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Research Article

STUDY ON HUMAN LIQUID WASTE AND ITS QUANTIFICATION

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ABSTRACT

Human liquid waste such as urine and feces are the most importance resources which are available on large scale, so to utilized this waste we should know its characteristics, importance, benefits to human beings and sustainable development, water conservation, efficient water use, water recycling and collection in the context of sustainable water management plans. To utilized this waste water we should quantify the amount of waste water generation at its source so that it can be minimize at the source of generation.

INTRODUCTION

Urine and feces are the by product from our diet, and management of it known as sanitation system. Feces are the solid and semisolid which remains of the food which could not be digested by our small intestine, but can be break down by bacteria. It also contains bacteria and a relatively small amount of metabolic waste or chemical waste products known as bacterial. It is discharged through the anus during a process called defecation. Urine and feces together are called excreta.

Urine

The characteristics of urine have been studied extensively (Diem and Lentner, 1970; Kirchmann and Pettersson, 1994; Karak and Bhattacharyya, 2011). Urine as a potential strength for fertilizer has attracted much attention in the treatability sector with a large range of literature exploring the agricultural fertilizer potential (Palmquist and Johnson, 2004; Karak and Bhattacharyya, 2011; AdeOluwa and Cofie, 2012). Urine presents less danger to human health in comparison to feces and contains few enteric microorganisms, however, some human pathogen microorganisms such as Schist soma haematobium, Salmonella typhi, Salmonella paratyphi, and Leptospira interrogans as well as helminth eggs can be found in the urine fraction (Feachem *et al*., 1978; Heinonen-Tanski and van Wijk-Sijbesma, 2005).

Liquid Generation

Human urine is a liquid that is secreted by the organ kidneys, which collected within bladder and excreted through urethra. Urine is composed of 91–96% water and the remainder can be broadly characterized into inorganic salts, urea organic compounds, and organic ammonium salts. Liquid generation from humans is dependent on the water balance of individuals. Liquid output is in the form of urine, fecal water, from the skin through sweating, and from the lungs through respiration. A median volume of 1.4 L/cap/day urine is excreted with mean values ranging from 0.6 to 2.6 L/cap/day (n = 14). In medicine, urine output is used to assess circulatory adequacy with inadequate urine output considered at <0.5 mL/kg body weight/hour for adults (Suen *et al*., 1998) and at 1–1.5 mL/kg body weight/hour in children (Yowler and Fratianne, 2000). This indicates the minimal urine output that can be expected. Variation in total urine output is primarily due to fluid intake and in a study by Parker and Gallagher (1992) accounted for 78% of the variation observed in a sample of 11,748 days'

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worth of data. It was noted by Garrow *et al*. (1993) that the volume of water drunk as fluid is generally equal to the volume of urine produced. Body size is inevitably important when assessing a human's urinary output; when assigning loading rates in wastewater, Almeida *et al*. (1999) reduced urinary output by 33% for children such that Karak and Bhattacharyya (2011) stated that children urinate about half that of the volume excreted by adults. Urine output therefore increases with body size. Other factors leading to variation such as excessive exercising or sweating will have an effect on the quantity of urine generated as they will impact hydration. Variation in urine output according to race has been proven significant with the urine volume of black women 0.24 L/day less than white women (p = .001) (Taylor and Curhan, 2007).

Characterization of Feces and Urine

Clark *et al*. (2011) that higher volumes of urine tended to be from subjects who were older, were more likely to be obese or taking medication. Information regarding the number of times urination takes place over a 24 hr period is sparse and is likely to vary greatly due to fluid intake, biological factors, and health of the individual. Schouw *et al*. (2002) recorded a urinations per day in a boy's prison in Thailand and Bael *et al*. (2007) reported a median urinations/24 hr (range of 2–11 urinations/ 24 hr) in a study of children aged 6–12 years. Urinations per 24 hr period was recorded for a population sample in the United State (n = 17) (Clare *et al*., 2009). The diurnal variation of urinary output is not commonly recorded, however, a control sample of 15 healthy adult subjects showed that 60% of total urine volume was excreted during the daytime (09:00–21:00) and 40% was excreted at night time (21:00–09:00) (Hineno *et al*., 1994).

Composition

Urine composition varies due to differences in physical exercise, environmental conditions, as well as water, salt, and high protein intakes. Urine osmolarity is a measure of the water distribution amongst fluid components. It can vary between 50 and 1200 mOsmol/kg, with the average urinary excretion of solute 1000 mOsmol/cap/day (Garrow *et al*., 1993; Callis *et al*., 1999). This solute is excreted in a median volume of 1.4 L/cap/day of urine. The quantity of solute varies between individuals and with differing diets; for example, the high consumption of meat leads to larger volumes of solutes as meat is a major source of urea (the largest solute fraction) as well as potassium and phosphates, whereas vegetarian diets are likely to lead to reduced solute production as most energy is derived from carbohydrate (Garrow *et al*., 1993). The median value of mean total urine solids loading rates is 59 g/cap/day (n = 7) and mean values range from 57 to 64 g/cap/day. The dry matter of urine was measured at 4.7–10.4 g/L by Heinonen-Tanski and van Wijk-Sijbesma (2005). The concentration of total suspended solids has been recorded at 21 mg/L (Almeida *et al*., 1999) and total dissolved solids have been recorded at 31.4 mg/g (Putnam, 1971). Organic matter makes up between 65% and 85% of urine dry solids (Strauss, 1985), with volatile solids comprising 75–85% of TS (Fry and Merrill, 1973; House, 1981). Urea is the most predominant constituent making up over 50% of total organic solids, and is produced through the metabolism of protein. The other major solutes excreted in urine are Na and K, which are largely derived from dietary intake.

