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Personal Apartment Composting Bin

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Degree Project for Master of Fine Arts in Design, Main Field of Study Industrial Design, from Lund University, School of Industrial Design
Department of Design Sciences

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ABSTRACT

This project aims to explore the possibilities of living sustainable lives in urban environments. I focus my project on food waste composting in apartments. I collected interviews about the problems people had with disposing of food waste in their apartments, and by searching the literature to select the most suitable composting ways. I have studied and summarized the problems of current products through market research. When designing my own products, I have tried to solve and optimize these problems as much as possible. I finally design a device that can finish the whole composting process for people who live alone in apartments or other housing environment without a garden or backyard. Through this project, I discovered that sustainability can be seen as a healthy attitude to life. What designers can do is to guide users to practice this kind of life through products, and bring users more convenient and high-quality experience in the process of practice.

INSPIRATION

Family compost is always an environmentally friendly and economic thing to do when you have several family members and a garden or backyard. It can provide. It can provide rich and natural fertilizer to the plants in your backyard, and at the same time take away the troubles of handling food waste. However, for those who live in an apartment, composting may not be an easy thing to do. They don't have a huge space to support them in turning kitchen waste into fertilizer, or raising large areas of plants that need to be fertilized.

The food waste generated by each person every day is not much, but the total amount of these wastes is still quite alarming. The rubbish is piled up in the trash can at home or downstairs, and it has begun to decay and deteriorate before being collected. I hope to design a series of small composting and planting products for people living in apartments to solve a series of problems caused by food waste stacking.

RESEARCH BRIEF

The survey of this project is mainly divided into three parts:

· The first part is about the investigation of food waste. I need to figure out what problems the people living in the apartment will encounter when dealing with kitchen waste. Some data also needs to be collected, such as how much food waste is generated per person per day and what impact the decomposition of those waste will have on the environment.

· The second part is about the types and basic processes of composting, and selecting the most suitable method for composting in the apartment.

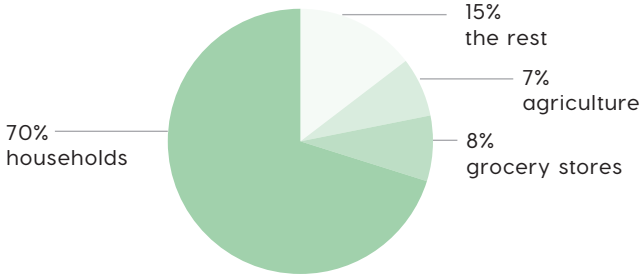
· The third part is to look for some of the problems that people encounter in growing plants in apartments currently, so as to provide some opportunities for product design.

BACKGROUND RESEARCH

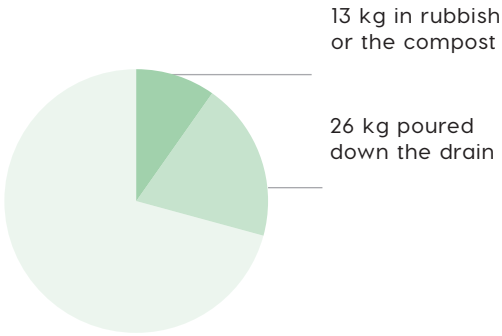
Food Waste Situation in Sweden

On average, in 2018 Swedes discarded 133 kilograms of food waste per person. Around the nation, more than 1.3 million tonnes of food waste were generated, about 4 per cent more than in 2016. The difference is mainly due to a new calculation method which reveals that grocery stores throw away more food than previously estimated. By comparison, households generate most food waste, 70 per cent. Grocery stores and agriculture that come in second and third places are well behind with 8 and 7 per cent respectively. Industrial kitchens, restaurants and the food industry account for even less.

According to the report, every year 13 kilos foodwaste end up in rubbish bags or on the compost heap and as much as 26 kilo per person is poured down the drain (SERI, 2020).



Sources of food waste

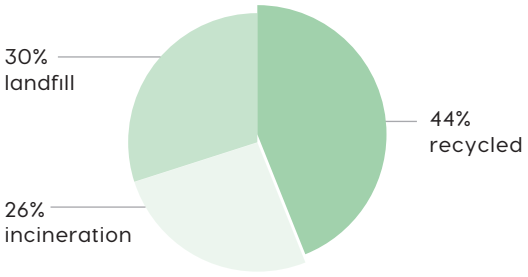


133kg foodwaste per person in 2018

From the report we can see that:

· Household life is the main source of kitchen waste
· Each person generates about 360g of foodwaste every day, but considering that this figure includes the amount of kitchen waste other than households, the amount of kitchen waste generated by each person's household life is about 250g per day
· In fact, only a small part of the kitchen waste is actually used for composting

Food Waste Impact towards the Climate and Environment



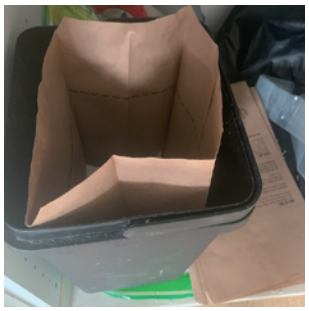
European Parliament, 2017

The way we dispose of food has a huge knock-on effect on the earth's delicate ecosystems. At an international level, the largest waste category is organic waste (food and green), making up 44% of global waste (Kaza, et al, 2018). Still today, much of the bio waste is not recycled or repurposed. Bio waste, and with that food waste, either us on landfills or is incinerated to make energy. On landfills, food decomposes and enters soil and air, severly damaging the environment and the surrounding communities. Incinerators on the one end may produce energy, but at the same time they also fuel a wasteful mentality in businesses and consumers, whilst also impacting people and the environment. These two options are most definitely the worst case scenario.

Food waste contributes to the emission of greenhouse gases.
Food that is thrown out often goes to landfills. As it rots in the landfill, it produces a greenhouse gas called methane. Greenhouse gases are emitted in the production and transportation of food as well. Cows that are grown as livestock produce methane. Emissions from the vehicles that transport food produce carbon dioxide.
Scientists believe that if we stopped throwing away food, we could prevent 11 percent of greenhouse gas emissions that are produced by the food system.

FIELD RESEARCH

I have always lived in the studio myself, without a garden or even a balcony. All my kitchen waste is thrown into a special trash can. When the trash can is full or starts to smell bad, I will throw away the garbage. The waste is brought to the housing's central waste disposal station and will be collected regularly by relevant companies. Most students live in corridor rooms. Although they use communal kitchens, the process of disposing of kitchen waste is similar to mine. In order to better understand some of the problems in the current handling methods, I interviewed some students.



foodwaste bin in studio

foodwaste bin in corridor

waste room

Interviews and Conclusions

The first interviewee lives in Spoletorp North, located in the center of Lund. He mentioned that although he lives in a corridor, he basically does not use a public kitchen, and all meals are done in his own room.

How often do you throw away the kitchen waste from your corridor?

I'm not quite sure, my own kitchen waste is poured into the drian. I think it will be poured once every two days, just a normal size trash can.

Is it almost full before pouring? Or strictly every two days?

Usually the trash can is filled in almost two days you know

Would you smell something awful if you were nearby?

Sometimes, sometimes the bag gets wet.

The second interviewee lived alone in Östra Torn's studio. Although she has a small appetite, she is keen on cooking. She mentioned that some food will accelerate decay.

How often do you throw away the kitchen waste from your studio?

Time is uncertain, I usually pour the trash can when it is full.

Will you smell something bad when you take out the trash?

I will.

And sometimes there is a slight mold underneath.

Have you noticed what kind of food is easy to smell awful?

Meat smells easily, and things with garlic go stinky fast, so does seafood.

Through these interviews, we can summarize the following points:

· No matter what type of room they live in, people generally tend to wait until the trash can is full before taking out the trash.

· Kitchen waste begins to rot long before the trash can is full, and the smell can sometimes make the trash bag damp or moldy.

· Some people are more inclined to flush the food waste directly into the se wer than to put the food waste in a bucket.

· Meat and some vegetables will accelerate the decay of food waste

Therefore, if people don't do anything about food waste but just collect it and hand it over to related companies, food waste will affect people's daily life quality and harm our natural environment.

RESEARCH ON COMPOST

Therefore, in order to prevent a series of negative effects caused by kitchen waste, composting with kitchen waste is a very good choice. Some common misconceptions of home composting are that it's too complicated, it'll smell awful, and it's messy. These are all true if people compost the wrong way. Luckily, composting the right way is quite simple: Just layer organic materials and a dash of soil to create a concoction that turns into humus.

However, there are many composting methods. Different types of composting methods have different requirements for the use of the site and the type of food. All I need to do is to find the most suitable composting method for indoor living scenes including apartments.

Traditional Composting

Traditional composting can be divided into two methods. The two methods introduced first are relatively similar, simpler and more commonly used. However, the food that can be broken down by these methods is limited, only including:

Fruit scraps, Vegetable scraps, Coffee grounds, Eggshells, Dry leaves, Finely chopped wood and bark chips, Shredded newspaper, Straw, Sawdust from untreated wood

If you add anything including meat, oil, fat, grease, diseased plant materials, dog or cat feces, weeds that go to seed, dairy products, it can make your compost smell bad and attract animals and pests. (BHG, 2021)

Cold Composting

Cold composting is as simple as collecting yard waste or taking out the organic materials in your trash (such as fruit and vegetable peels, coffee grounds and filters, and eggshells) and then corralling them in a pile or bin. Over the course of a year or so, the material will decompose.

- super easy
- super slow
- can be done at home
- limited kinds of food can be composted

It is not that suitable to use in apartment.

(William, n.d.)

Hot Composting

Hot composting requires you to take a more active role, but the return is that it's a faster process; you'll get compost in one to three months during warm weather. Four ingredients are required for fast-cooking hot compost: Nitrogen, carbon, air, and water. Together, these items feed microorganisms, which speed up the process of decay. In spring or fall when garden waste is plentiful, you can mix one big batch of compost and then start a second one while the first "cooks."

Combine the material

Water the pile

Stir up the pile

Feed the garden

(Marty, n.d.)

- easy
- not too slow
- need a garden or backyard
- limited kinds of food can be composted

It is not suitable to use in apartment.

Worm Composting

Worm composting is using worms to recycle food scraps and other organic material into a valuable soil amendment called vermicompost, or worm compost. Worms eat food scraps, which become compost as they pass through the worm's body. Compost exits the worm through its' tail end. This compost can then be used to grow plants. To understand why vermicompost is good for plants, remember that the worms are eating nutrient-rich fruit and vegetable scraps, and turning them into nutrient-rich compost.

- need to maintain regularly
- need to buy worms
- slow
- can be done indoor
- limited kinds of food can be composted

worm composting

Suitable for:
fruit or vegetable food waste, coffee grounds, filters, napkins, shredded paper towel, non- plastic teabags

Not suitable for:
fats, bones, dairy, meat, stems, onions, too much citrus, dog or cat feces

It is kind of suitable to use in apartment.

Bokashi Composting

Bokashi is a process that converts food waste and similar organic matter into a soil amendment which adds nutrients and improves soil texture. It differs from traditional composting methods in several respects. The most important are:

The input matter is fermented by specialist bacteria, not decomposed.
The fermented matter is fed directly to field or garden soil, without requiring further time to mature.
As a result, virtually all input carbon, energy and nutrients enter the soil food web, having been neither emitted in greenhouse gases and heat nor leached out (Footer, 2013).

Bokashi Bin

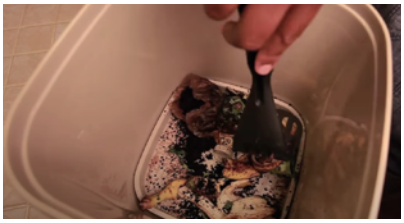
Now people mainly rely on Bokashi Bin to complete most of the Bokashi composting process. The Bokashi Bucket home composting system is an easy and clean way to compost all of food scraps including meat right at home. There are no foul smells and no mess. People can turn their waste into superfood for their garden, lawn or house plants, while playing a crucial role in reducing landfill waste.

However, food residues processed in bokashi buckets actually need to be buried in the soil for a while before they can become fertilizer.

bokashi bin

Using Process

Add a 2" layer of food scraps to the Bokashi Bucket. We can add food scraps as we make them or collect your daily food scraps (in a shopping bag or container) and add all at once.



