3th IWA Specialized Conference on Small Water and Wastewater Systems &
5th IWA Specialized Conference on Resources-Oriented Sanitation
14 – 17 September 2016, Athens, Greece

Science in Urine Handling and Utilization

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Thursday, 15 September 2016, Olympia Hall IV, 12:00 ~ 12:15

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Introduction

Sanitation is a Worldwide Problem

- 2.4 billion people lack access to basic sanitation services, such as toilets or latrines.
- More than 80 per cent of wastewater resulting from human activities is discharged into rivers or sea without any pollution removal.
- Each day, nearly 1,000 children die due to preventable water and sanitation-related diarrhea diseases.

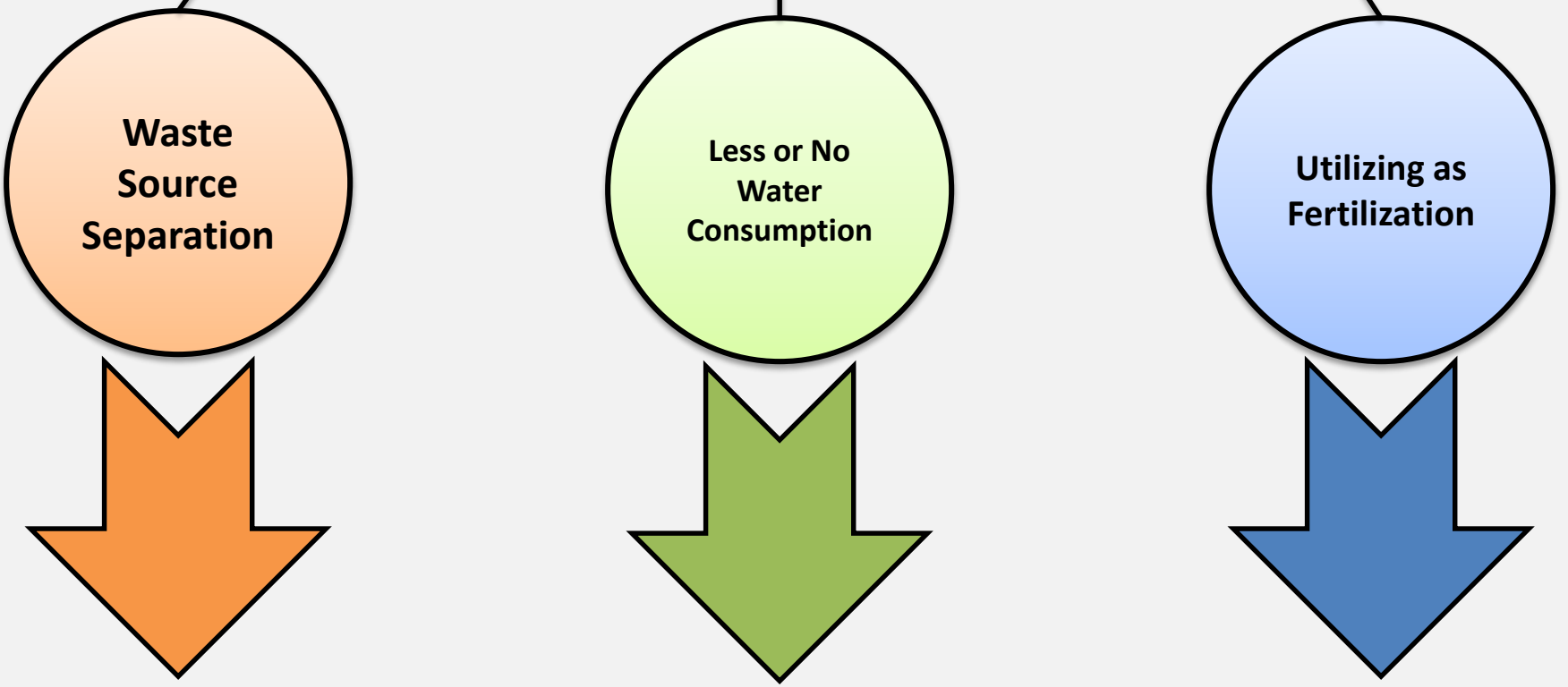
SDG–6 For Ending Water and Sanitation Problems

Objectives of SDG-6

- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
- Support and strengthen the participation of local communities in improving water and sanitation management.

