Microbial Degradation of Biodegradable Plastic Straws:

For Non-incineration Disposal of 10,000 Straws/Day in Kamakura



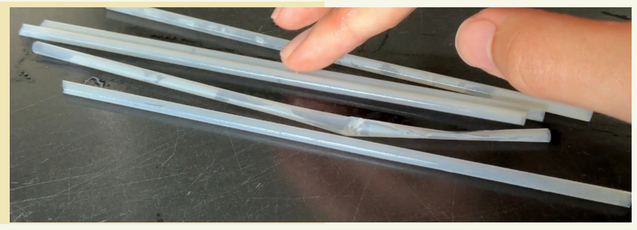
Figure 1 . 2-liter microbial degradation tank

ABSTRACT

Since the age of 9, I have been actively working to solve the plastic waste problem, and I have achieved a reduction of 10,000 straws. Through media and public talks, I have advocated for Kamakura city to transition away from plastic straws. Consequently, Kamakura city officially resolved to abolish plastic straws and adopt 100% biodegradable alternatives. However, despite this shift, these straws are currently incinerated as general waste instead of being biodegraded.
To address this issue, I conducted an experiment to completely biodegrade these straws into water and carbon dioxide, in collaboration with Dr. Miyamoto at Keio University.
In Kamakura, 10,000 straws are currently thrown away daily. Our goal is to decompose them with microbes to truely reduce plastic waste.



We used Kaneka's "Green Planet" biodegradable straws, which are designed to biodegrade in soil and water. While the official decomposition time is 88days, Dr. Miyamoto newly discovered a microorganism that reduces this to just 14 days. We carried out our experiment using this specific microbes.



EXPERIMENT① Time-Dependent Change in Straw Decomposition Rate

METHOD

【Materials】
- 50 straws
- Microbial degradation tank
- Microbials
- Microbials' Nutrition
- Air pump
- Water(2 L)

50 straws were placed in Microbial degradation tank(Figure 1);
Every 2days, 5 straws were sampled, dried, and their mass was measured. 5 straws were collected every 2 days, dried and weighed.

RESULTS

Decomposition ratio(%)＝［(Initial Mass)－(Final Mass)］÷(Initial Mass)×100

By Day 10: more than 80% had been biodegraded.
By Day 12: most of them had been disintegrated.
Unmeasurable due to degradation.(Figure 2, 3).

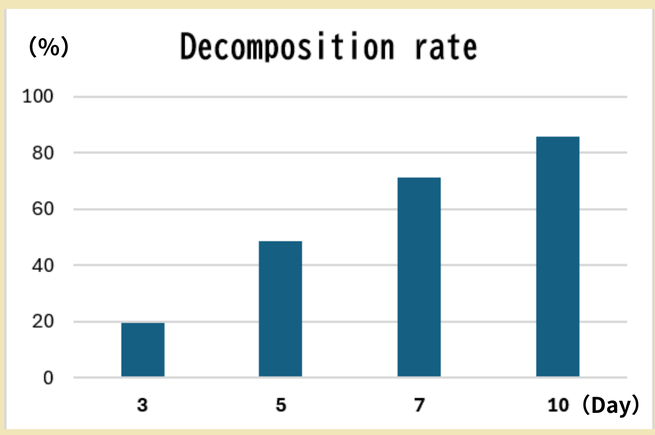


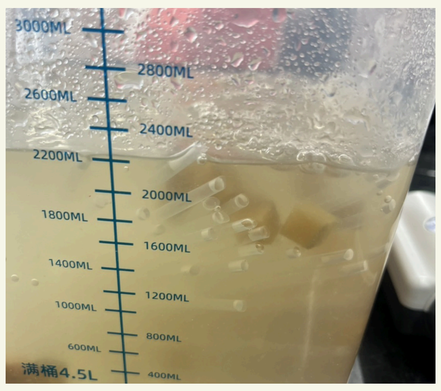
Figure 2 . Time-Dependent Change in Straw Decomposition rate



Figure 3 . Time-dependent change of straws

DISUCUSSION

50 straws biodegraded almost completely within 14 days.
We decided to continue the experiment with an increased number of straws on this scale in 2L tank.



EXPERIMENT② Comparison of Degradation Capacity by Straw Quantity

METHOD

To investigate the limits of degradation capacity, 50, 75, and 100 straws were placed in Experiment ① 's tank(Figure 4). After 14 days, their decomposition rates were compared.

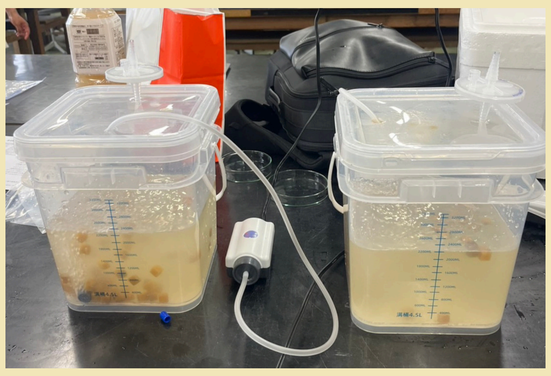


Figure 4 . Investigation into the limits of degradation capacity

RESULT

75 and 100 straws: The decomposition rates remained below 80% (Figure 5)

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It is found that degrading more than 50 straws is difficult at this scale. According to calculations, 60 straws is the limit, which was experimentally verified.

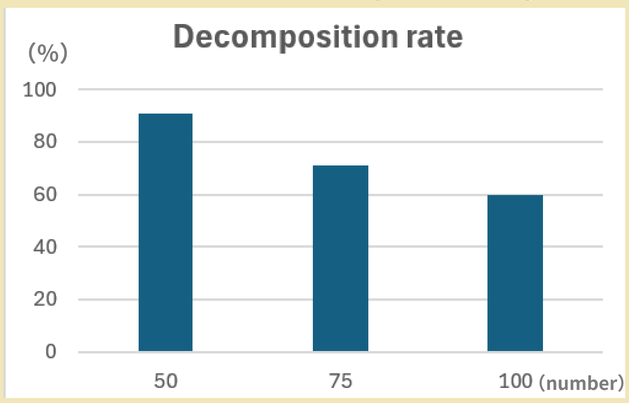


Figure 5 . Comparion of decomposition rates by straw quantity

DISCUSSION

Based on Experiment ②, 50 straws was determined to be optimal for a 2L tank. Theoretically, a 40L tank could biodegrade 1,000 straws. Currently, 1,000 straws are being collected in cooperation with a local junior high school, and the experiment will begin as soon as they are collected.

CHALLENGES

① We need to change the water and nutrients every 14days

② Odor generated during degradation

CONCLUSION

These biodegradable straws can be degraded within 14 days using microbial tank of this experiment.
Furthermore, we found that the optimal quantity of straws is determined by the scale of the tank.
As a next step, we aim to evaluate the effect of scaling up the experiment, using 1000 straws, on decomposition rate.

[References]
https://www.kaneka.co.jp/
https://miya-lab.jp



FUTURE WORK

Through this experiment, we hope to tell children the differences between plastic and biodegradable straws. Our target is to raise awareness about environmental issues and plastic waste problem among the next generation.

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Based on the results of these experiments, we aim to implement this straw degradation systems in public elementary and junior high schools. Our ultimate goal is to achieve non-incineration disposal of used straws.



Cooperation : Dr. Miyamoto, Keio University