Use the smasher tool to smash down the food scraps into an even layer. This helps to make room for more and also reduces air pockets.

Sprinkle a handful (approx 2-3oz) of Bokashi Activator Mix on top of 2" layer of food scraps. Use more Bokashi Activator Mix when adding meat, fish, cheese or egg and in hotter weather.

Carefully seal the lid to make sure the Bokashi Bucket is airtight. This will ensure no air gets in and the right conditions for anaerobic (no oxygen) fermentation are in place. Not doing so could result in a stinky bucket.

Every 2-3 days, drain the bokashi bin. The liquid that comes out is primo plant food. We call it "Bokashi Tea". To use the Bokashi Tea, dilute it at 2-3oz per gallon of water and apply to soil or spray on plants.

Once bokashi bin is full, the fermented (half-composted) food scraps need to be mixed with the soil to finish off the composting process. In about 4 weeks, we will have nutrient-rich compost ready to plant in.

- not too easy
- quicker than tranditional way
- can be done at home
- all kinds of food can be composed
- can be smelly

It is suitable to use in apartment. But the process is still incomplete.

Cross-Contrast

	Cold Composting	Hot Composting	Worm Composting	Bokashi Composting
Space Required	small place indoor	A few square meters outdoor	small place indoor	small place indoor
Food Types	fruit or vegetable food waste, coffee grounds, filters, napkins, shredded paper towel, non- plastic teabags	fruit or vegetable food waste, coffee grounds, filters, napkins, shredded paper towel, non- plastic teabags	fruit or vegetable food waste, coffee grounds, filters, napkins, shredded paper towel, non- plastic teabags	almost all kinds of food
Equipments	a pile or bin	a garden or backyard, water, shovel	a box, worms,moist newspaper strips	Bokashi bin, Bokashi activator mix
Operation Difficulty	super easy	easy	need maintaining regularly	need maintaining regularly
Time Required	a year	half a year	3-6 months	1-2 months
Advantages	easy and cheap	easy, get more fertilizer	faster process	fastest process, all kinds of food
Shortages	too slow, little fertilizer	slow, need outdoor space	need to raise worms	need to buy equipments, SMELLY
Conclusion	If you want to compost indoors, you must use some methods and devices to speed up the composting process. In comparison, the traditional composting method is more suitable for farms that have large sites and require a lot of fertilizer. If you want to compost in an apartment, worm compost and bokashi compost are recommended. If you want to use meat and other food residues for composting, bokashi composting is the only option			

MARKET RESEARCH

Based on the previous research, I can basically determine that the product I want to design uses bokashi composting. Because bokashi composting requires an anaerobic environment, the styles of bokashi bins on the market are relatively simple. I found three main products on Amazon for analysis of competing products.

Product Analysis

Name: SCD Probiotics All Seasons Indoor Composter
Price: $56.95
Dimensions: 12*12*18 Inches
Volume: 22.7 Liters
Material: plastics

This is the most common and cheapest compost bucket on the market. The shape of the cuboid is suitable for placing against the wall. The large capacity is suitable for family units with more than three people. The disadvantage is that the materials are not environmentally friendly and the entire composting process cannot be completed.

Name: Growing Organic Indoor Bokashi Composting System
Price: $65
Dimensions: 12 x 12 x 14.5 inches
Volume: 22.7 Liters
Material: plastics

The structure and price of the second product and the first product are similar. The design of the cylinder saves material and is more suitable for use on the ground. The black barrel can increase the temperature in the barrel and speed up the composting process. The shortcomings are the same as the first paragraph. The composting process cannot be completed completely, and the materials are not sustainable enough.

Name: TeraGanix Bokashi Organiko Composter Kit
Price: $120
Dimensions: 34 x 24.5 x 24.5 cm
Volume: 9.6 Liters
Material: recycled polypropylene (PP)

The third product and the first two products are quite different in structure, capacity, and price. The capacity of about 10 liters is more suitable for two to three people. This product simplifies the design of the faucet, so when you want to drain the liquid in the bucket, you need to lift the bucket, which is not as convenient as the previous two products. The main reason why this product is more expensive is the simple and novel shape and environmentally friendly materials. Like the first two products, this bucket cannot complete the entire composting process.

Conclusion

· The bokashi bin styles on the market are relatively simple, all of which are barrel-shaped designs. Pour into the kitchen waste, the liquid flows out from below
· The difference in product prices mainly comes from the difference in materials used. Recyclable materials are more expensive
· None of the bins on the market can complete the entire composting process, and the kitchen waste still needs to be buried in the soil after the fermentation is completed.
· The capacity of these buckets is too large, if one or two people use it, the entire composting cycle will be very long

RESEARCH ON HOUSEPLANTS

After completing the research on composting, understanding some of the conditions required for the growth of indoor plants can help people make better use of the fertilizer that is made from kitchen waste. The growth of plants is affected by many factors. I mainly focus on the factors of soil and nutrients (MasterClass, 2020).

Learn to recognize when houseplants need water. The goal is to provide your plants with enough water to keep the soil moist but not soggy

Be aware of temperature, humidity, and ventilation. In general, houseplants require a level of humidity similar to that of their natural growing conditions.

Ensure that your houseplants get the right amount of light. All plants need light energy for photosynthesis, but different houseplants require different amounts of light.

Select a pot that fits your plant. When choosing a pot, make sure to consider its material, size, and drainage capability. Use a pot that's proportional to your plant's current size

Use the right potting soil. A high-quality potting soil will help plant roots grow by providing the ideal balance of nutrition, aeration, and water absorption.

Use fertilizer to supply nutrients. To achieve sustained, healthy indoor plant growth, regularly replenish the nutrients in the potting soil. In general, fertilize your houseplants once a month when they're growing or flowering.

Product Analysis

After understanding some of the basic factors that affect the growth of indoor plants, I interviewed some people who are or have been growing indoor plants, and selected two representative ones.

Chen, female, 23 years old
Chen lives in a studio apartment of about 20 square meters in Delft, Netherlands. She mainly likes to grow some succulents. She has been planting for about two years.

I remember you would grow plants in your dormitory when you were undergraduate.

Yes, but in fact they always died in weeks.

Have you thought about the reasons in soil and fertilizer aspect?

I basically only watered them. I was too busy studying, I didn't have time to fertilize and change soil, and there was no flower shop nearby to buy fertilizer.

By the way, my mother regularly transports soil from the village to raise the plants at home, and the plants in my house can live for a long time.

Peter, male, 34 years old
Peter lives in a single apartment of about 40 square meters in Lund, Sweden. He prefers to grow some leafy plants. He has been planting for about seven years.

I heard that you have some plants in your apartment and they are growing very well

Yes, but it actually takes a lot of effort.

Do you regularly fertilize plants or change soil.

Approximately once or twice a month, the fertilizer is applied, and the soil may be replaced once every six months, or when the plants look wrong.

Have you considered using kitchen waste as fertilizer?

I used to dump the food waste on the soil, but it got bugs and it smelled bad.

Conclusion

The interviewees had some similar experiences and problems when growing home plants. The following points can be summarized.

- Some people think that buying fertilizer and soil is a hassle, comparing with getting some water. Buying less fertilizer is not enough, but buying too much takes up too much space.
- Changing the soil or applying fertilizer to ensure the nutrients of the soil is easier to be overlooked. Some people think that water and sunlight are enough.
- Pouring food directly on the soil attracts insects and become stinky.

For many reasons, people don't often fertilize plants, which leads to poor growth or death of plants. This provides opportunities and possibilities for the products I want to design. I hope that my product can help people to easily obtain fertile fertilizer at home to fertilize plants, and at the same time save the trouble of disposing of plant waste.

Fertilizers

Putting aside the fact that people don't like to use chemical fertilizers often, chemical fertilizers themselves will have a certain impact on the environment, especially when they are overused. The impacts mainly include the following two points.

(Penn, n.d.)

Groundwater pollution :

Nitrate leaching through the soil can present a serious health hazard and contributes to soil acidification. When high rates of nitrogen are used or where clover grass pastures fix substantial nitrogen, especially on sandy or permeable soils, inevitably some nitrate is leached and may enter groundwater if there is a watertable (Savci, 2012). If this groundwater is used for domestic supplies, the leaching presents a serious health hazard.

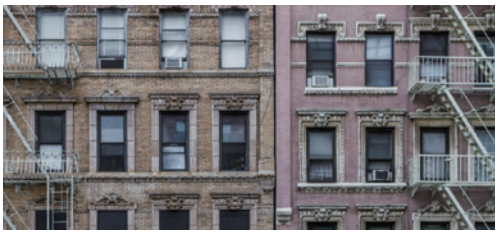
(Jennifer, 2006)

Eutrophication:

Eutrophication is the enrichment of water by the addition of nutrients. The extra nutrients encourage the growth of algal blooms, particularly in stagnant water. Blue–green algae may produce toxins poisonous to animals, including humans. Phosphorus may be introduced into waterways in run-off from pasture, forests and fertilised land, and in drainage from irrigated land and urban areas (Savci, 2012).

DESIGN DEFINITION

Design a device that can finish the whole composting process for people who live alone in apartments or other housing environments without a garden or backyard.



Apartments in Sweden

(Visualspace, 2019)

APPLICABLE PLACES

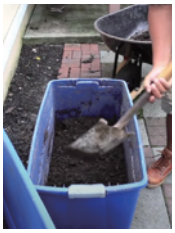
In high-rise buildings without backyards or gardens, such as apartments. It is not recommended to use in the case of shared rent, because it will be smelly sometimes.

TARGET GROUP

For people who live in urban areas and like to raise houseplants.

SITUATION ANALYSIS

bokashi bin



soil bin

So nowadays, people who live in apartments without a garden or a yard want to do composting, they need to buy a bokashi bin and a soil bin to finish the whole compost process. There are three main points that are inappropriate. The first point is that the capacity of these containers is too large. If one person lives and cooks, he can actually not produce so much food waste, and he does not need so much soil for planting plants. Second, the living area of an apartment is usually limited. These barrels cover an extremely large area and affect people's lives. Third, digging in an apartment is a difficult task, and it may make a mess.

Problem 1 : The volume of bokashi bin is too large for one person

The capacity of barrels on the market is generally too large, ranging from 10L to 15L. According to my previous research, the average amount of food waste generated by people is about 250g per day. For individuals, it takes a long time to fill a bokashi bucket, which will make the entire circulatory system of composting and planting extremely long, which is not suitable for individuals to grow small plants.

Problem 2 : Those bins take up too much space

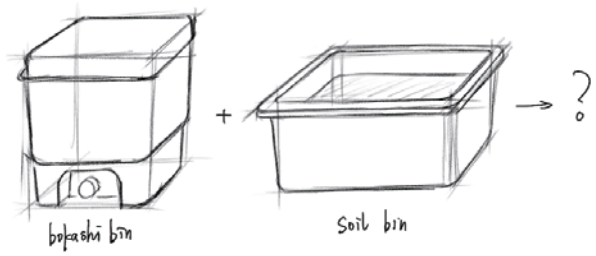
Larger capacity means larger volume, which is undoubtedly a bad thing for users who live alone in apartments. If you live in a corridor room or studio, your activity space is limited, and there is hardly much extra space for people to store these vats. If it is stored forcibly, the living space will become very crowded.

Crowded living space

Problem 3 : It is not easy to bury food waste in soil in apartments

In the small space of an apartment, burying kitchen waste in the soil is not an easy task. You need to divide the soil into two parts, pour the kitchen waste on one part and cover it with the other part of the soil. You can drop dirt on the floor of the originally tidy kitchen or living room or even the bedroom and make everywhere messy and dirty.

DESIGN PROCESS

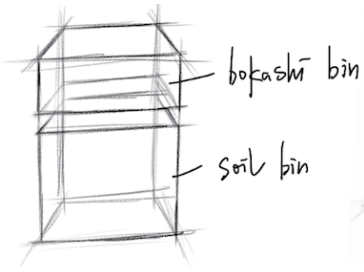


My initial idea was to integrate Bokashi bin and soil bin into one product, and make some adjustments to make it fit my design definition.