ROS Toward SDG-6

Characteristics of Ideal Sanitation Toward SDG - 6



Resource Oriented Sanitation Fits SDG-6

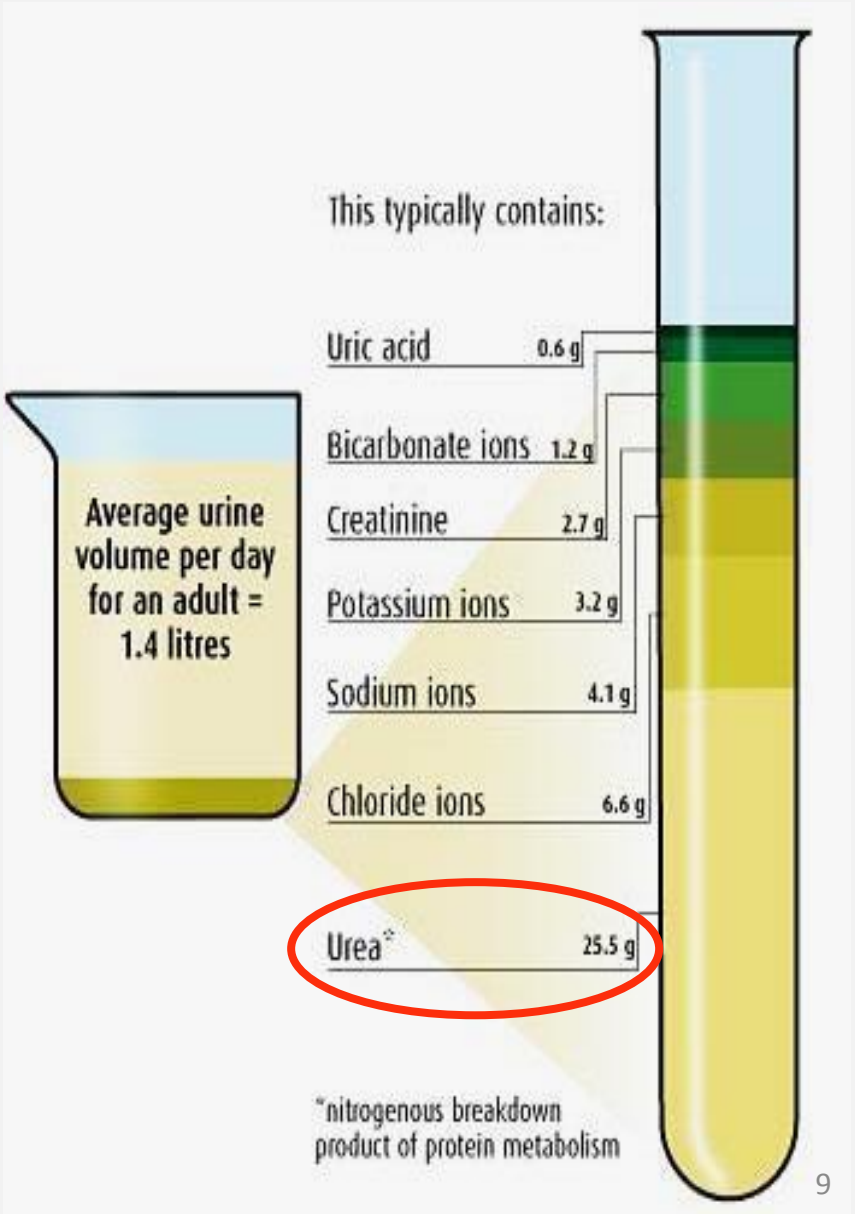
Challenges of Urine in ROS

- Managing urine in ROS is essential due to several critical challenges.
- Challenges like awful odor or scale formation important to be solved scientifically.
- Urine should be handle in the way getting prepared for further utilization (as fertilizer, etc.).
- However, scientific knowledge in the life cycle process including collection, transport, storage, treatment and utilization of urine limits the wide adaptation of ROS.

