Convert Human Urine into a Fertilizer (Crystalline Form)

Patel Purvang A[1] Joshi Harsh R[2] Prajapati Neel N[3] Patel Shivam R[4] Prof. Rina K Chokshi[5]
[1,2,3,4,5]Parul University, Vadodara, Gujarat, India

Abstract— The overuse and misuse of chemical fertilizers attributed to critical environmental and health problems such as chronic kidney disease (C.K.D) in Sri Lanka. Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production. Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production. This study was conducted to explore the possibility of utilizing human urine in edible crop production as a low cost and effective nitrogen fertilizer. Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production.

Keywords: Human Urine Fertilizer, Nitrogen, Phosphorous, Ligands Chemicals, Carbon, Calcium, Struvite, Urine Collector Tank

I. Introduction

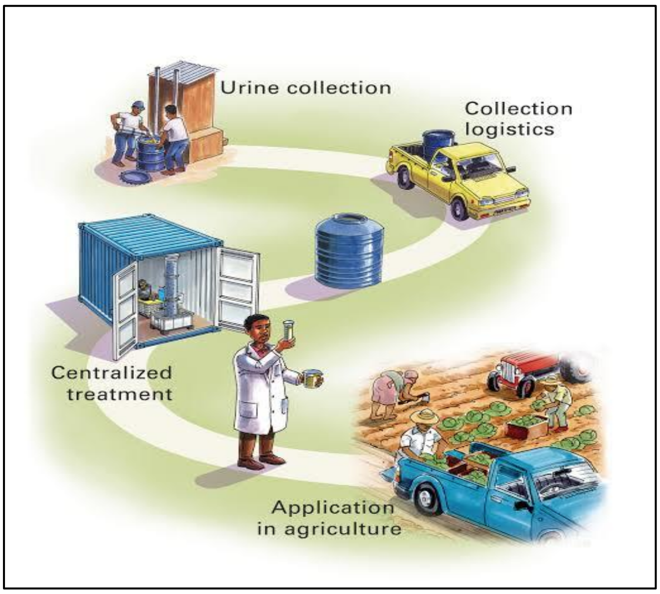
THE CONVERTION OF HUMAN URINE INTO FERTI LIZER is a term that is used to refer to the process of collecting and treating liquid wastes. It also offers solutions for recycling items that do not belong to garbage or trash. As long as people have been living in settlements and residential areas, garbage or liquid waste has been an issue. Waste management is all about how liquid waste can be changed and used as a valuable resource. CONVERT HUMAN URINE INTO FERTILIZER should be embraced by each and every household including the business owners across the world. Industrialization has brought a lot of good things and bad things as well. One of the negative effects of industrialization is the creation of liquid waste. Every day, tonnes of liquid waste are disposed off at various landfill sites. This waste comes from homes, offices, industries and various other agricultural related activities. These landfill sites produce foul smell if waste is not stored and treated properly. It can pollute the surrounding air and can seriously affect the health of humans, wildlife and our environment.

A. Residential

Residences and homes where people live are some of the major sources of liquid waste. Garbage from these places include food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes and special wastes like bulky household items like electronics, tires, batteries, old mattresses and used oil. Most homes have garbage bins where they can throw away their liquid wastes in and later the bin is emptied by a garbage collecting firm or person for treatment.

B. Industrial

Industries are known to be one of the biggest contributors of liquid waste. They include light and heavy manufacturing industries, construction sites, fabrication plants, canning plants, power and chemical plants. These industries produce liquid waste in form of housekeeping wastes, food wastes, packaging wastes, ashes, construction and demolition materials, special wastes, medical wastes as well as other hazardous wastes.



C. Commercial:

Commercial facilities and buildings are yet another source of liquid waste today. Commercial buildings and facilities in this case refer to hotels, markets, restaurants, go downs, stores and office buildings. Some of the liquid wastes generated from these places include plastics, food wastes, metals, paper, glass, wood, cardboard materials, special wastes and other hazardous wastes.

D. Institutional:

The institutional centres like schools, colleges, prisons, military barracks and other government centres also produce liquid waste. Some of the common liquid wastes obtained from these places include glass, rubber waste, plastics, food wastes, wood, paper, metals, cardboard materials, electronics as well as various hazardous wastes.

E. Construction and Demolition Areas:

Construction sites and demolition sites also contribute to the liquid waste problem. Construction sites include new construction sites for buildings and roads, road repair sites, building renovation sites and building demolition sites. Some of the liquid wastes produced in these places include steel materials, concrete, wood, plastics, rubber, copper wires, dirt and glass.

II. Methods of Convert Human Urine into Fertilizer

There are different methods of CONVERT HUMAN URINE INTO FERTILIZER. The following are some of the recognized methods:

A. Sanitary Landfill

This is the most popular liquid waste disposal method used today. Garbage is basically spread out in thin layers, compressed and covered with soil or plastic foam. Modern landfills are designed in such a way that the bottom of the landfill is covered with an impervious liner which is usually made of several layers of thick plastic and sand. This liner protects the ground water from being contaminated because of leaching or percolation. When the landfill is full, it is covered with layers of sand, clay, top soil and gravel to prevent seepage of water.