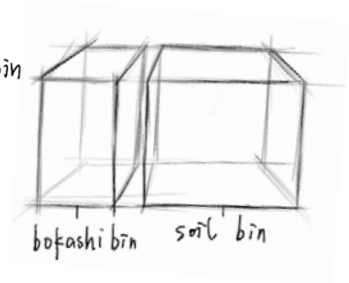
In detail, I need to reduce the size of the product to make it suitable for one or two people, and at the same time fit the limited space indoors; at the same time, make some changes in some details to make the entire composting process easier and simpler.

Brief Structure

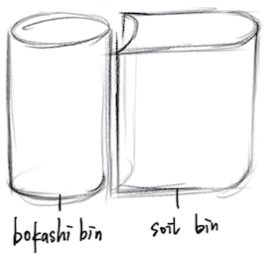
There are many ways to combine two products. They can be stacked vertically or combined horizontally, or they can be made into different geometric bodies to fit together.However, considering the characteristics of the product I want to design, production cost and other factors, I don't have many choices. Below I have listed the most basic combinations.



a.Inappropriate



b.Appropriate



c.Inappropriate

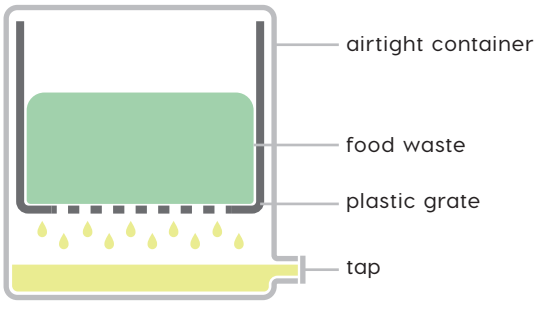
d.Inappropriate

a. Combining the two bins up and down can save floor space, but the height is definitely higher for indoor furnishings. The shape of the bokashi bin would be inappropriate. Moreover, it is very inconvenient to separate the two barrels and stack them together when using it.

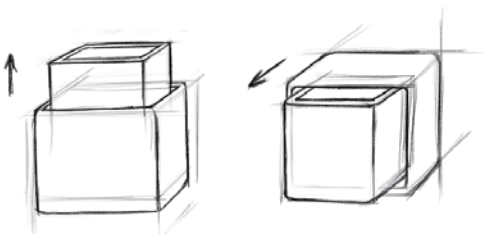
b.It is most appropriate to arrange the products horizontally. Many indoor appliances are in the shape of a lying rectangular parallelepiped. Such a product is suitable whether it is placed on the table or on the floor. The left and right separated structure also makes the use of the two barrels independent of each other.

c&d. Although the shape of the cylinder can save material or increase the capacity, correspondingly, the shape of the other barrel fitted with it will be very irregular. Such a shape is difficult to produce, and food and soil are also easy to remain in the gap, which causes troubles to the product experience.

Bokashi Bin



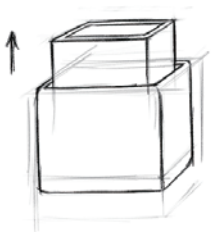
The structure of the bokashi bin is not complicated. A container that can be sealed, a plastic grid that allows liquid to drain, and a tap that allows liquid to flow out can achieve all functions.



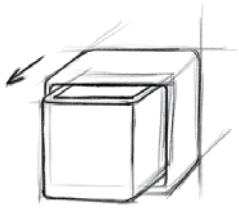
two potential ways of opening the bin

There are two ways to open the airtight container, one is to open from above, the other is to open from the front.

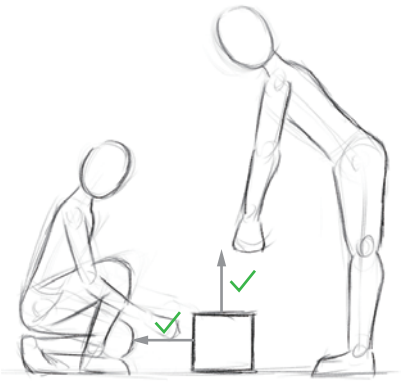
All bokashi bins sold on the market use the first method, but this method is not necessarily suitable for the use scenario of the apartment. I also need to make specific comparisons based on usage scenarios and ergonomics.



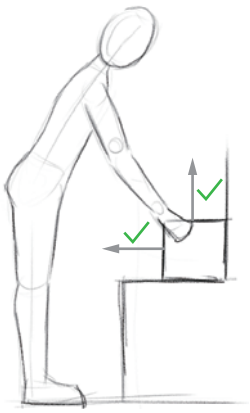
This method of opening the container is most often applied to the structure of bins and buckets. The structure of such a product is simple and straightforward.



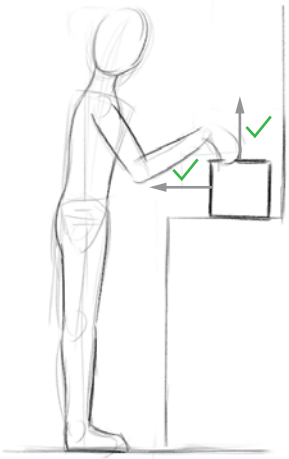
This method of opening the container is most often applied to the structure of drawers. This structure is more complicated, but the space above the product will not be affected



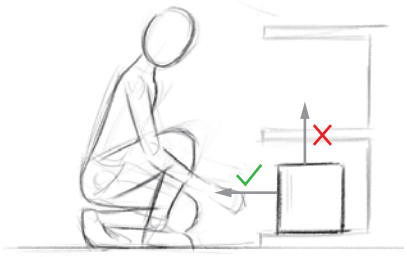
on the ground



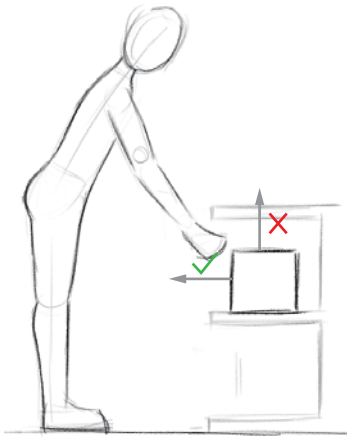
on the windowsill



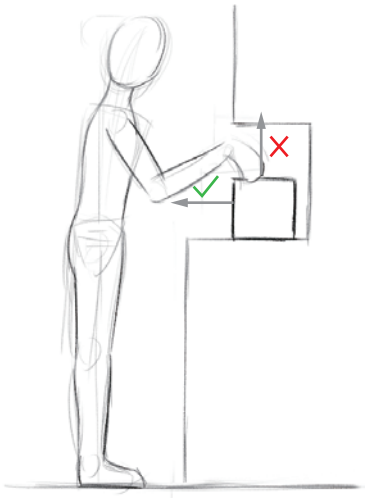
on the table



on the lower shelf



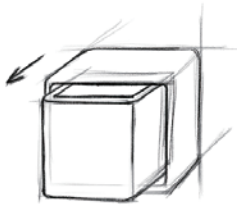
on the middle shelf



On the table under the cabinet

In open space, there is almost no difference between those two methods of opening the container.
However, in some common indoor environments, the way to open the container from above is greatly restricted. For example, the table tops under shelves or wall-mounted cabinets, there is not enough space above these for easy operation. Unless the user removes the bin from the shelf while using it. This is actually the reason why drawers are often used for indoor storage.

Conclusion



Based on the above analysis, I think it is more appropriate to apply a drawer-like structure to the bokashi bin. Such a structure is more suitable for indoor space. Of course, this also has the disadvantages that the structure is more complicated and the cost is more expensive.But I decided to design this way first, and then consider whether there is a way to simplify the construction and reduce the cost.

Soil Bin

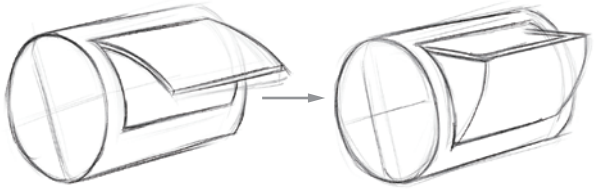
If the soil bin is placed outdoors, it is a simple container with a lid, and there is nothing to improve. But if you are indoors, any activity on the soil may be messy, especially when mixing food and soil evenly. Imagine that if you want to mix two objects completely in a container, shaking or rotating the container while keeping the container sealed is the best choice. I also want to apply this method to the soil bin in my product.

(O_Lypa, 2016)

These products have achieved the function of easily mixing the contents evenly through the horizontal barrel structure. If I apply this structure to the soil bin, the steps of mixing food and soil will become simple and clean

Large Dual Chamber Compost Tumbler, 37 Gal.Tumbler Composter, Tierra-Derco 50 Gal. Compost Tumbler

Structure Adjustment



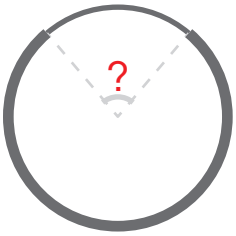
common structure　　new structure

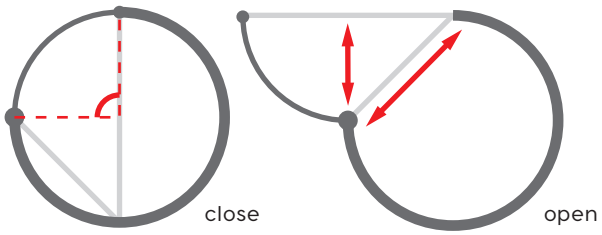
These products are used outdoors, so they are very large. If I want to apply this structure to the indoor soil bin, how to open the bin becomes very important. If the opening is too small, it will be difficult to pour food waste in and dig out the soil. I want to make some changes to the existing roller structure to make it more consistent with the use process of small-volume products. It can be seen from the figure that the improved structure can be easily used even when the space above is restricted.

on the ground　　on the middle shelf　　On the table under the cabinet

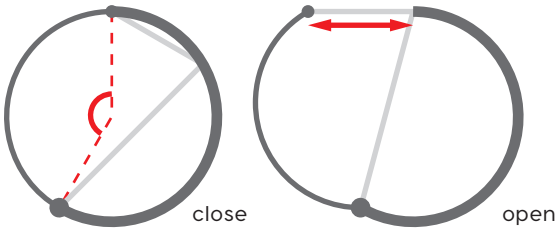
Structure Details

In the new structure, the arc and angle of the opening become very important. If the arc is too small, the opening will become very narrow, making it inconvenient to pour food waste in and take out the soil. If the arc is too large, the soil bin will become difficult to operate and the production cost will also increase. Therefore, the opening with a moderate angle and arc can make the soil bin easy to use.



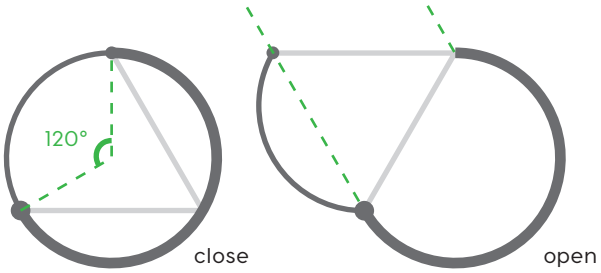


when the arc and angel are too small



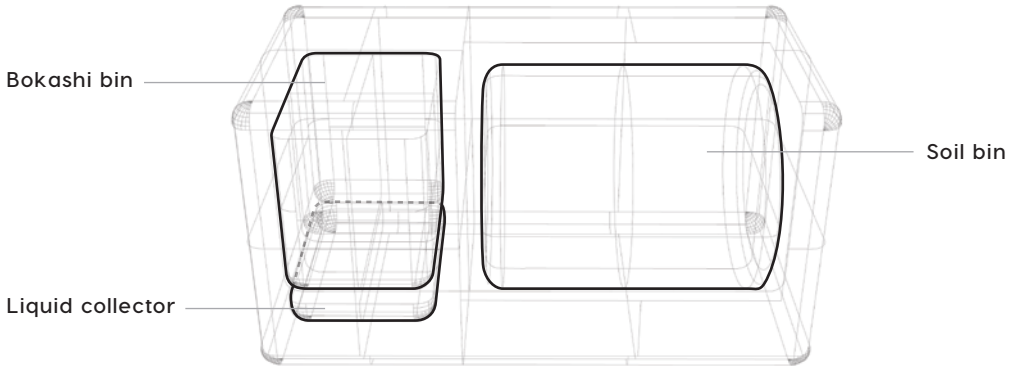
when the arc and angel are too large

when the arc and angel are too small, the open space will be too shallow. Users have to pour in food waste in small quantities many times. And it is hard to touch the bottom of soil bin, making it inconvenient to get the soil out of the bin. When the arc and angel are too large, the opening will become too narrow, also causing inconvenience.