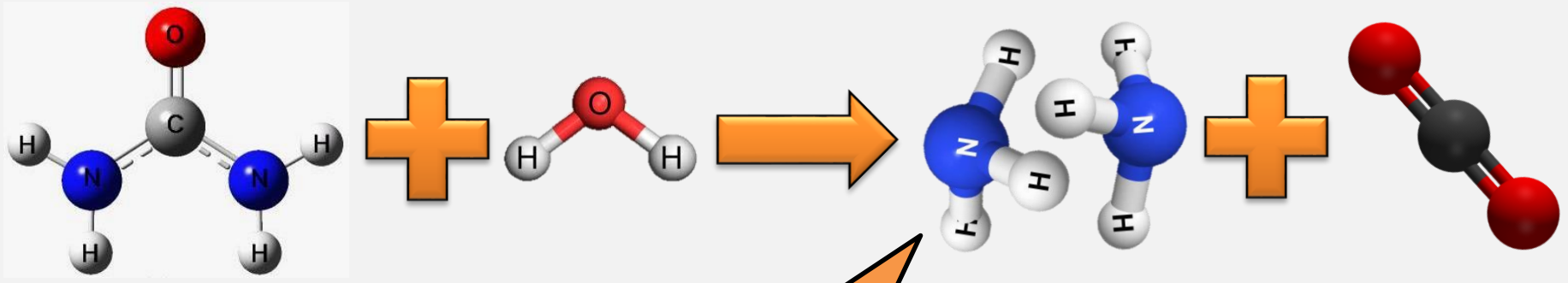
SCIENCE OF URINE

Composition of Fresh Urine

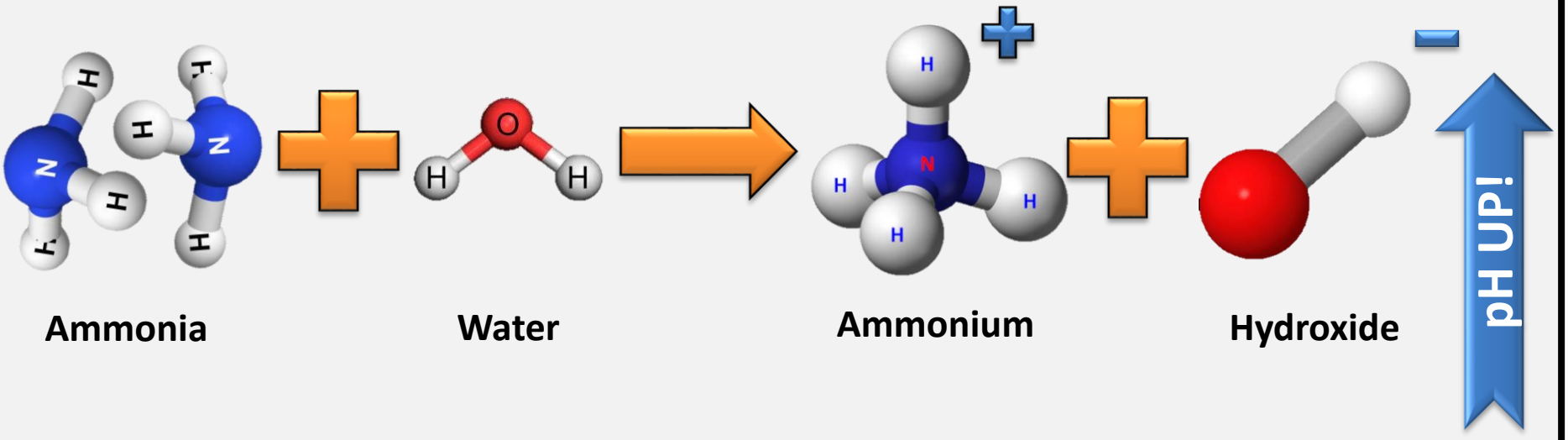
- About 95% of fresh urine is water.
- The rest is the minerals and other organic compounds.
- Among these materials, urea is the majority.
- Urea is the product of breakdown of amino acids.