Water Conservation

Water shortages have been recognized as the most immediate and serious threat to humanity. Australia is the world's driest continent; yet our per capita water use of 320 liters/person/day is the second highest in the world after the United States of America, which is a continent with significantly higher rainfall levels. (ATSE, 2004) Melbournians have been recorded as using 423 liters/person/day on average over 1990-1999. (Water Resources Strategy Committee 2002) In view of projected population growth, it is anticipated that water supply and demand will increase by 50 per cent by 2020. (DNRE 2002) Considering the current persistent drought conditions and catchment storage infrastructure capacity limitations, it is essential to integrate into new buildings measures that reduce water resource use if sustainable development is to be achieved. [3]

Increasing Efficient Water Use

Water efficiency can be viewed as 'doing more with less': through the implementation of technology that provides the same or better level of service, while using less water. Saving water through the use of efficient fittings and fixtures is the least sensitive issue of human concern, as it does not require lifestyle changes. Better performance of these fittings is also associated with other advantages, such as operational cost savings and reduced energy consumption, especially for hot water use as less water needs to be heated. There are a number of options available for each type of fitting and fixture, such as toilets, showers, taps and urinals. [3]

Water Recycling

Water recycling is a process by which treated water becomes suitable for direct use or a controlled use. (Asano, 2002 and ATSE, 2004) The Australian Academy of Technological Sciences and Engineering has suggested the term water recycling be used to refer to generic water reclamation and reuse; hence it comprises the beneficial use of rainwater, storm water, grey water (wastewater from showers, basins, sinks and kitchens) or black water (wastewater from toilets). In this context, the CH2 building has integrated all aspects of the Water Sensitive Urban Design within its ESD features. Water recycling of treated wastewater effluents has been practiced since the early 1990s, mainly for irrigation. (ATSE 2004) The effluents are usually treated to a secondary level, using a biological process without the need to disinfect. Secondary level treatment goes beyond primary treatment, which involves the removal of bulk solids from the waste stream, to reduce the amount of nutrients, usually by the action of biological organisms in the presence or absence of oxygen. The increased uses of recycled water for applications that involve human contact have necessitated the inclusion of advanced treatment and effective disinfection processes. These may include combinations of filtration, activated carbon processes, lagooning, constructed wetlands, chlorination, ultraviolet light, and o-zonation. Membrane bioreactors and membrane filtration are increasingly being used because of their effectiveness and small footprints, particularly with the successes achieved in reducing their capital and operational costs. (Macpherson, 2004, Metcalf and Eddy, 2003). [3]

Table 1 water saving devices (Refer 3)

Low-flow (LF) dual flush	Dual flush, 6/3 liters/flush. Approximately 50 per cent savings in water use compared with conventional use of 12 liters/flush. For example, the toilets (6/3 liters) at 8 Brindabella Circuit on average use four liters/flush compared to 10 liters/flush for standard toilets (www.canberraairport.com.au). For households, a saving of approximately 55 per cent was achieved on average water consumption of 24.4 litre/day/household, for houses using dual flush toilets (6/3 and 9/4.5 litres). This compared with those using single flush toilets (6 liters and 9 liters). (Gato, et al, 2004) A net potential savings of 39.8 liters/capita/day was estimated for homes fitted with Ultra Low-Flush toilets (ULF), compared with non-ULF homes. (Mayer, Deoreo, *et al*, 1999)
Water less/water free urinals	Saving of two liters/flush, potential 45 to 55 per cent water savings, depending on size and flushing method. A waterless urinal system is used in the new visitor center at the Ightham Mote National Trust property (www.greenbuildingstore.co.uk), and in 60L Green Building (http://www.60lgreenbuilding.com). The system uses two liters/flush less than conventional urinals. Water-free urinals are installed at 8 Brindabella Circuit, Canberra. Water-free urinals use a biodegradable blocking fluid to contain odors, rather than the conventional water flush (www.canberraairport.com.au).
Sensor operated low-flush urinals	2.8 liters/flush. Up to 70 per cent water savings.
Flow regulators or aerators on taps	Flow rate is 6-12 liters/min compared with 15 liters/min. Water savings vary from 30 to 60 per cent depending on the period the tap is run at each use.
Sensor activated (infra-red) taps (used on basins in public toilets)	Same water savings as above, in addition to a potential reduction due to enforced shorter running time at each use. Infra-red taps are also being used in 8 Brindabella Circuit, Canberra. The use of these taps is associated with energy savings. Water is only released when hands are placed under the infra-red beam below the tap spout. Subsequent energy savings were reported, as less hot water is required to be heated.
Composting toilet	This product has a very low water demand. Its main drawbacks are capital cost (thousands of dollars/single toilet) and negative public perception. It is not widely used globally, particularly in multi-story commercial buildings. There are a few examples in Sweden and Germany, and one in Australia (a two-storey building on the Thurgoona Campus of Charles Sturt University in Albury).
Vacuum toilets	Use only 0.3 – 1.2 liters/flush. Mainly used on transport (such as aircrafts, trains and ships). These units are very expensive and energy intensive.

CONCLUSION

The need to develop new water storage capacity, import water from beyond existing water catchments, Reduction in the need to upgrade existing sewage and potable water infrastructure, Reduction in the energy costs of sewage and potable water pumping and treatment, The ability to obtain full value from a precious resource, Best practice sustainable design at the 'top end' of the property and building industry – commercial offices, educational building and Reduction in the treated flow volume from sewage treatment plants to receiving environments.

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