THE USE OF COFFEE GROUNDS AS AN ADDITIONAL MATERIAL IN CERAMIC PLANTER PRODUCTS

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Abstrak: Coffee consumption in Indonesia increased by 8.22% annually from 2016-2021, reaching 360,000 tons of consumed coffee. However, the processing of coffee waste in Indonesia is still not optimal, despite the fact that coffee waste can emit methane gas and is toxic to the environment. One idea to reduce waste by utilizing the porous nature of coffee is to turn it into a self-watering planter. This research is based on the Material Driven Design method, interviews with ceramicists and plant experts, collaboration with a coffee shop as a provider of coffee waste, literature studies, and personal experiments. The results showed that the best design criteria were: 1) Clay with 5% fine ground coffee waste; 2) Throw and carve forming technique; 3) Overall shape like a cone to prevent plants and planting media from falling; 4) Textured and rough planter surface to prevent slipping; 5) "Pockets" feature to facilitate planting; 6) The design focuses on microgreen planting but can also be used for ornamental plants. From the experiments conducted, coffee waste can be mixed with the highest percentage of 5% with fine ground coffee waste and throw and carve technique as the chosen forming technique. One planter has the potential to absorb waste from 5 ½ cups of coffee.

Keywords: coffee, ground, waste, planter, ceramic

INTRODUCTION

Coffee shops in Indonesia have mushroomed in recent years, Indonesian coffee consumption in 2016-2021 rose 8.22% per year, reaching 360 thousand tons of coffee consumed (Industry.co.id, 2022). However, the processing of coffee grounds waste in Indonesia is still not optimal, even though coffee grounds can emit methane gas and are toxic to the environment.

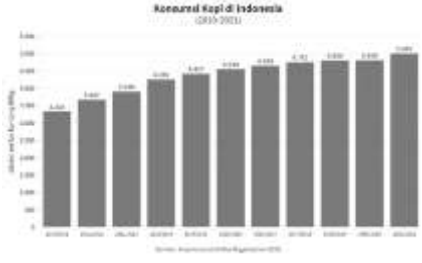

Figure 1. Coffee Consumption in Indonesia (2010-2021)

From the problem of coffee grounds came the idea to use it with clay material into a self-watering planter. The addition of other material elements such as sawdust is often used to produce ceramics that are lightweight and have higher porosity.

From existing studies, generally the percentage of coffee 5%-15% is considered to produce good porosity but ceramics still have their strength. The higher the percentage of

organic material, the higher the water absorption, but the lower density so that the strength of the ceramics decreases. While the optimal combustion temperature is at a temperature of 900C-950C (Busch & Holand, 2022; Eliche-Quesada, et al., 2011; Saberian, et al., 2021; Sena da Fonseca, at al., 2014).

Figure 2. Tevaplanter & DOAA Planter

The disadvantages of the product that already are: 1) The price is relatively expensive; 2) The bottom of the planter is absent or made unable to hold water; 3) Plant acclimation requires a long time; 4) Aesthetically looks rigid; 5) Sticking old and difficult plants. The advantages of existing products are: 1) Facilitate planting and plant care; 2) More efficient use of fertilizer; 3) Water requirements are less and efficient; 4) Does not depend on weather conditions or environmental conditions (DOAA, Tevaplanter, 2022).

METHOD

This research is based on the Material Driven Design method (Karana, et al., 2015), interviews with ceramists and plant experts, cooperation with coffee shops as coffee grounds providers, literature studies, and personal experiments

FINDINGS AND DISCUSSIONS

Material Process

Before the coffee grounds are mixed with the ground, the coffee grounds are dried using an oven for 1-3 hours with a temperature of 70C-90C (fan mode). Drying coffee grounds is done so that coffee grounds do not mold when stored. Only then can the soil and coffee grounds be mixed according to the required percentage.

Figure 3. Material Processing Process

Material Research & Experiment

The material research method is carried out by experimentation aimed at understanding the character of clay with a mixture of different percentages of coffee grounds. The coffee grounds used for experiments are fine-medium grind (arabica coffee) and coarse (robusta coffee) with different ratios of coarse and fine coffee grounds. Not only on the main part or ceramic body, experiments are also carried out using slips with coffee grounds mixture to get the desired texture on the ceramic surface. The experimental results will also be tested by calculating porosity, water absorption and density in ceramics. After conducting material experimentation, a study of manufacturing techniques and plant growth studies was carried

out to determine the most effective technique in forming materials and find the most optimal percentage of coffee grounds for plant growth.

Coffee Grounds Mixture Experiement (Fine & Coarse Ground)

The texture and percentage of coarse and fine coffee grounds affect the porosity of ceramics. The more and larger the ground of coffee grounds used, the more porous. The higher the percentage of coffee grounds used, the harder the soil is to form. In a mixture of clay with coffee grounds above 5% and mixing with coarse coffee grounds (in the manufacturing process) easily produces small cracks. The use of coarse coffee grounds entirely on the soil results in weaker soil characteristics compared to clay soils that have a fine coffee grounds mixture. A slip with a mixture of coarse coffee grounds and fine coffee grounds is easier to shape and stronger compared to slips that only use coarse coffee grounds. Coffee grounds can increase the porosity of ceramics, so that ceramics can be burned at higher temperatures but still have high porosity.

