



A New Concept to Produce Bio-gas in a Space Station

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Abstract:

In space station, the toilet system is really different than Earth. In space the toilet system is based on 'Zero Gravity Toilets' which also called as Waste Collection System. From the beginning to now, there (in space), human daily wastage are separated and differently stored in tanks. Those wastage are sent to Earth for disposal. This paper deals with a proposed concept of disposing the waste generated in the space station in the space itself. Similar to the process producing bio gas in earth the wastage generated in the space can also be used to produce bio gas which can be utilized as a fuel and thus the waste disposed in the space.

Keywords: Bio gas; Space station; Toilet system; Fuel.

I. INTRODUCTION

There are mainly two types of gases found in the World, which can be used as a fuel, and they are- Natural gas and Bio gas or Bio organic gas. Bio gas is a non conventional source of vitality. The procedure of producing bio gas is really old, but producing bio gas in Space station is a raw concept. The bathroom in the space station is really dissimilar than the toilet in Earth. The operating rule of zero gravity toilet is really different. Like the Earth, in space there is no gravity, so scientists have cooked up a toilet, which is workable in zero gravity. In space station the toilet is called 'Waste Collection System (WCS)'. In 1967 the space toilet was introduced and for the first time it was built in the 'Soyuz Space craft' with an on board toilet facility. All Gemini and Apollo space craft required astronauts to urinate in a so-called "Relief tube" in which the contents were dumped into place, while fecal matter was gathered in a specially designed handbag (Hauptlik-Meusburger, 2011). Those installations were very uncomfortable for the cosmonauts. Then they were straining to avoid this system and they used up less than half the food available on their flights (Bourland, 2006). NASA built a space station named 'Skylab' between May 1973 and March 1974, which has an onboard waste collection facility which served as a paradigm for the shuttle's waste collection system, but also featured an onboard shower facility. The Skylab toilet was designed and constructed by the Fairchild Republic Corporation on Long Island, was a primarily medical system to gather and bring back to Earth samples of urine, feces and vomit so that calcium balance in astronauts could be considered. The Soviet Russian Space station Mir's toilet also used a scheme similar to the waste collection arrangement (Shuttleworth, 2002). There are two stools on the International Space Station, situated in the Zvezda and Tranquility modules (Mansfield, 2008). An additional Waste and Hygiene Compartment is part of the Tranquility modules which was set up in 2010. In 2007, NASA purchased a Russian made toilet similar to the one already aboard ISS rather than develop one internally (Fareastgizmos.com, 2007). The Space Station toilets or the zero gravity toilets are really unlike, there they use a fan driven suction similar to the Space Shuttle's waste collection scheme. There they separately collected the liquid and the solid wastage. Liquid waste is gathered in 20 liter

containers and solid wastage is collected in individual micro perforated bags which are salted away in an aluminum container (Lu, Ed., 2003). Full containers are transferred to progress for disposal. On May 21, 2008, the gas, liquid separator pump failed on the 7 year old toilets in Zvezda, but the solid wastage portion was even running. The crew tried to replace various parts, but was unable to fix the malfunctioning component. In the meantime, they employed a manual way for water collection (BBC News, 2008). The crew had another option: to use the lavatory on the Soyuz transport module or use urine collection bags as required. A replacement pump was sent from Russia in a diplomatic pouch so that Space Shuttle Discovery could bring it to the post as part of mission STS124 on June 2 (Spacefellowship.com, 2008, Redorbit.com, 2008). Straight off a day a next generation space station toilet called the Universal Waste Management System is being developed by NASA for Orion and other long duration missions (Broyan et. al., 2014). This toilet is designed to be more lighter, more reliable, more hygienic and more compact than previous space station toilets (Broyan et. al., 2014, Stapleton et. al., 2013). A flight test article of the Universal Waste Management System is planned to be handed over and probably tested on the ISS in 2018 (Broyan et. al., 2014).

2. WORKING PRINCIPLE

This is a simple method of producing bio gas and bio organic fertilizers from human daily wastes. Normally in a space station's sanitation system, human wastes are stored in a wastage tank and after a period of time, when the tank is full, the wastage is transferred into another space ship and broadcasted it to Earth for disposal. With this novel concept, we are working to produce bio gas in the Space Station, just like on Earth, the first step is to fix a toilet seat as in airplane having a suction pump which push away the daily wastes and sends it to the wastage chamber. Then bacteria called 'Methanosime' are injected into the wastage chamber. Methanosime is a bacteria which get around the human wastage to bio gas and bio organic fertilizers. By causing this, this bacteria will do its work and wears out the decomposition part into bio-gas and biological slug. This bio gas is actually Methane, which is inflammable and need to be stored, so a pipe is associated from the wastage tank to the gas storage tank

(pictured in Figure-1), and the flow of gas is kept in line by a valve. This gaseous state can be directly applied as a fuel, other than it can be flow through a high pressurized pipe and by rotating a turbine we can produce electricity, this electric can be practiced as a backup energy. Also the 'Biological Slug' can be utilized as an organic plant food. This punch can also be stashed away; a pipe is also linked with the slug storage chamber from the human wastage chamber (As indicated in Figure-1). A valve can also control it. This lick is a bio organic fertilizer and can easily used for plants. There are many plants

such as Lettuce, Ginger, Spinach, Flowers etc. are grown in a space station. This organic fertilizer is really useful for these plants. Other than the slug can also be stored in a cylinder and send to Earth for cultivation or disposal purpose.