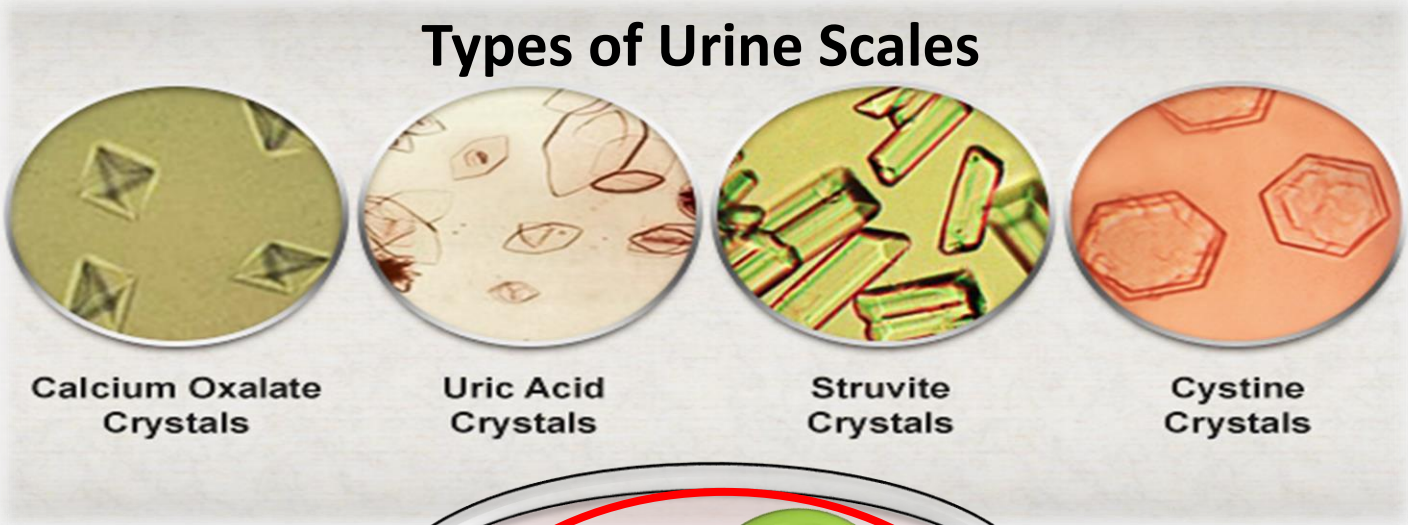
Fate of Urea in Aged Urine

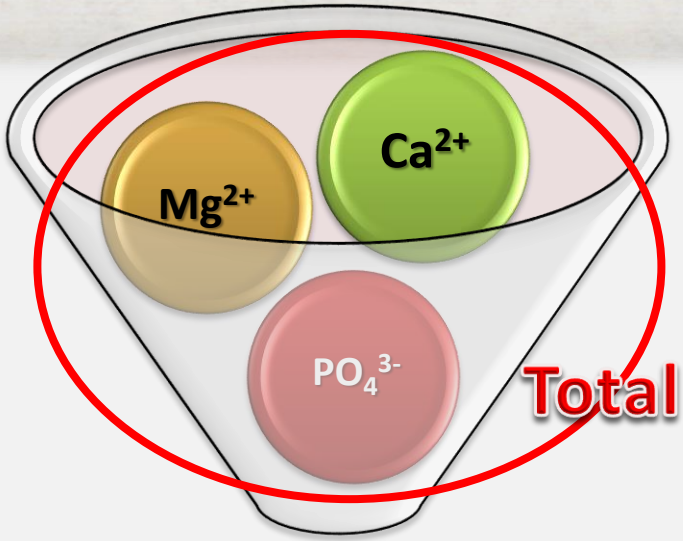


Cause of Odor!



Cause of Urine Scale Formation





Total Dissolved Solid (TDS)

Urine Scales

EXAMPLES OF URINE UTILIZATION

Urine Deserves More Attentions

I Used My Own Feces and Survived in Isolated Mars!

But you know what?

I Missed Urine!

Korean Recipe for Gunpowder Production

Choi Mu-Seon

Gun Powder = Mixture of Sulfur + Potassium Nitrate + Charcoal

Sulfur + **KNO_3** + **Charcoal**

Organic Matters in Soil

Mixture of Soil (Bacteria living in Soil) + Urine

$$NH_4NO_3\ (aq) + KOH\ (aq) \rightarrow NH_3\ (g) + KNO_3\ (aq) + H_2O\ (l)$$

Fertilizer in Soil

Available in Soil & Urine

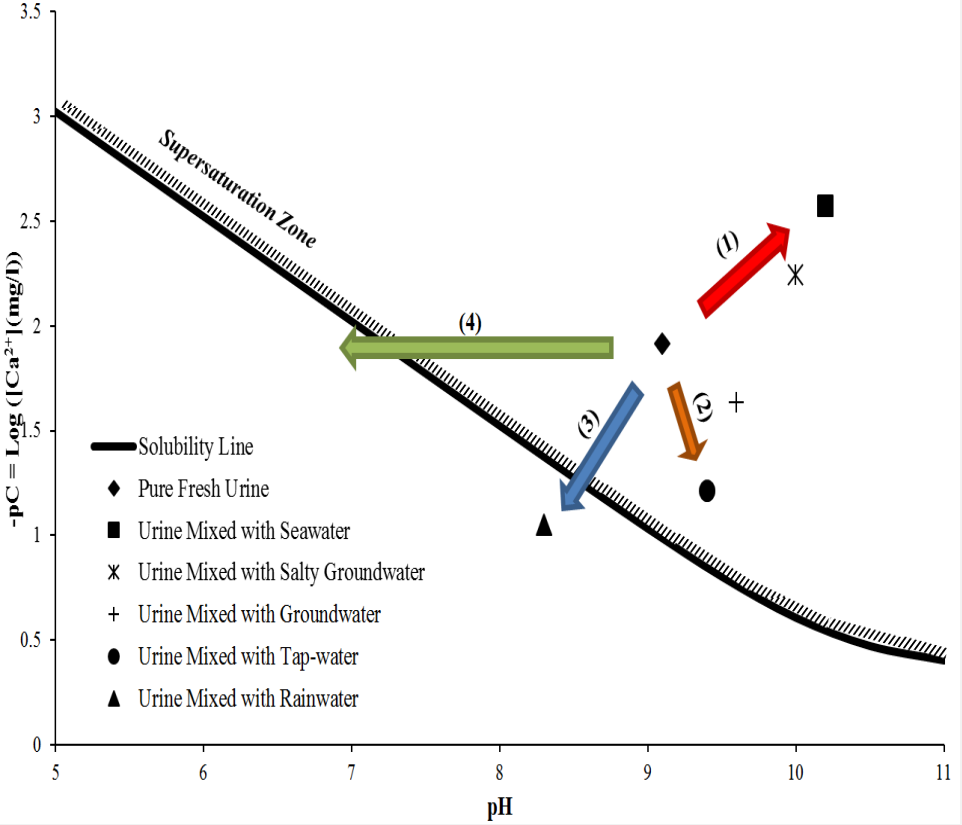
Potassium Nitrate (Goal)

