helminths cannot multiply in humans.

Latrine: Also called an on-site sanitation technology. A latrine is made up of all the parts included in the first two boxes of a sanitation system: user interface and excreta storage. Latrine parts include the superstructure, toilet, slab, and the pit, tank or chamber to contain excreta. It may also include accessories such as handrails and a handwashing station.

Nutrient: Any substance that is used for growth. Nitrogen (N), phosphorus (P), and potassium (K) are the main nutrients in agricultural fertilizers.

On-site sanitation technology: Also known as a latrine. An on-site sanitation technology is made up of the parts included in the first two components of a sanitation system: user interface and excreta storage. Excreta is collected and stored where it is produced (for example, a pit latrine, septic tank, aqua privy, and non-sewered public toilets). Often, the fecal sludge has to be transported off-site for treatment, use or disposal.

Organic material: Also called organic matter. Comes from the remains of living things, such as plants and animals.

Parasite: An organism that lives on or in a host organism and gets its food from or at the expense of its host.

Pathogen: An organism that causes disease.

Protozoa: Microscopic, one-celled organisms that can be free-living or parasitic in nature. They are able to multiply in humans, which contributes to their survival and also permits serious infections to develop from just a single organism.

Quantification: Describing the quantity of fecal sludge produced.

Sewered system: Also called a sewer system, sewerage system, sewers, connected sanitation, and networked sanitation. A sanitation system that transports wastewater through a pipe network (like a simplified sewer, solids free sewer or conventional sewer) to another

location for treatment, use or discharge. This includes centralized systems and decentralized wastewater treatment systems.

Stabilization: Degradation of organic material with the goal of reducing readily biodegradable compounds to lessen environmental impacts (such as oxygen depletion and nutrient leaching).

Treatment: Any process to inactivate pathogens, stabilize, dewater, or manage nutrients in fecal sludge.

Wastewater: Used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff (stormwater), and any sewer inflow (infiltration). Wastewater can be managed on-site or off-site. Wastewater managed off-site is often called sewage.

7 Additional Resources

Faecal Sludge Management: Systems Approach for Implementation and Operation. Strande, L., Ronteltap, M. & Brdjanovic, D. (Eds.) (2014). London, UK: IWA Publishing. Available at: www.sandec.ch/fsm_book

- This is the first book dedicated to faecal sludge management. It summarizes the most recent research in this rapidly evolving field, and focuses on technology, management and planning. It addresses faecal sludge collection and transport, treatment, and the final end use. The book also goes into detail on operational, institutional and financial aspects, and gives guidance on integrated planning involving all stakeholders. It is freely available online in English and Spanish, and is coming out in French in 2017.

Sustainable Sanitation Alliance (SuSanA). Available at: www.susana.org

- SuSanA is an open international network of members who share a common vision on sustainable sanitation. SuSanA works as a coordination platform, working platform, sounding board, contributor to the policy dialogue on sustainable sanitation, and as a catalyst. The SuSanA website provides extensive resources including publications, case studies, photos and videos and a discussion forum targeted at practitioners, educators and researchers.

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Akvo images can be retrieved from http://akvopedia.org/wiki/Main_Page

CAWST (Centre for Affordable Water and Sanitation Technology)
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