B. Recovery and Recycling

Recycling or recovery of resources is the process of taking useful but discarded items for next use. Traditionally, these items are processed and cleaned before they are recycled. The process aims at reducing energy loss, consumption of new material and reduction of landfills.

C. Composting

Due to lack of adequate space for landfills, biodegradable yard waste is allowed to decompose in a medium designed for the purpose. Only biodegradable waste materials are used in composting. Good quality environmentally friendly manure is formed from the compost and can be used for agricultural purposes.

D. Pyrolysis

This is method of CONVERT HUMAN URINE INTO FERTILIZER whereby liquid wastes are chemically decomposed by heat without presence of oxygen. This usually occurs under pressure and at temperatures of up to 430 degrees Celsius. The liquid wastes are changed into gasses, liquid residue and small quantities of liquid.

In summary, proper CONVERT HUMAN URINE INTO FERTILIZER is an integral part of environmental conservation that should be observed by individuals and companies globally. This will keep the environment clean and reduce health and settlement problems.

The combined effects of population explosion and changing modern living standard have had a cumulative effect in the generation of a large amount of various types of wastes. Liquid waste can be classified into different types depending on their sources.

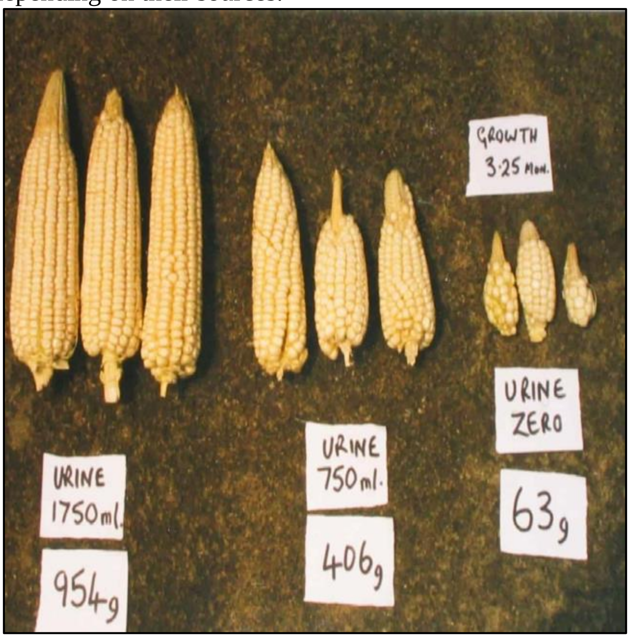


Fig. 1: Result of Fertilizer Used

III. PRINCIPAL

When chemically isolated from soil, nutrients can be detected using this technique. Nitrogen and phosphorus, typically found in the form of nitrates and phosphates, are extracted with a chemical extractant that will bind the nutrient of interest. Once extracted from soil, each nutrient can be combined with a known reagent that causes the nutrient solution to change to a nutrient-specific color in a linear relationship, with a darker color indicating increased concentration of the nutrient. To analyze the concentration of each nutrient, a chemical reagent will be used to color each sample with an increase in color intensity indicating increased concentration of the nutrient.

In the high and medium-range nitrate tests, cadmium metal is used to reduce nitrates (NO_3^-) to nitrites (NO_2^-). The cadmium is contained in the purchased Nitraver 5 (high and medium range) and Nitraver 6 (low range) powder pillows.

$$NO_3^- + Cd + 2H^+ \rightarrow NO_2^- + Cd^{2+} + H_2O$$

Nitrite ions then react with sulfanilic acid (in an acidic medium contained in the NitraVer 5 powder) to form an intermediate diazonium salt. When coupled with gentisic acid (also contained in the NitraVer 5), an amber-colored solution is formed. Color intensity of this compound is directly proportional to the nitrate concentration of the water sample and can be quantified by using the nitrate color comparator box with a continuous nitrate amber color disk.

For phosphorus, sodium molydate, and potassium pyrosulfate in the purchased PhosVer 3 reagent powder react with the soluble reactive phosphates to form a phospho-molybdate complex.

$$H_2PO_4^- + 12\ Na_2MoO_4 + \rightarrow PMo_{12}O_{40}^{3-}$$

The complex is then reduced by ascorbic acid (also contained in PhosVer 3 powder) to form a molybdenum blue color. The blue color is quantified using a phosphate color comparator box with a continuous phosphate blue color disk.

A color comparator box is used for this method. This tool operates based on known color intensities for each concentration between 0-50 mg/L. A color disk on the box is turned until the color in both viewing windows (blank and sample) matches. Once the colors are matched, the corresponding nutrient concentration (mg/L) will be displayed in a separate lower window on the color comparator box. These boxes are robust enough to be used with students at any level up to introductory college courses and can easily be transported as part of a field soil testing kit that can be used at a sampling location. These methods allow for basic nutrient testing in the classroom lab without requiring expensive pieces of equipment that may not be available. To ensure test accuracy, nitrate and phosphate standard solutions can be used in place of a sample in the procedures before traveling to field site or beginning analysis of soil samples in the lab.