Heat (Fire) to remove water, make KNO_3 Scale and Have Charcoal from Soil Organic Matters

Time to Change Toward Solving Urine Challenges!

PRACTICAL IMPLICATION

Rainwater is a Solution

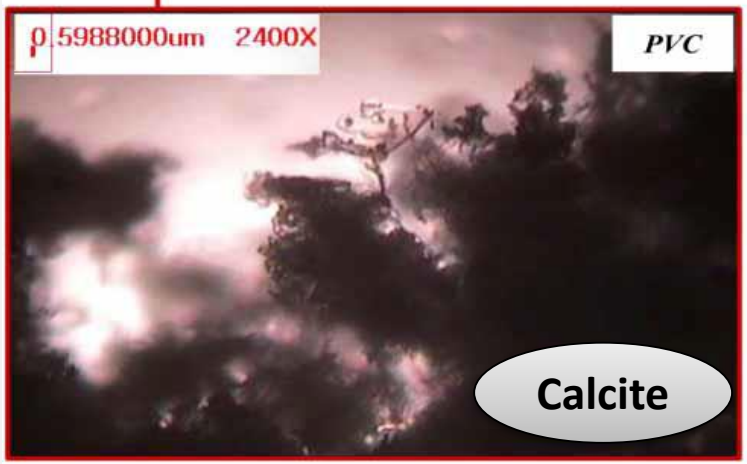


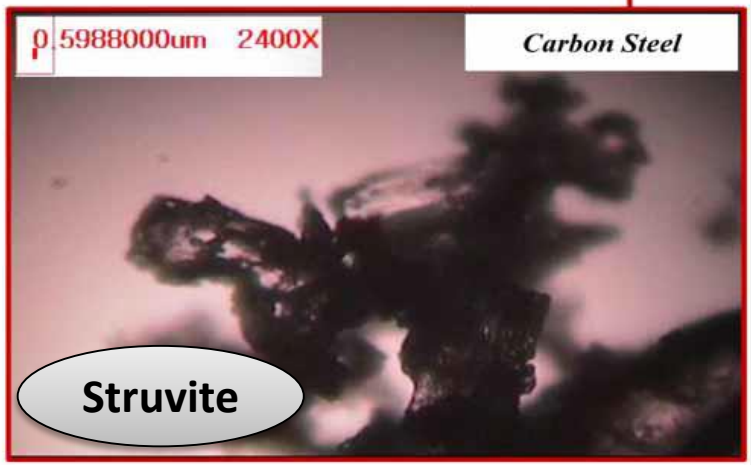
1. Do not use water with high TDS ***(Hong-Kong Practice)***.
2. Using Tap-water can help but too much water consumption is required.
3. **Using little amount of rainwater can solve the issue.**
4. Another solution is using acids which may not be suitable for pipelines.

Effect of Sanitary Ware Material

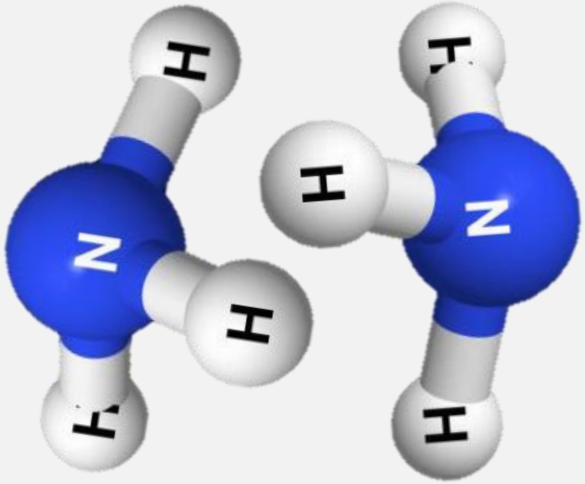
Less Scale

More Scale



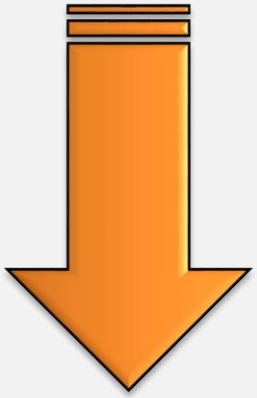


Odor of Urine and Flushing as a Solution



Ammonia (Cause of Urine Odor)