After calculation, the opening of the cylinder at an angle of 120 degrees is the most comfortable angle for the user to use. The space of the opening is large enough and the depth is deep enough. It is no longer difficult for users to add things to the bin or take things out of the bin.

Structure Conclusion



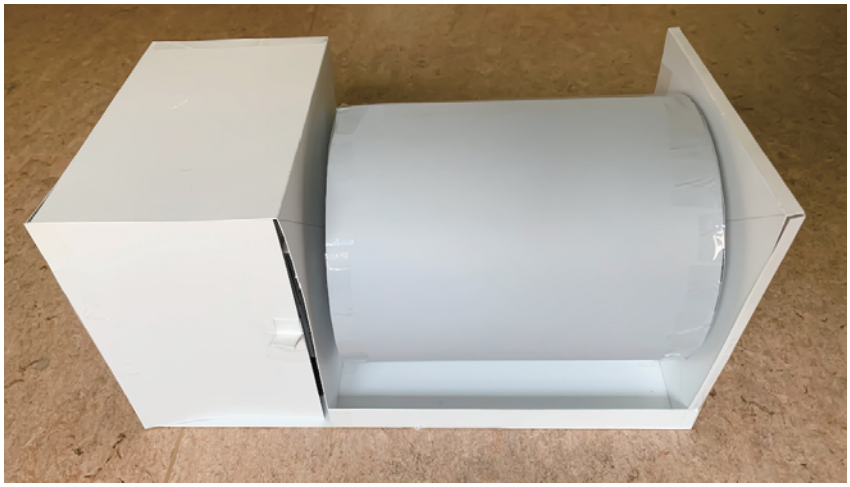
As shown in the figure, the basic structure of this product is divided into two parts, bokashi bin and soil bin. The volume of the bokashi bin is about 5l, which is more suitable for one or two people. And compared to the current way of opening from above, I chose the way of opening from the front which has been adapted to the use environment of the apartment. The liquid collector below can collect the liquid produced in the fermentation for watering the plants.

On the right is the soil bin, which is a horizontal cylindrical structure. The capacity is about 15L, which is 3-4 times that of a bokashi bucket. This ensures that there is abundant soil for composting the kitchen waste. This bucket mixes soil and kitchen waste by rotating.

Improvement Conclusion

- Reduce the size of bokashi bin and soil bin and combine them together so that food can be turned into fertilizer within one or two months to meet the needs of single-person farming of small plants
- Make the product as square as possible and have a drawer-like structure. In this way, people can put the products on various cabinets and shelves for easy storage and use.
- Make the soil bin into a horizontal cylinder. In this way, people only need to pour the kitchen waste and turn it around, so that the soil and kitchen waste can be mixed evenly.

Model Test



add the food waste

pour out the liquid

pull the food waste in soil bin

close the soil bin and rotate it

use the soil when composting is finished

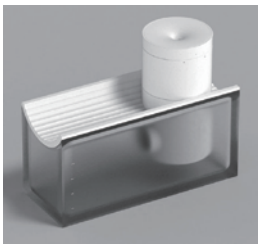
On the windowsill

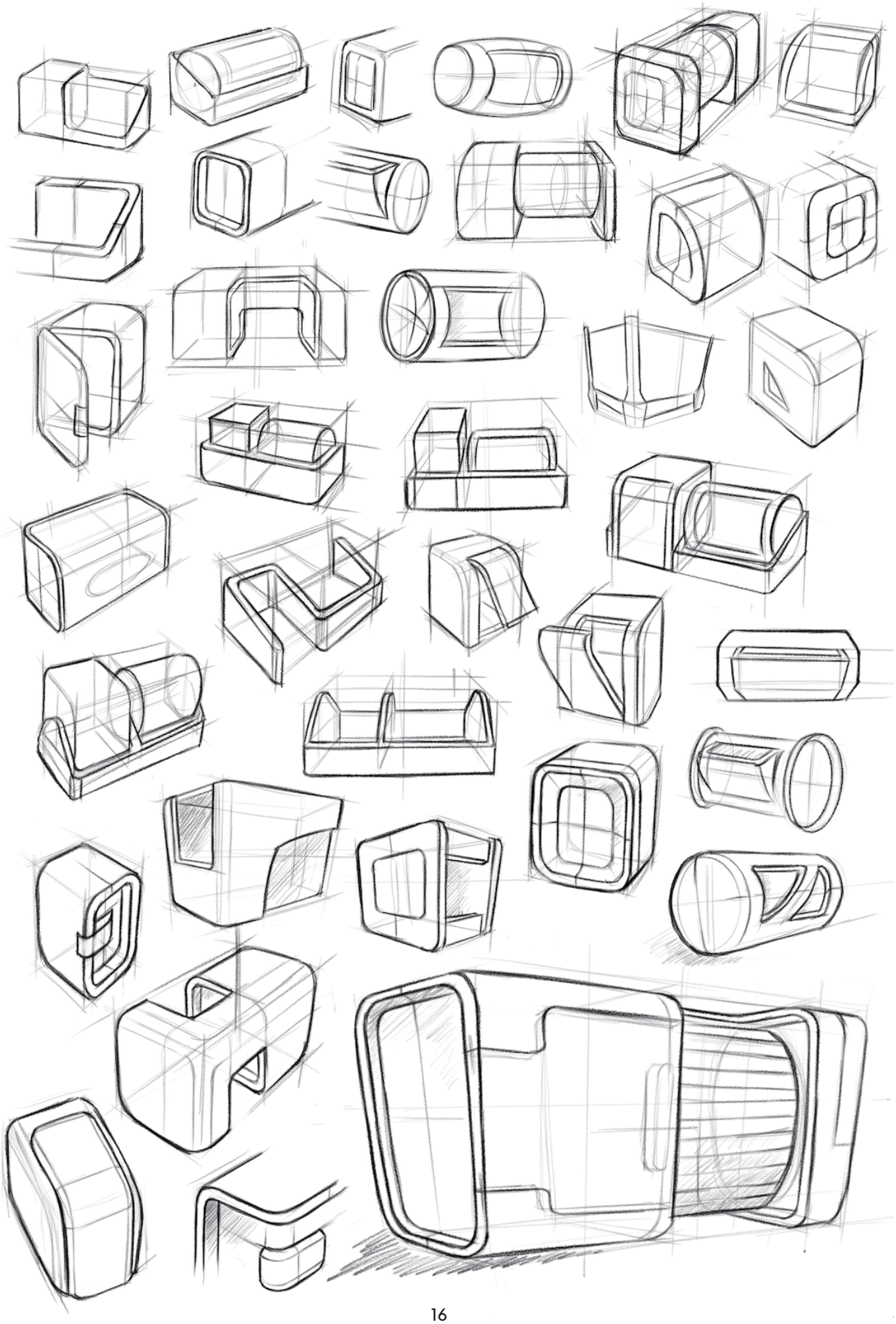
On the shelf

In the kitchen cabinet

on the table

Mood Board

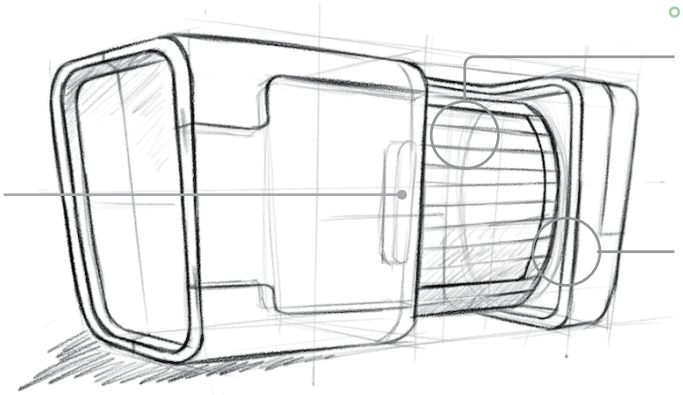




User Interfaces

Bokashi Bin

The structure on the left is crowded. If I add some extra buckles, the rotation and opening of the soil bin will be affected, so no additional interface is designed on the door of the bokashi bin.

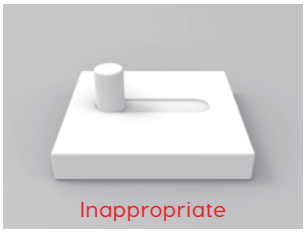


Soil Bin

The soil bin needs an interface to control the opening and closing.

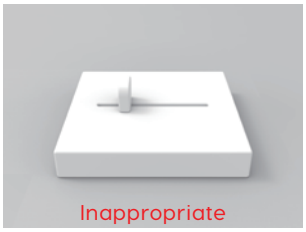
Another interface is needed to keep the soil bin stuck when people open the soil bin for operation to prevent it from spilling soil due to rotation.

In summary, there are two places where the user interfaces are needed. In order to ensure product consistency, I want to ensure that the two interfaces are designed in the similar or the same way. The following step is to try different forms of physical user interfaces.

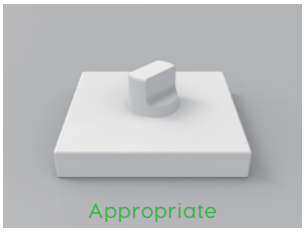


Physical interface that often used on home appliances with differents gears.The internal structure is a bit complicated and not suitable for my product

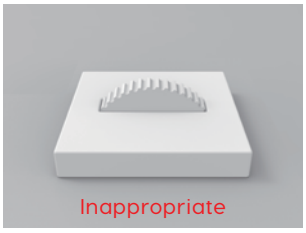
A switch that slides left and right is usually used to control lights or home appliances. Suitable for use as a switch to control the rotation of the soil bin, but not suitable for the switch of the soil bin itself.



Physical interface that often used on music products, suitable for finer adjustment. Totally inapproriate for my product.



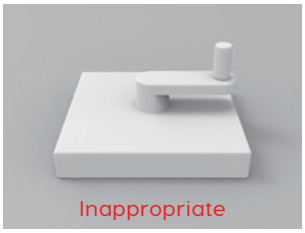
Common knob, small and simple in structure, which can control the switch and adjust the gear position. Very suitable for my product.



Physical interface that often used on lighting products, suitable for finer adjustment or linear change. Inapporiate for my product.

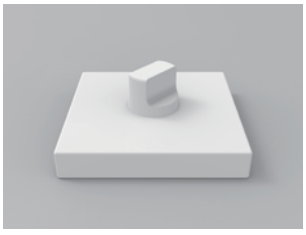
The most common switch, only appropriate for controlling on and off. Usually used on electric products. Inappropriate for my design.

Physical interface that often used on home appliances with different gears like lighting products or washing machines. Unsuitable for my design.



Structure that can save strength. Originally suitable for the rotation design of the soil bin. However, the size of the product itself is large, which violates the original intention of my product design.