In the potassium tests, the potassium ions combine with sodium tetraphenylborate contained in the purchased Potassium 3 reagent powder to form potassium tetraphenylborate, a white precipitate. The precipitate remains in suspension in samples, causing an increase in turbidity.

$NO_3^- + Cd + 2H^+$ $NaB(C_6H_5)_4 + K^+ \rightarrow KB(C_6H_5)_4 + Na^+$

A potassium-measuring dipstick is used to quantify the amount of turbidity that is converted to potassium concentration. The dipstick has a black dot on one end that is placed in the sample until the dot is no longer visible through the white precipitate. the dipstick is incrementally marked to indicate a scale of visibility that is then converted to potassium concentration with a conversion chart. this method is an inexpensive procedure with minimal equipment that can be transported to an outdoor sampling site and robust enough to be used with students at any level up to introductory college courses.

IV. Concept & Functioning

A. Two Process Steps for Complete Recovery:-

The complete nitrification process developed by the PROJECT 1 (CONVERT HUMAN URINE INTO A FERTILIZER) consists of two main process steps:-

1) Nitrification:

Approximately 50 % of the total ammonia (NH3 and NH4+) contained in stored urine is transformed to nitrate (NO3–) by bacteria. Simultaneously, about 90 % of the organic matter is degraded. The remaining nitrogen leaves the reactor unchanged as ammonium. The resulting liquid is free from malodour and can be distilled without losing ammonia via volatilization, i.e. the urine and the nutrients contained in it are stabilized by the nitrification process.

2) Distillation:

The stabilized urine is distilled to approximately 3 to 5 % of its initial volume. The remaining concentrated liquid contains all the nutrients from urine. At ambient temperature, all nutrient salts stay in solution. Distilled Urine is recovered.

3) Reactor Construction for Distillation

The following section describes what components are necessary to convert urine to fertilizer at the scale of a building or a neighborhood. Though the general components and their functioning are outlined, it cannot replace the engineering required to install and operate such a system. The system will have to be carefully adapted to new situations. Furthermore, the technology is still being developed further, so components may vary or be replaced in the future.

4) Integration into Building Environment

When assessing the potential of integrating the complete nutrient recovery system into a new environment, the full system has to be taken into account: From the urine collection from the toilet users to the use of the final products, i.e. the concentrated nutrient solution and the distilled water. The complete installation has a footprint of approximately 5 m2, whereas the room accommodating it should not be smaller than 10 m2.The building environment varies from one place to another:

- Eawag: Urine is collected from 31 urine-diverting toilets and 7 waterless urinals and piped directly to the storage tank in the basement. Rainwater is used to flush the toilets.
- Newlands-Mashu: Urine is trucked from household urine-diverting dehydration toilets and stored in large tanks on site.
- Customer Care Centre: At present, 3 waterless urinals are connected to the system located in the underground parking. At a later stage, when new urine-diverting flush toilets will be available, urine will be collected from toilets.

Fig. 2: Crystallizer Tank

B. Instrumentation and Process Control

The following online sensors are integrated into the plant:

- Urine storage: level
- Nitrification reactor: pH, temperature, dissolved oxygen
- Intermediate storage tank: level
- Distiller: pressure, temperature, electric conductivity data of these sensors is recorded in 1-minute intervals and logged directly into a data base for an easy analysis. The influent pump is controlled by the pH value in the nitrification reactor. For details refer to the recommended publications.

Fig. 3: Urine Treatment Plant

ACKNOWLEDGMENT

First of all, I would like to thank the almighty or granting me perseverance. I wish to express my special thanks and deepest regard to my guide PROF. RINA CHOKSHI, HOD, Civil Department, P.I.E.T (DS) for providing me valuable guidance, suggestions and support which helped me to submit the project on time. Once again I take this opportunity to express my gratitude and thanks to HOD PROF. RINA CHOKSHI (P.I.E.T) (DS), OF Civil Engineering Department for valuable suggestions and for providing me the opportunity to complete my work simultaneously. This work would not have been possible without the support, and guidance, helping us with different case studies. She has always been there for us at time of difficulties and constant source of inspiration. We would like to thank all the faculties and staff members of Civil Engineering Department for providing us all the support required for the completion of this project. Thanks to our family for their encouragement and support.

PATEL PURVANG .A.
JOSHI HARSH .R.
PRAJAPATI NEEL .N.
PATEL SHIVAM .R.

V. CONCLUSION

The overuse and misuse of chemical fertilizers attributed to critical environmental and health problems such as chronic kidney disease (C.K.D) in Sri Lanka. Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production. Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production. This study was conducted to explore the possibility of utilizing human urine in edible crop production as a low cost and effective nitrogen fertilizer.

Therefore, there is a growing trend among present researches to explore low cost, effective fertilizer substitutes for inorganic fertilizers in crop production.

REFERENCES

[1] Mazzanti & Zoboli, 2008
[2] Kathiravale & Mohd Yunus, 2008
[3] Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2009
[4] Idris et al., 2004
[5] van de Klundert, 1999
[6] Agamuthu et al., 2009
[7] UNEP, 2006