Flushing Water



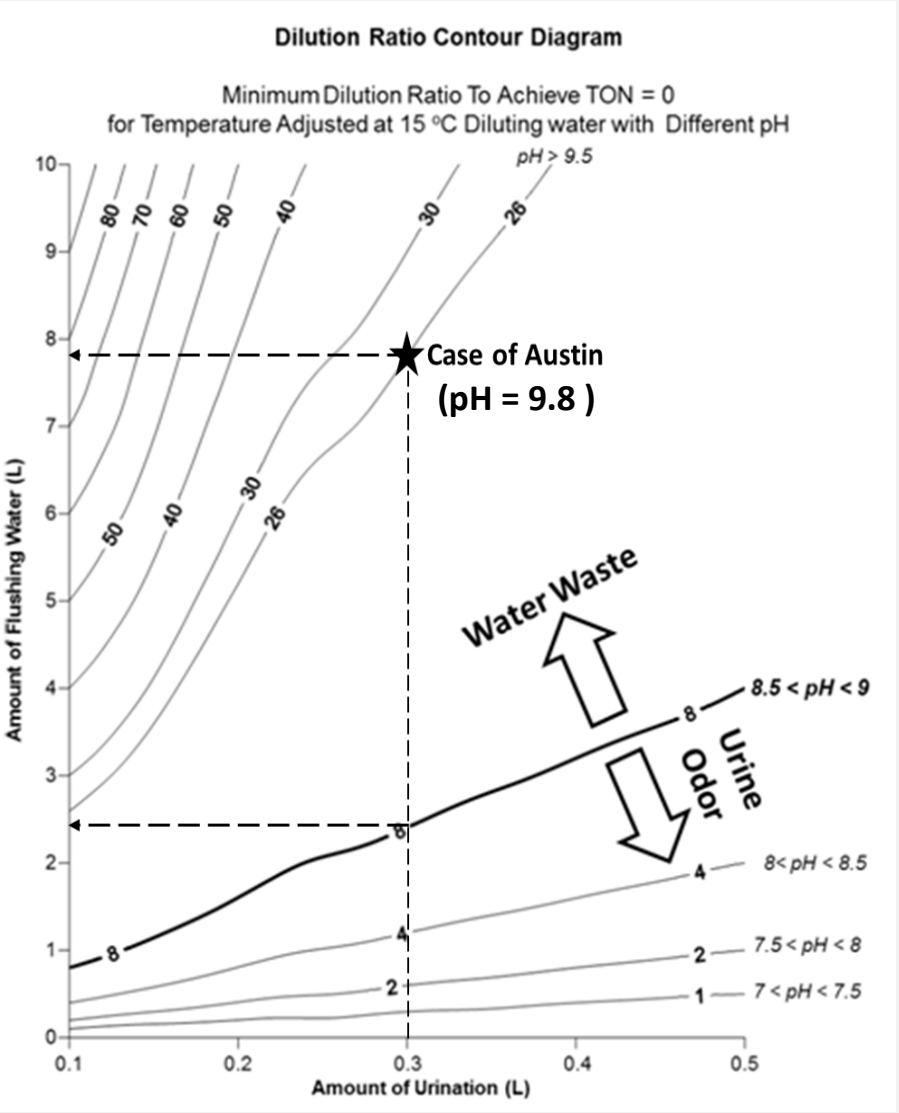
DOSE SUCH HIGH WATER CONSUMPTION REQUIRES?

Required Flushing Water for a Certain Amount of Urination

- The amount of flushing water should be corresponded to the amount of urination as well as characteristics of flushing water such as pH and temperature.