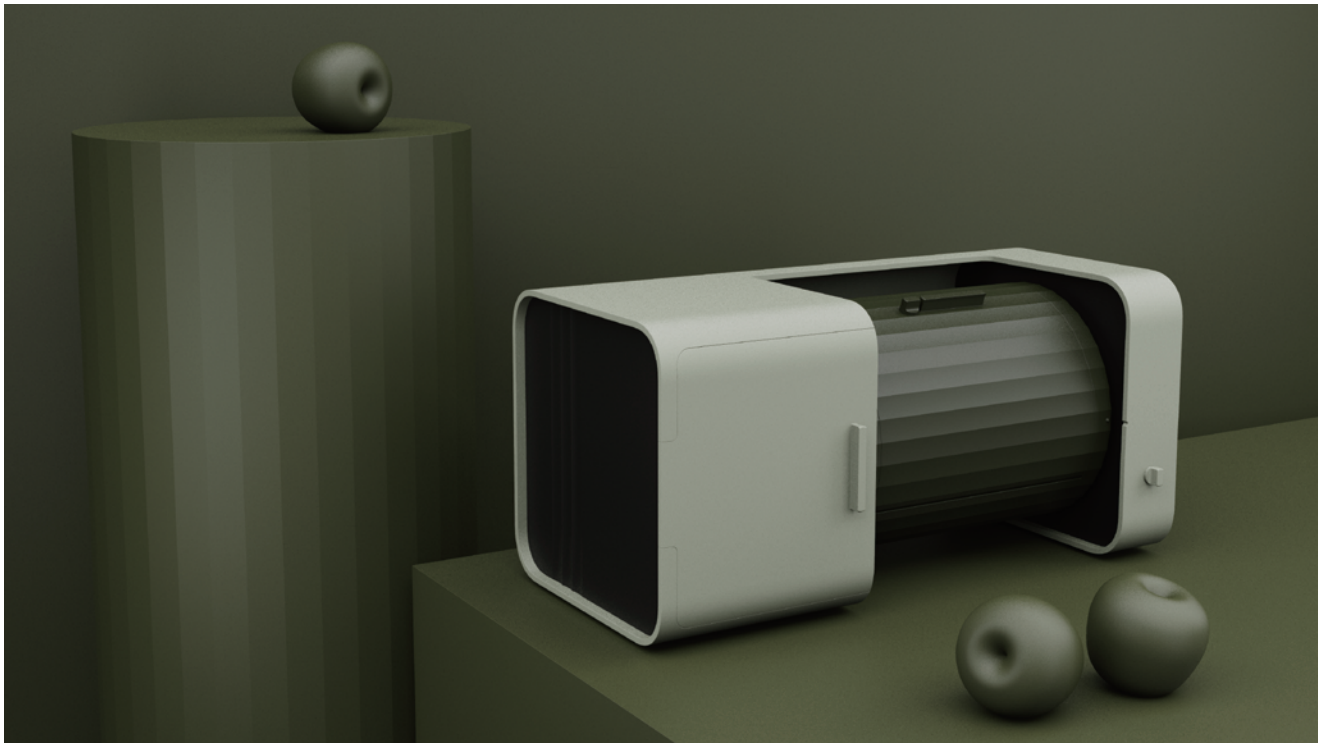
Conclusion



Based on the above analysis, if I want two physical interfaces in the same shape and meet the users' need, knobs are the best choice. There are two knobs, one for controlling the opening and closing of soil bin, another for controlling the free rotation of soil bin. According to the size of human finger, the diameter of these knobs is about 20 mm.

PRODUCT

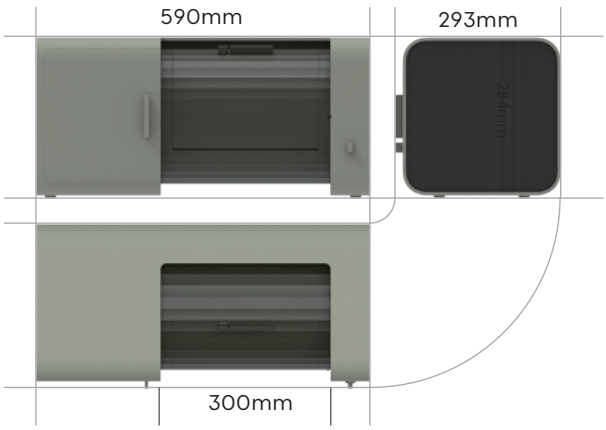
This is the final product. I use green as the main color cause the composting itself is an eco-friendly thing to do. And soil bin need dark color to absorb the heat to accelerate the composting process. Black is the best. But I just make it a little bit green to meet the whole color series.

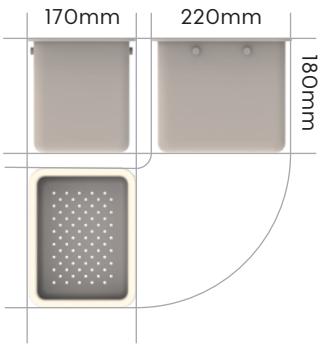


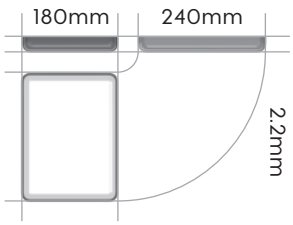
Structure

This is the product when it is fully opened. Food waste bin can be removed from the slides easily. Convenient for people to pull out the food waste and clean the bin itself. Soil bin can be open widely for people to operate.

Size



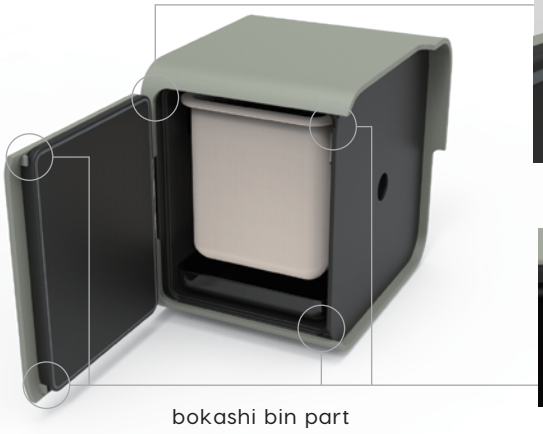




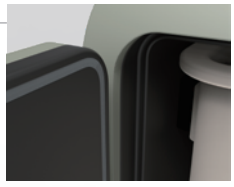
The volume of food waste bin is about 5l and soiled bin is 4times bigger than that. It wouldn't produce so much liquid so the volume of liquid collector is not that matter. I just don't want the liquid to drop on the inner surface of the product.

Details

First the bokashi bin part. It need anaerobic environment so I add silicone strip to prevent air from getting inside the bin through the gap. And I add some protrusion and depression on the edges to ensure that the door closes tightly. Stainless steel slides make it easy for user to pull in or draw out the food bin waste. And they are durable enough to handle a bin filled with food waste. There are some holes in the bottom of the food waste bin. The liquid produced the fermentation will flow down and be collected. If the liquid stay in it, the whole process can go wrong.



bokashi bin part

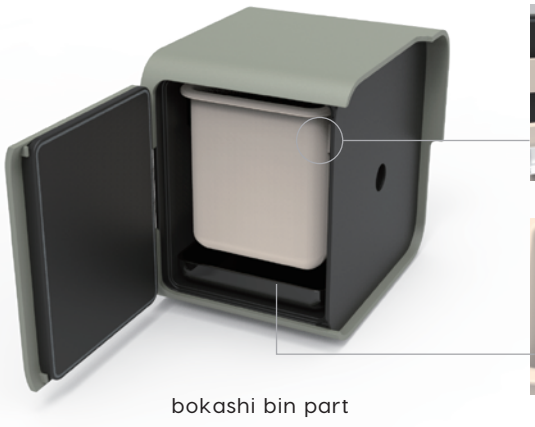


Silicone Strip

Bokashi composting requires an anaerobic environment, so the silicone strips and protrusions on the edge of the door will fit tightly when the door is closed, preventing oxygen from entering the bin from the gap.

Protrusions and depressions

The protrusion and depression of the door edge can ensure that the door closes tightly.



bokashi bin part

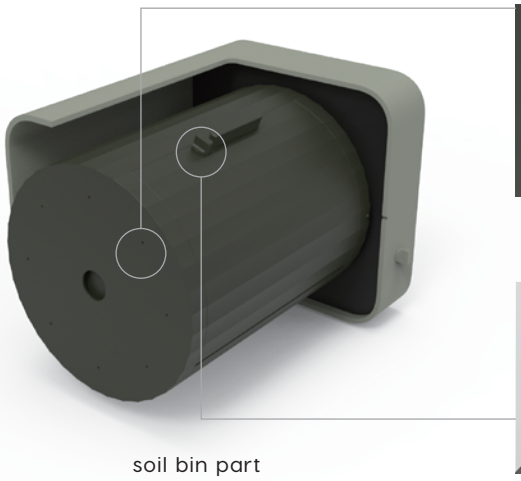
Slides

Slide rails make it easy to take in and out of the food waste bin. Stainless steel is durable and can withstand heavier weight.

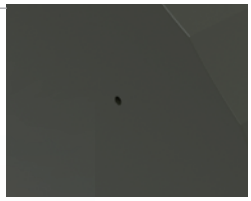
Holes

There are small holes in the bottom of the food waste bin. The liquid produced during the fermentation process will flow from them to the liquid collector below. If these liquids do not flow out in time, the fermentation process will go wrong.

The second part is the soil bin. There are air holes in the both side of the soil bin, cause unlike the bokashi process. This one need air. And this knob make sure the soil bin stay closed. You don't want the soil to spill out everywhere when rotating. All the angles about the soil bin is decided based on the users' experience. It is always placed much lower than users. Those angles will make it easy for users to pour in the food waste or take out the soil. And You don't want the soil bin still capable of rotating when you open the soil bin for further use. So this is what the second knob is designed for. It can rotate out a metal bar to stick the bin from moving. And I also add a little dot and a recess to form a reference about the right angle to lock the soil bin.



soil bin part

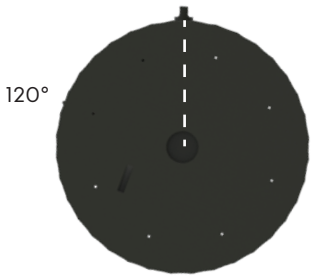


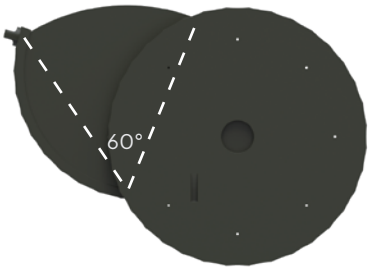
Air Holes

The kitchen waste that has been fermented in bokashi bins is buried in the soil and continues to be composted. This process requires oxygen.The holes on both sides of the bucket ensure the oxygen required during the composting process.

Knob

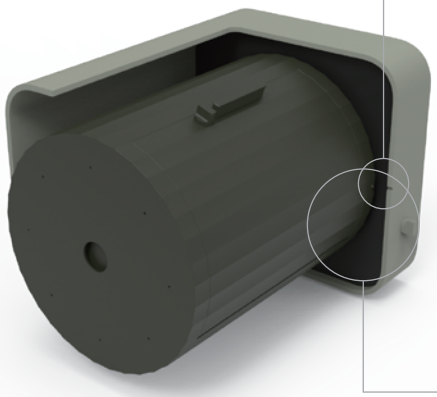
The knob on the soil bin ensures that the bin will not open when it is rotated





Angles

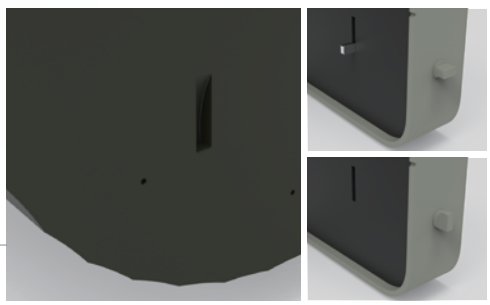
Although the soil bucket can rotate freely, when you open it for further use, angels can still inflence the using experience. The whole product is placed on the ground or on the table. Those angels will make it easy for people to add food waste in the soil bin or take out the soil.



soil bin part

Reference

The protrusions on the edge of the barrel and the recesses on the edge of the shell form a reference. When the two are closest, the user knows that the bucket has turned to a position suitable for opening.



Knob No.2

There is a groove in the right side of bin besides the air holes. When the knob is turned horizontally, a metal bar will be rotated out to stick the soil bucket in that groove and prevent it from turning.

Material

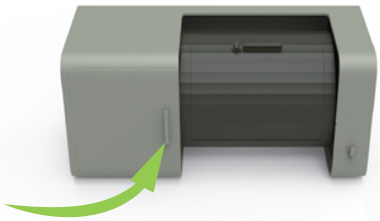
- Polypropylene

In addition to the aforementioned silicone strips, stainless steel slides, and metal objects such as axels and screws, the main material of this product is polypropylene. It is a kind mechanically rugged material and has a high chemical resistance. So it is tough enought to deal with food waste and soil.

Using Steps

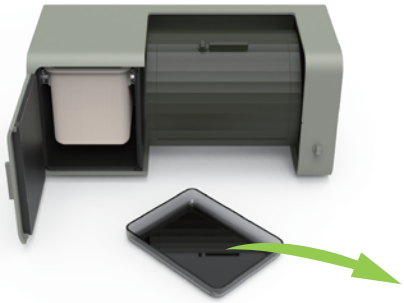
- STEP 1

After each meal, add the kitchen waste to the bokashi bucket and sprinkle with an appropriate amount of activator mix.