Figure 4. Coffee Grounds Mixture Experiment

Techniques Study

Twisting and carving techniques produce the neatest shapes with consistent wall thickness. The rotary technique is more efficient and faster, but the percentage of coffee grounds is a maximum of 7.5%. The most difficult and time-consuming process is the coiling technique but shapes and textures can vary greatly. The kurinuki technique produces interesting textures and shapes without having to add slips. The kurinuki technique can highlight the texture of the coffee grounds in the ground, so that the surface is rougher. The thickness of ceramics with the kurinuki technique is uneven and a lot of cut soil is wasted.

Figure 5. Techniques Study

Plant Growth Study

Chia seed growth fails due to poor seed quality. The fastest and easiest growth is microgreens, which is 7-12 days until the plants can be harvested. Planting microgreen seeds will be more effective and easy to use small-sized seeds. The fibrous roots of microgreens cannot be too strong to stick to ceramic surfaces. Microgreen planting is easier and optimal with the help of cocopeat planting media. The growth of philodendrons or ornamental plants is only clearly visible in week 2, with a study time of 4 weeks so it takes a long time. Philodendron root growth grows 1-4 cm per week. The taproot type in houseplants is more firmly attached to the ceramic surface. Spaghnum moss planting medium helps root growth in ornamental plants, but is prone to rot.

Figure 6. Plant Growth Study

Quality Function Deployment

Persentase Ampas Kopi	Kekuatan Material	Variasi Teknik	Porositas dan Daya Serap	Pertumbuhan Tanaman	Ekspresi Limbah	Total
5% Kasar	5	3	1	3	5	17
5% Halus	6	6	2	5	6	25
5% Halus dan Kasar 1:1	4	5	3	6	4	22
5% Halus dan Kasar 1:2	3	4	4	4	5	18
10% Halus	2	2	6	7	2	23
15% Halus	1	1	5	1	1	8

Material

Teknik	Efisien	Keberhasilan	Estetika	Tekstur	Pertumbuhan Tanaman	Total
Pinching dan Impasto	1	1	1	1	1	5
Karanuki	2	3	2	2	3	12
Putar dan Ukir	3	2	3	3	2	13

Teknik

Figure 7. Material & Techniques QFD Summary

Interview Summary

The interview was conducted with Mrs. Ling Tjakra a ceramicist who has been in the ceramics world for a long time, owner of Pelangi 12 ceramics studio in Tangerang and also a plant expert. From the interviews conducted, the author's conclusions are as follows: 1) Ornamental vines, ferns, mosses, orchids and other plants that require higher humidity can be used on planters; 2) Microgreens can be grown on planters but need growing media as a mixed medium; 3) Small microgreen seeds are more ideal for use on planters; 4) Seeding and growth of microgreens is faster compared to houseplants; 5) Planter can be made using clay with high burner temperature for stronger results; 6) The pouch feature can be applied to the planter to facilitate the planting process; 7) The shape of the planter is made pursed so that the plant does not fall easily; 8) Lids and water containers are crucial in the use of planters.

CONCLUSIONS AND SUGGESTIONS

A few conclusions of this research are:

- The best design criteria are: 1) Clay with 5% fine ground coffee ground; 2) Throw and carve forming technique; 3) The overall shape is like a cone so that plants and planting media do not fall easily; 4) The surface of the planter is made textured and rough so that it is not slippery; 5) 'Pouch' feature to facilitate planting; 6) The design is designed with a focus on microgreen planting, but can be used for houseplants as well.
- Coffee grounds collected from Evlogia coffee shop. Evlogia sells 15-20 cups of coffee every day. Each glass requires 18 grams of self-processed coffee grounds with medium to fine ground grinding sizes. With the data above, it can be estimated in one month around 7.4 - 10 kg of coffee grounds wasted from Evlogia coffee shops. If the planter is made with 1 kg or 1000 grams of clay x 2 (inside and outside) and mixed with 5% coffee grounds, then per one planter of coffee grounds used reaches 100 grams of coffee grounds. This means that one planter is equal to the coffee grounds of 5 1/2 cups of coffee. In addition, the material exploration that will be carried out can produce valid data so that it can be a benchmark for other ceramic craftsmen who also want to use coffee grounds in their products or works to increase selling power.

- With a high coffee consumption rate, the waste produced is also high, but without waste treatment efforts it will have a bad impact on the environment. Utilizing coffee grounds as an additive to ceramics can produce something new that can create products that are unique, functional and useful and have a good impact on the environment. From the experiments carried out, coffee grounds can be mixed with the highest percentage of coffee grounds, which is 5%, with fine coffee grounds and twisting and carving techniques as the selected manufacturing techniques.
- Further research can focus on: 1) Conducting plant trials (microgreens and ornamental plants) with samples made following design criteria; 2) Conduct trials with users; 3) Equip and develop samples; 4) Develop the product into a DIY Kit (with microgreen seeds, planting media and booklets); 5) Create design alternatives for houseplants.

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