3. DISCUSSION

Every new program or production takes in its own advantages. Hence this plan of zero gravity toilet has those attributes as well. When we think about those properties, we found some of them and we are

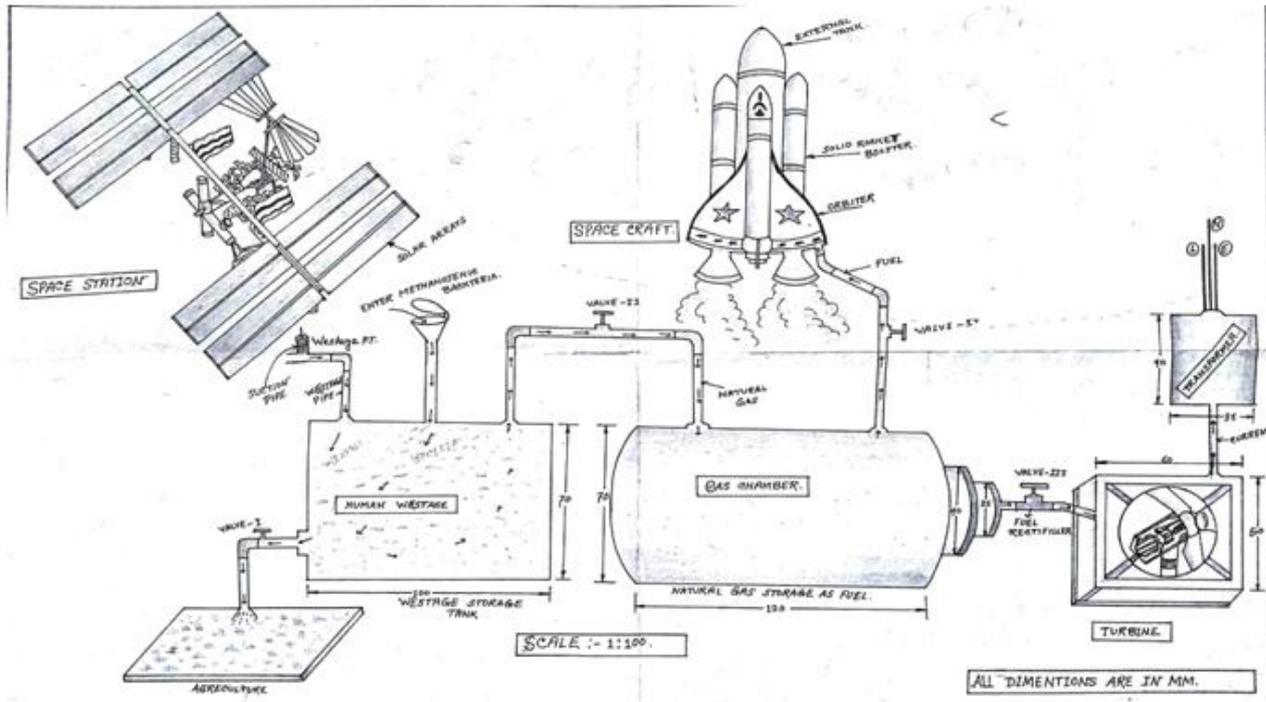


Figure.1. A Proposed Sanitary System in Space Station

Dying to talk over those properties here. The advantages are-

1. We can get Methane gas from this procedure, which is flammable and can be utilized as a fuel or by going around a turbine we can produce electricity as well.
2. By throwing out the wastage we can find organic fertilizers too, which is good for plants in a space station.
3. By this process the daily human wastage can be thrown out in Space, so the price of carrying those wastage to Earth will be scaled down.
4. If we can create electricity, then we may use it as a backup energy.
5. Bio gas has its own, bad smell, and then if any leakage occurs, man can easily notice that and for this we don't have to mix Mercoptain to make it look exactly like natural gas.

4. CONCLUSION

All this process is based on assumptions; there is no practical proof to make bio gas in place. We are adopting this operation by producing bio gas on Earth. The production of Bio gas is very older, but produce it in Space is a new concept. Here we thought that if we can produce bio gas in space by decomposing human wastage then we take in both Gas and fertilizer. A gas for direct usage, and fertilizer for plants. Also we can directly decompose the wastage in Space. So the price of bearing those wastage to Earth will be shortened or will be no more. This process of producing bio gas in Space will be very different, but very effective, and this way human can save time and money. This novel procedure will change the system

of Space toilets or zero gravity toilets, and this prototype may be a new and effective one. At last we have to state that this process will be safe for astronauts and space research too. In future, it is very much necessary to construct more spacious as well as light weight two tanks, One for storing wastage and the other for storing gas for which daily human wastage, including liquid and solid together to produce the gas, so the drinking water for the astronauts will have to provide separately.

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