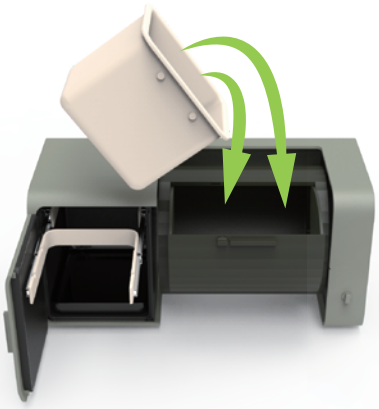
- STEP 2

Always remember to close the bokashi bin to prevent air from getting inside.



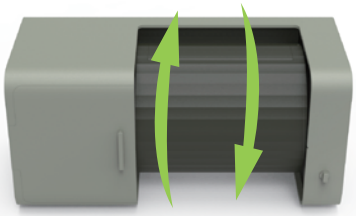
- STEP 3

Pour out the liquid from liquid collector every two or three days. It can water the plants after diluted.



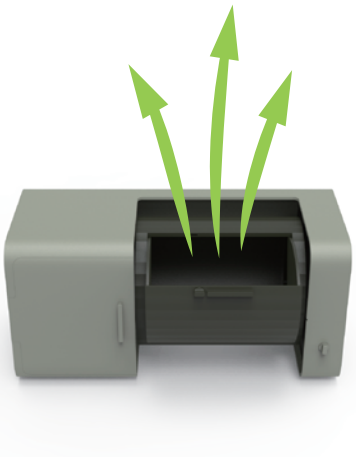
- STEP 4

Once the bokashi bin is full, add the food waste into the soil bin to mix with the soil.



- STEP 5

Remember to rotate the soil bin once every one or two day to mix the soil with food waste better and let air in.



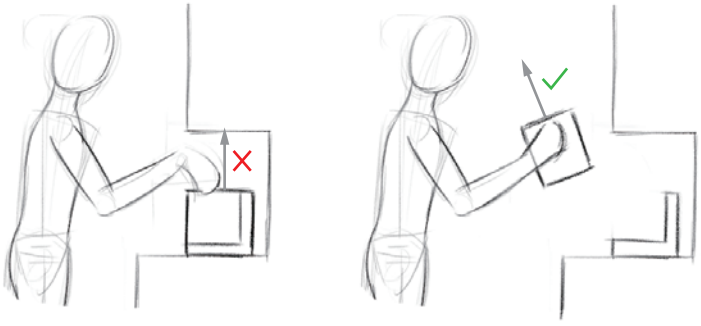
- STEP 6

After one month, the soil is already rich in nutrients. Use it to feed your plants.

REFLECTION

After the presentation and some rethinking, there are obviously some points that need improving about this product. I designed the drawer structure to meet the different using scenarios. However the drawer structure leads to so many problems including the production cost and poor space utilization. The drawer structure needs metal slides and extra material to achieve the function, which means more cost in producting. All those slides and inner container also take space. That is the reason why the product is huge but its actual volume is much smaller.
Also, the physical interfaces seem to provide conveniency. For the same reason, it is not worthy to spend much more money for such a litte improvement on user experience. And with these delicate structures, it takes more effert to maintain or repair the product.
I need to simplify the product while keeping the funcions.

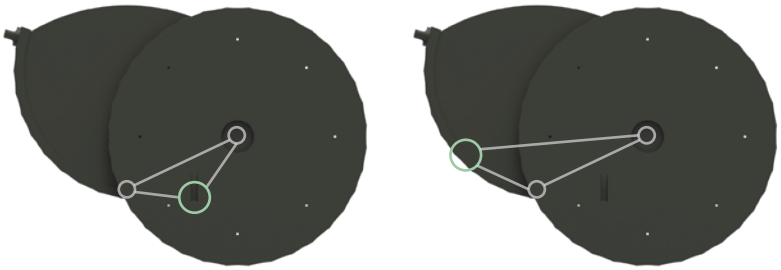
About two ways of opening bokashi bin



As I mentioned before, I used to think that opening bokashi bin like a drawer could let product fit into more using scenarios. But as a product for indoor composting and planting, production cost also plays an important part.

Products can be placed and used in different places, at least some parts of the product can. So I decide to use typical bokashi bin structure. And if bokashi bin can seperate from the whole product easily, the problem of insufficient space above the product will not exist any more.

Delete the physical interfaces



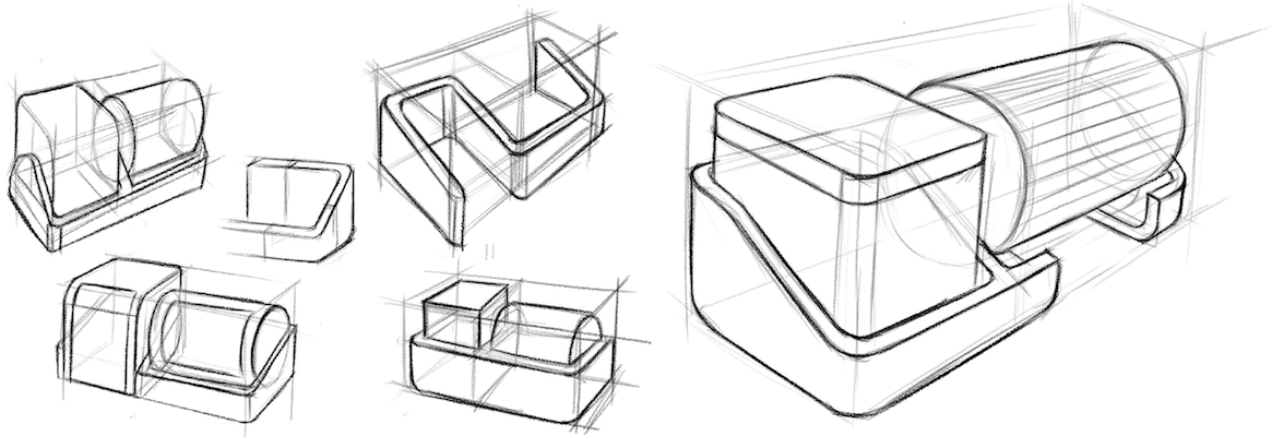
old three fixed points

new three fixed points

Physical interfaces also improve a litte user experiences with much higher cost. So I delete it. Physical interfaces used to exist in order to close the soil bin and create the third fixed point to make soil bin stuck.
In theory, the third point can achieve this function anywhere in the soil bin. So I try to fix the soil bin door this time. If the door of the soil bin is stuck with an external structure, the soil bin also can't rotate freely.

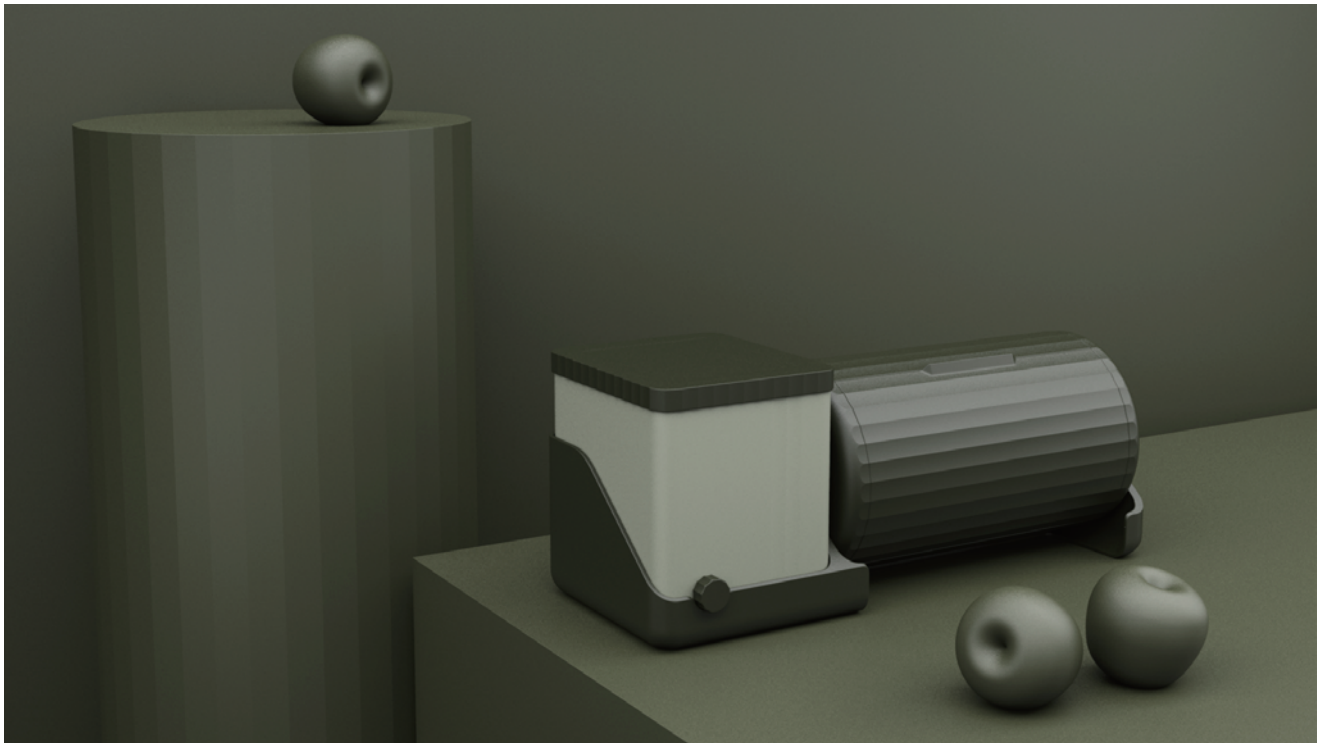
Redesign the shape

After determining the direction of the change, I recombined some tried shapes in the hand drawing, and finally formed a new shape

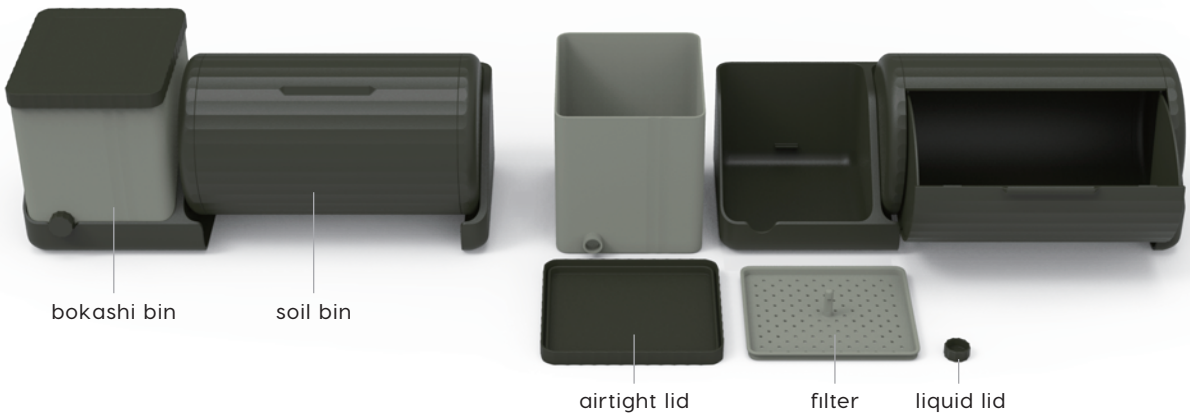


FINAL PRODUCT

After the redesign, this is the final product. All the functions are remaining the same. I still choose dark green as main color due to the reason of heat absorbing. The volume is smaller, the structure is simpler. Users can buy it with lower price and use it more conveniently.