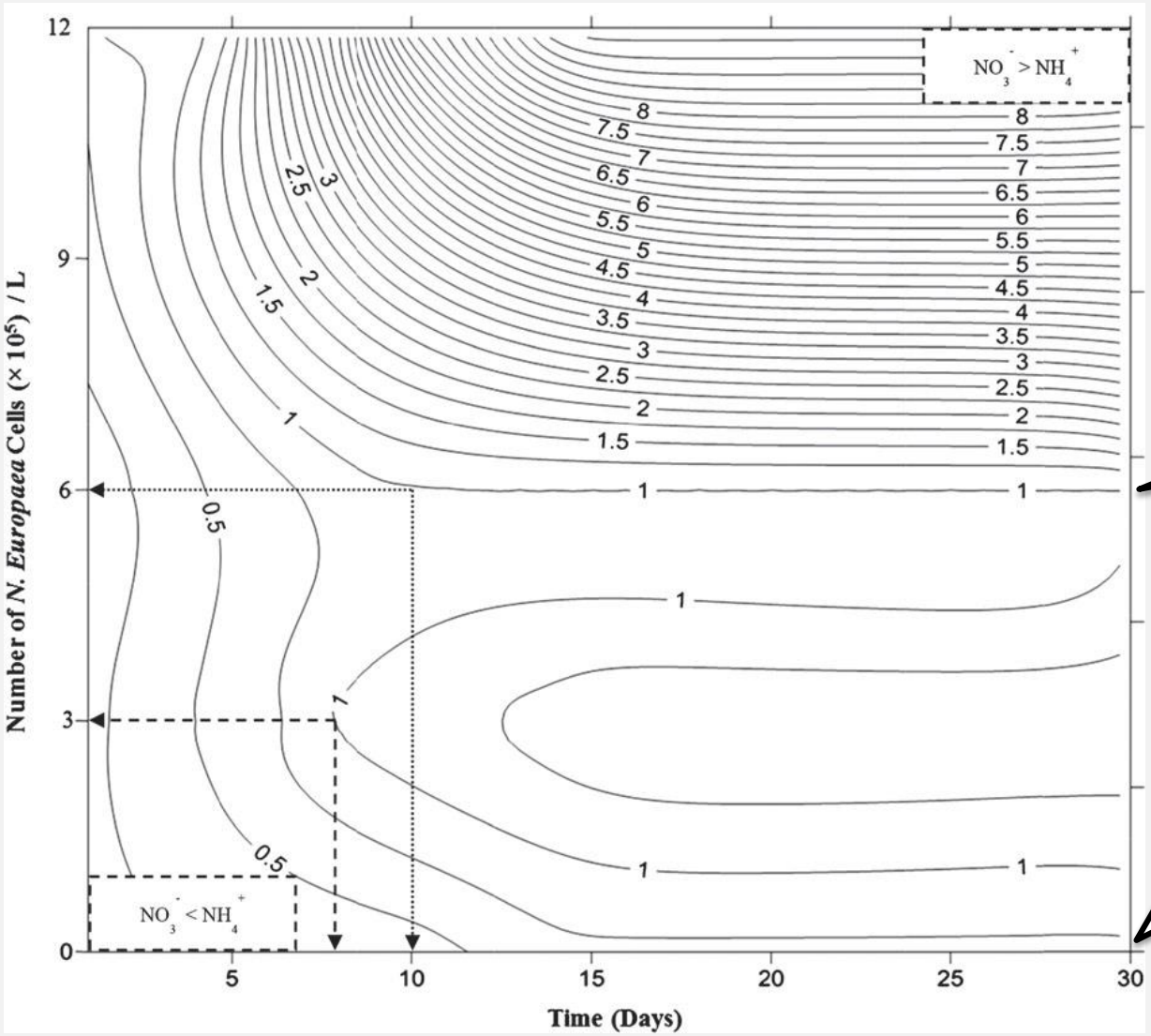
- For example if flushing water has 8.5 < pH < 9 with temperature = 15 ^{o}C, the dilution ratio should be 8 units of water for 1 unit of urine. More than this causes water waste and less than this causes odor.

- Water consumption can be reduced by using flushing water with lower pH. For example for case of Austin (pH = 9.8) the required dilution ratio can become a 4 times less if pH get adjusted to 8.5 ~ 9.