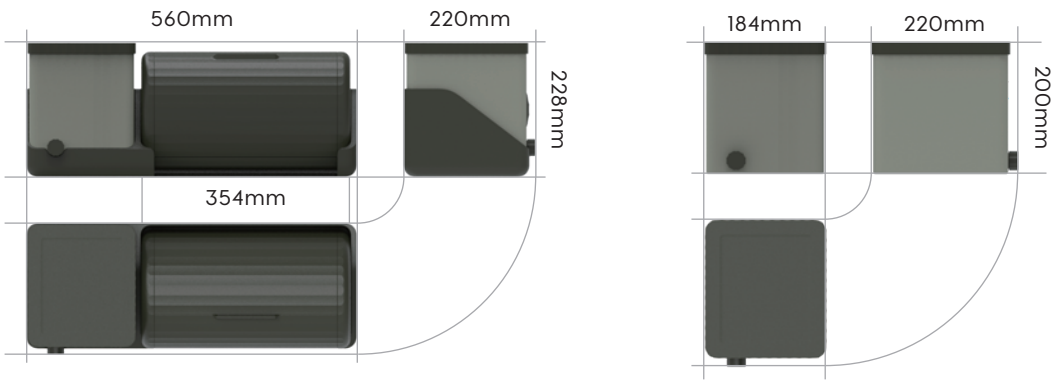


Structure



These are how products look like then they are closed and fully opened. The whole bokashi bin is placed inside the frame and can be taken out easily. So when you have to put the whole product in an area with limited upper space, you can take the bokashi bin off the product and operate seperately. The soil bin remains the same method of using, so it can still used in narrow space.

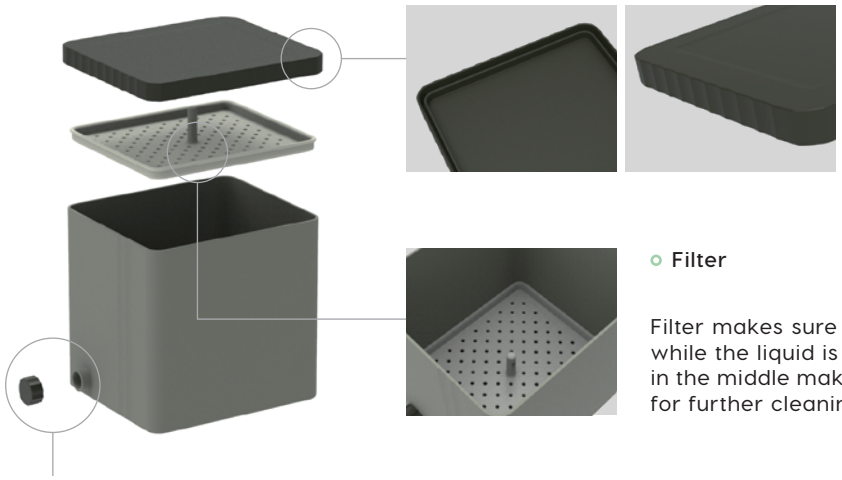
Size



As we can see, I decrease the unnecessary parts and the size has already shrinked a bit. However the volumes become slightly larger on contrary. The volume of the bokashi bin is around 5.5L except for the space to collect remaining liquid. The volume of soil bin is approximately 15L.

Details

On bokashi bin part, I give up the drawer structure and choose the classic bokashi bin structure again. Even though drawer structure may have smoother user experience, the additional production cost and structure is a difficult problem to solve. So it is not worthy to make structure changes. The design now is lower in cost and more direct.



Airtight Lid

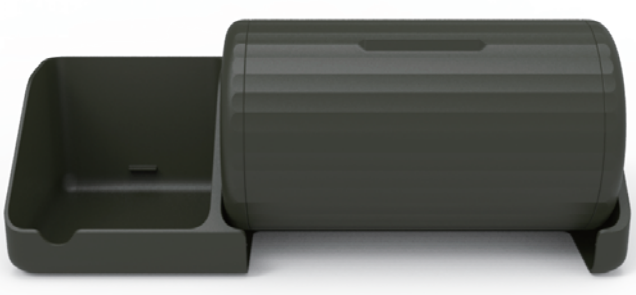
The double-layer structure at the edge guarantees air isolation. The texture on the side increases the friction and makes it easier for people to operate.

Filter

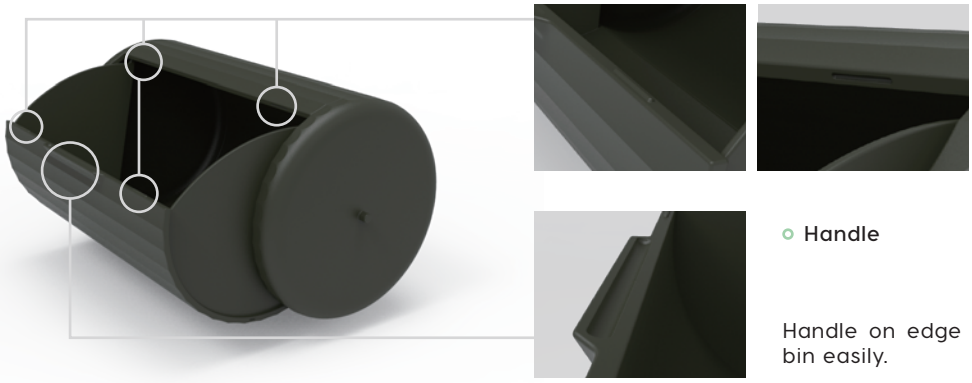
Filter makes sure the food waste stays dry during fermeting while the liquid is flowing down to the bottom. The little stick in the middle make it convenient for users to get the filter out for further cleaning.

Liquid Lid

Open the liquid lid every two or three days to pour out the liquid inside. Don’r forget to tighten it again after using to keep the air out



The soil bin part almost remains the same with slight change about structrue and material thickness. In order to low the cost of manufacturing, I remove all the physical interfaces and replace them with the simplest structure. All the parts use friction and protrusion to stick with others.

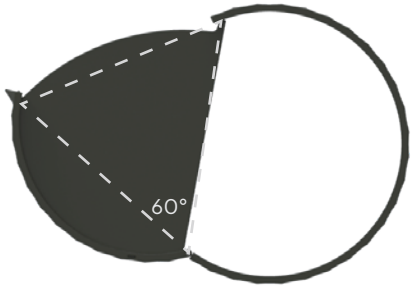


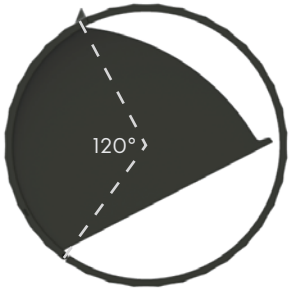
Protrusions

The protruding and recessed structures can snap together to keep the bin tightly closed.

Handle

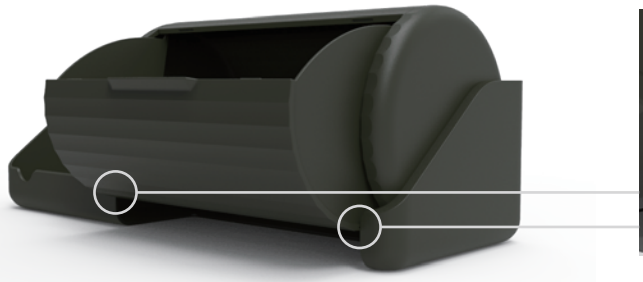
Handle on edge helps people open the soil bin easily.

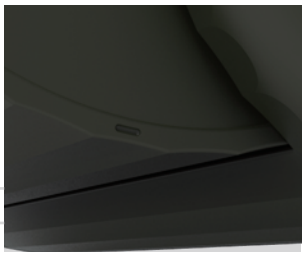




Angles

Regarding the opening and closing angle of the soil bin, although the angle has been slightly adjusted according to the actual situation of the product, the overall design is based on the opening and closing angles of 120 degrees and 60 degrees in the survey.



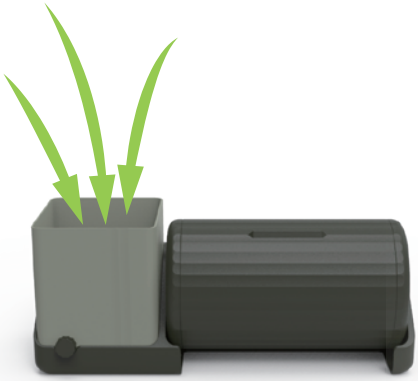


How to fix the soil bin while opening it ?

There are two small grooves on both sides of the soil bin door, which fits into the protrusions on the inner side of the shell. Counting the axis of the soil bin and the axis of the soil bin door, there are three fixed points to form a stable triangle. So that the soil bin will not be able to rotate or move freely once you fix the soil bin door with the shell.

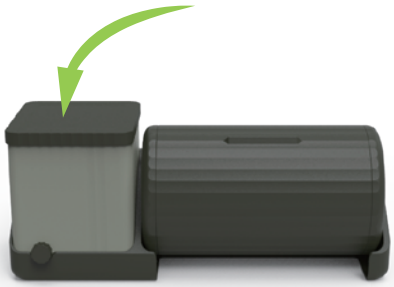
Using Steps

Except for some details, the usage of the product has basically not changed.



STEP 1

After each meal, add the kitchen waste to the bokashi bucket and sprinkle with an appropriate amount of activator mix.

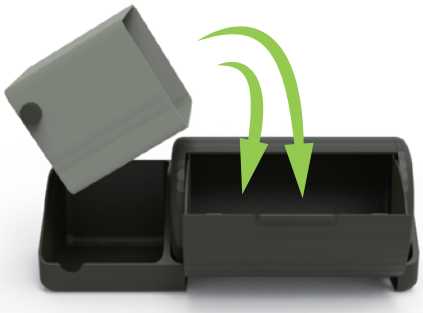


STEP 2

Always remember to cover bokashi bin with airtight lid to prevent air from getting inside.

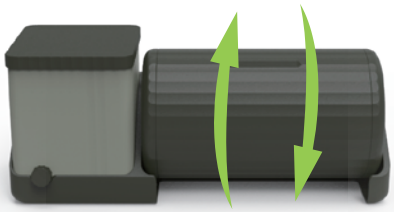
STEP 3

Pour out the liquid from liquid collector every two or three days. It can water the plants after diluted. Close the lid after use.



STEP 4

Once the bokashi bin is full, add the food waste into the soil bin to mix with the soil.



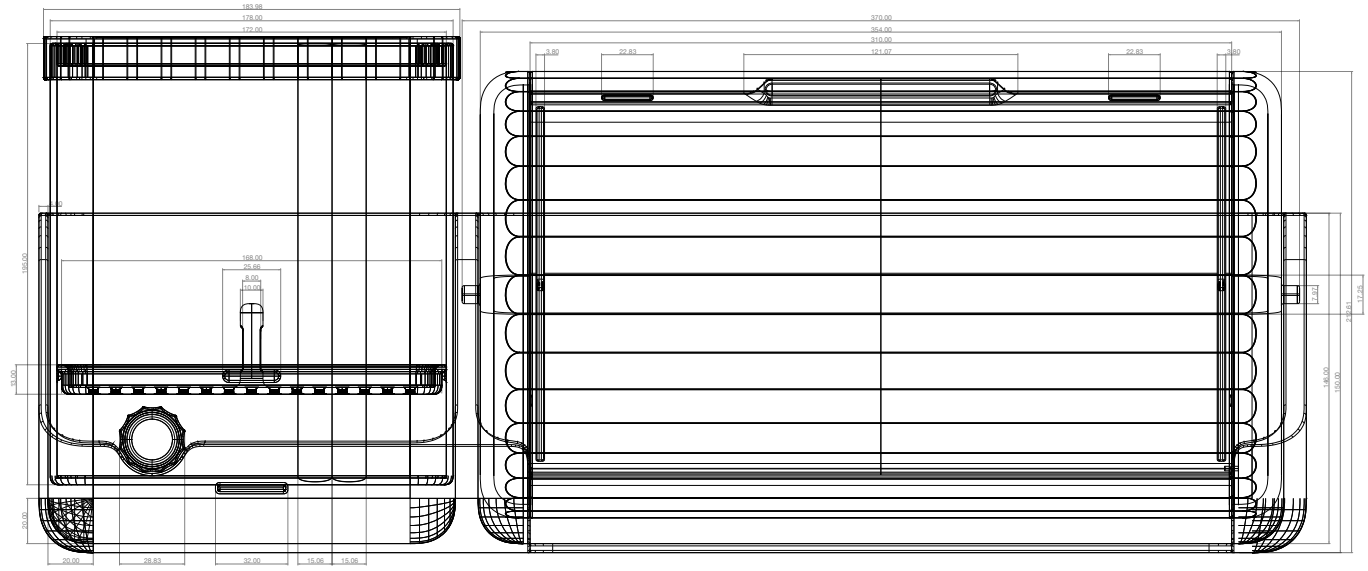
STEP 5

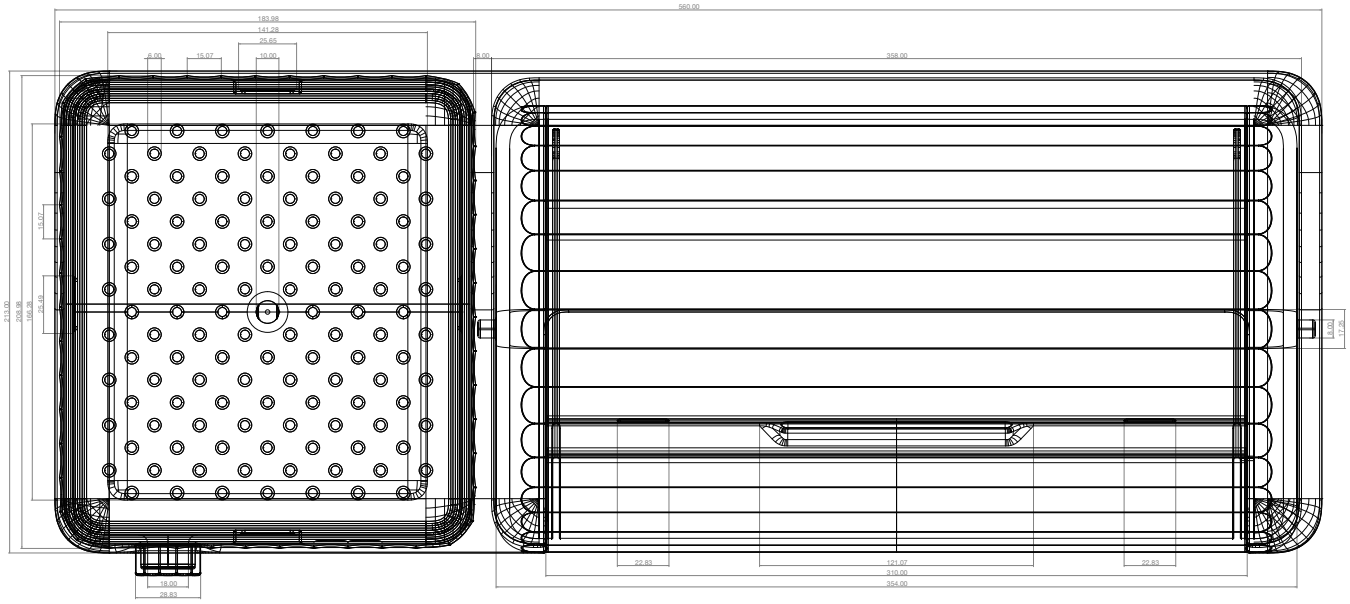
Remember to rotate the soil bin once every one or two day to mix the soil with food waste better and let air in.

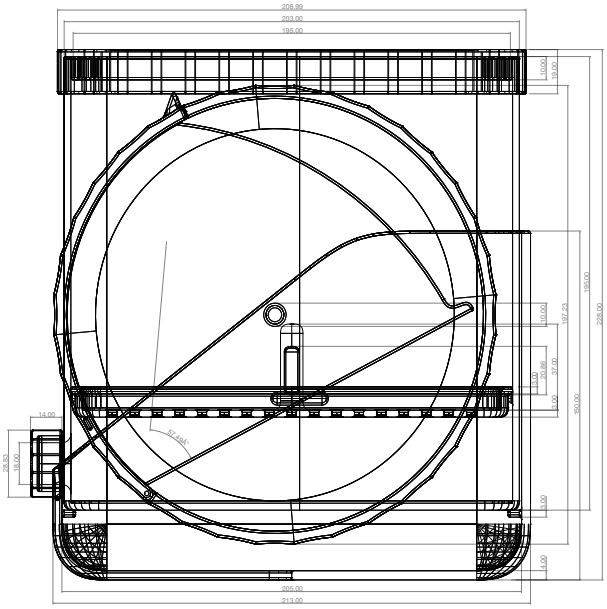
STEP 6

After one month, the soil is already rich in nutrients. Use it to feed your plants.

TECHNICAL DRAWING







Unit of measurement: mm

CMF REPORT

Color

The temperature most conducive to organic matter decomposition is at 52 to 60°C (MacGregor, et al., 1981), which is warmer than human habitability. In order to provide appropriate inner temperature for composting, the color of my product need to be dark. Generally the opaque objects absorb 40%-95% of incoming solar radiation from the sun, depending on their color–darker colors typically absorb a great percentage than lighter colors(Tarigh,Tarigh and Nikranibar, 2012). Technically, black is the best option for my product. But due to aesthetic reasons, I chose dark green, which is slightly lighter than pure black, as my main color.

The color of shell, soil bin and lids
C80 M73 Y84 K57

The color of bokashi bin body:
C63 M52 Y60 K3

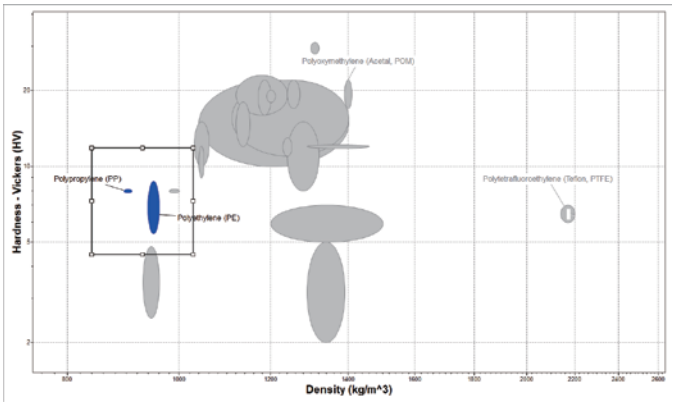
Materials

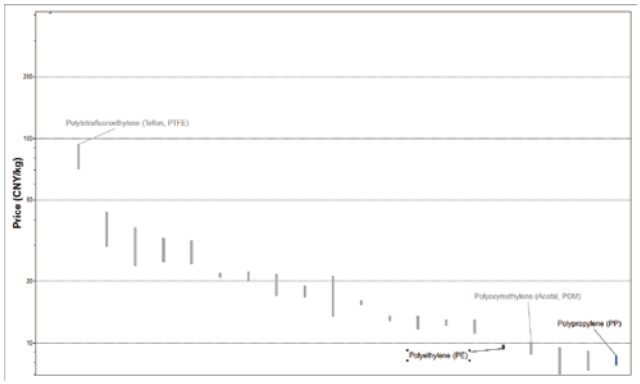
I decide the materials with the help of CES. The final product mainly have two kind of material. Soil bin, shell and bokashi bin except for lids are made of the same material. And airtight lid are make of another material.

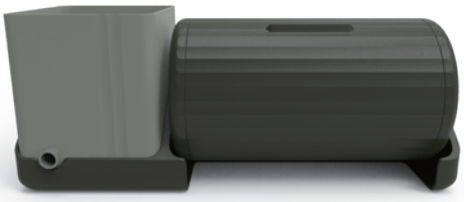
Stage 1
Melting point: >80 °C
Water (fresh): Excellent
Water (salt): Excellent
Soils, acidic (peat): Excellent
Soils, alkaline (clay): Excellent
Wine: Excellent
Acetic acid (10%): Excellent
Citric acid (10%): Excellent
Sodium hydroxide (10%): Excellent

- Material 1

The first material is material of soil bin, shell and bokashi bin except for lids. First of all, the materials used need to have excellent resistance to water, soil, alcohol, weak acids, weak alkalis, etc. Then I compare the density and hardness of the four selected polymer materials. As the main body of the product, this material need to be hard enought to carry stuffs inside while being as light as possible. According to the chart, PP and PE can be light but hard at the same time. The last step is comparing the price. With all the needs met, PP is the cheapest material. So the first material I need is Polypropylene(PP).







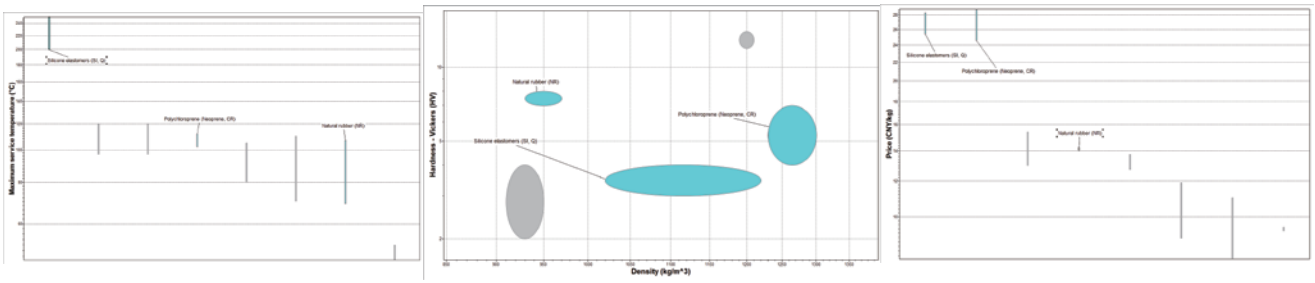
Polypropylene (PP)

So, the part on the left is best to use Polypropylene. Polypropylene (PP), also known as polypropene, is a thermoplastic polymer used in a wide variety of applications. It is produced via chain-growth polymerization from the monomer propylene. Polypropylene belongs to the group of polyolefins and is partially crystalline and non-polar.

Stage 1
Water (fresh): Excellent
Water (salt): Excellent
Soils, acidic (peat): Excellent
Soils, alkaline (clay): Excellent
Wine: Excellent
Acetic acid (10%): Excellent
Citric acid (10%): Excellent
Sodium hydroxide (10%): Excellent

- Material 2

The second material I need to select is the material for lids. It need to be airtight so I select material in elastomers. Firstly, the material need to have the same resistance as material 1. Elastomers don't have fix melting point so I check the max using temperature, all three selected material can be used by far. Then I compare the density and hardness among them. It is obviously that natural rubber can be less heavy but harder at the same time. Counting its price is much cheaper than the other two materials, natural rubber is excetly the most suitable material for lids.



Natural Rubber (NR)

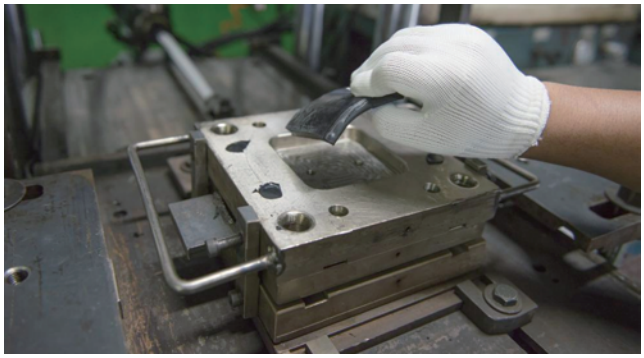
So, the part on the left is best to use Natural Rubber. Natural rubber is used extensively in many applications and products, either alone or in combination with other materials. In most of its useful forms, it has a large stretch ratio and high resilience, and also is water-proof.

Finishes

The major material for my product is polypropylene. The most suitable finish for polypropylene part is injection molding. Injection molding is the most widely used for polymer processing. The main advantage is that this material is capable of repetitively fabricating and having complex geometries at high production rates. Product outputs have virtually unlimited complexity and different sizes from very small to very large. Critical to the adoption of this high volume, low cost process technology is the ability to consistently produce quality parts (Kavade and Kadam, 2012). My product has geometric appearances and moderate size. And as a domestic garden product, its cost should be narrowed down as well, which makes injection molding the best choice.

Two lids are made from natural rubber. The most appropriate finish for rubber parts is compression molding. It is very suited to manufacturing parts with great strength and durability. Compared to other processing techniques, less automation is present, and press cost, tooling cost and cycle time tend to be moderate (Tatara, 2017). Compared to the other parts of my product, lids require less accuracy and complexity, which are not worthy of injection molding. Due to the cost consideration, compression is the best choice.

(Injection Molding Machines Definition Types, n.d.)



(Soon_Sound, n.d.)

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