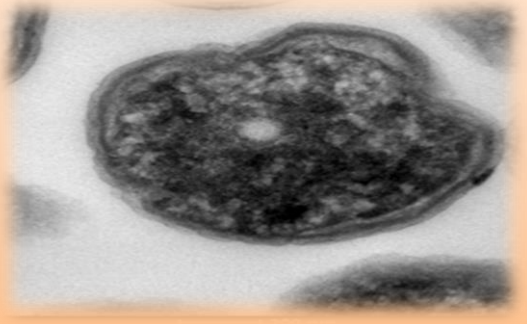


Recipe for Making Standard Organic Fertilizer

Condition of a Standard Fertilizer: $NO_3^- = NH_4^+$

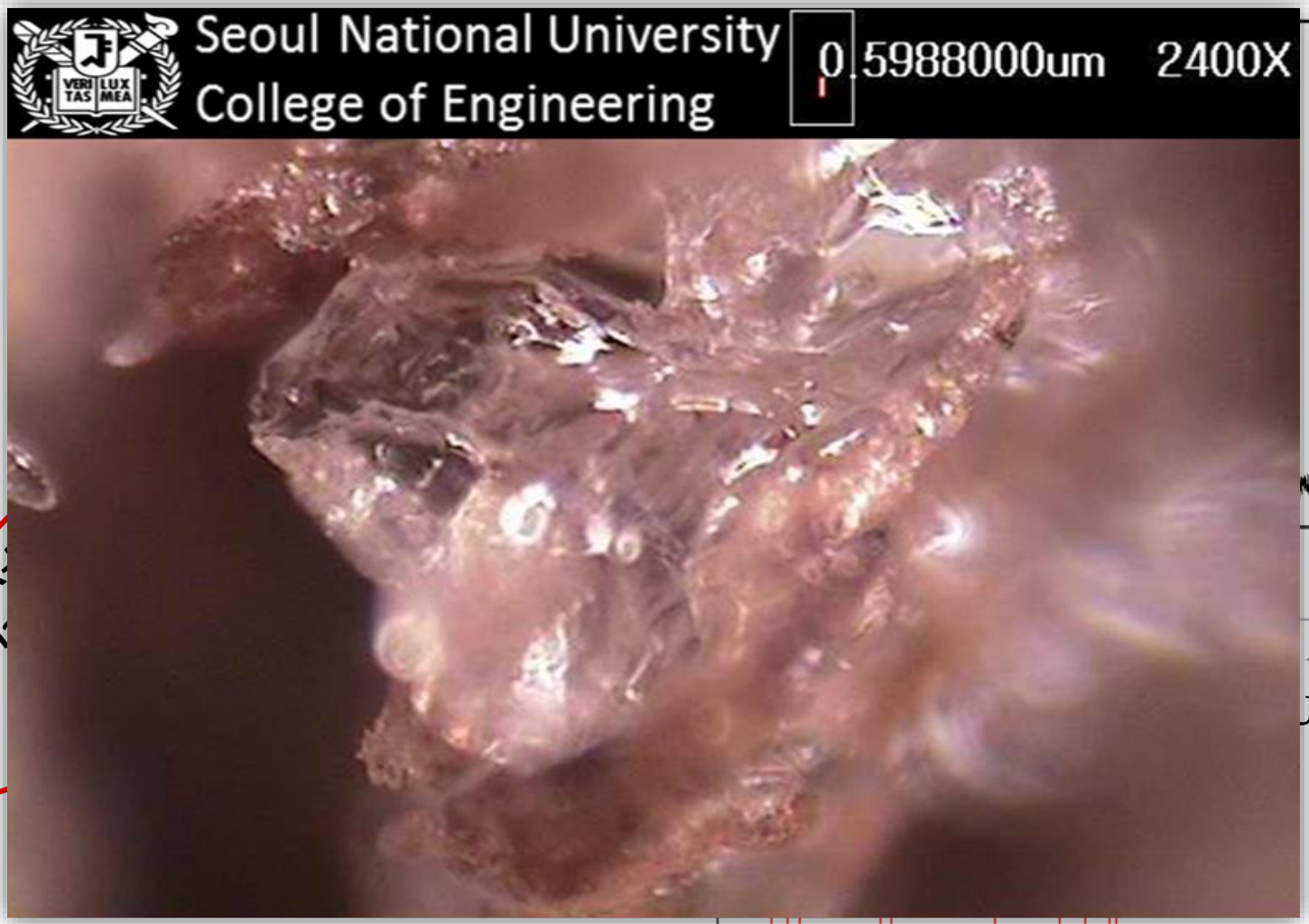


Improving Fertility Using *N. Europaea* Bio-Seeds



Case of Untreated Urine (오줌장군)

Harvesting Nutrients from Urine



Struvite Harvesting = Solid Fertilizer


Conclusion

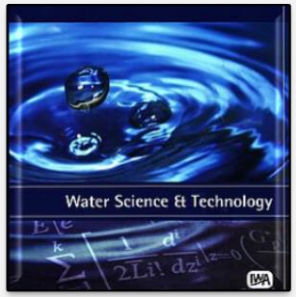
Conclusion

- By the advance of urine science, we can promote more to ROS by improving current problems and challenges in sanitation.
- Let's take SDG-6 seriously!
- We are at the beginning of the road ahead. More research is required in all aspects!

Related Publications

Hashemi, S., Han, M. and Kim, T. (2016), Optimization of fertilization characteristics of urine by addition of *Nitrosomonas europaea* bio-seed. J. Sci. Food Agric. doi: 10.1002/jsfa.7652

Hashemi, S., Han, M., & Kim, T. (2015). The effect of material and flushing water type on urine scale formation. *Water Science and Technology*, *72*(11), 2027-2033.



Hashemi, S., Han, M., & Kim, T. (2015). Identification of urine scale problems in urinals and the solution using rainwater. *Journal of Water Sanitation and Hygiene for Development*, *5*(2), 322-329.

FOR MORE INFORMATION, PLEASE VISIT OUR WEBPAGE

WWW.DRURINE.TK

Dr. Urine

How to Manage and Utilize

The Yellow Wine!


Thank You!