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AROMA EARTHENWARE DESIGN FOR HOA BOENG VILLAGE, MUANG DISTRICT, KHON KAEN PROVINCE

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ABSTRACT

The research is an experimental research for a clay formula suitable for absorbing pure essential oils, containing evaporation ratio and suitable as interior use inside house accommodations, spas and cars. The production process is designed in a way that the local villagers can produce this design by themselves. The packaging and brand logo are as well designed. The experiment results reveal a clay formula with the mixture of Hoa Boeng clay 40%, Grog (clay) 30%, ball clay 30%. This formula provides 8.5% shrinkages and 19.76% water absorption ratio. The design data comes from questionnaires given to room, car and spa perfume diffusers, and a survey conducted in the aromatic product market. The collected data then is summarized as a concept of "Isan Wisdom, Nature and Simplicity". The design conditions were to use bright and colorful colors with glossy surface. Ten product prototypes were made, and the product logo was "Isan-clay" with packaging designed. These products were tested in the market at gift and houseware exhibition fairs in October 2017. The results revealed that the products gained interest from the consumers and were ready to be distributed. The production process was transmitted to the villagers in Hoa Boeng village.

INTRODUCTION

In the Northeast, there are two types of pottery; earthenware and stoneware. Pottery in this region is found to have been inherited from the past, and the earthenware pottery was found to have existed since the Ban Chiang period or more than 3,000 years ago. Currently there are some communities that still produce Ban Chiang pottery; a clay anvil is used to to form the shape by beating the clay body made from soil mixed with rice husk, and burned by using rice

straw method. Hoa Boeng village in Muang district of Khon Kaen province is one of them (Brahmasakha, 2009) (Figure 1).

Samruat Inban et al. (1989:149) found that in Khon Kaen there were six earthenware production sources, including Hoa Boeng village, Photak village, Don Bom village, Non That village, Wang Thua village and Khum Sadao Waan. Later, Thanasit Chantaree (1996:32) revealed that there were only three earthenware production sources in Khon Kaen, including the production in Hoa Boeng village, Photak village and Wang Thua village. However, today Khon Kaen has only one source producing earthenware in Wang Thua village in Nam Phong district. It can be seen that the earthenware pottery production is likely to disappear in the near future if there are no conservation and development efforts from various agencies, both from the government and private sector.

The researcher appreciated the quality of the soil texture used in making earthenware as it has high water absorption rate. Thus, it should be useful in producing aromatic earthenware. The researcher has conducted a preliminary experiment using the soil texture from Hoa Boeng village. The soil texture was formed into a smooth sphere, drilled one whole and glazed only on the outer surface, and subsequently heated at 1,000 °C. Essential oil was then added into the finished earthenware samples and placed in a car, an office and bathroom. The result was a light and long lasting fragrance, depending on the amount of the essential oil used. Therefore, the researcher had the idea of developing Hoa Boeng village earthenware by creating new earthenware products that were aromatic to use in living spaces, spas and cars. The development were based on experiments of finding suitable porosity and absorption rate, testing the evaporation by designing various volumetric shapes and scent release holes that could be turned on and off in order to control the evaporation amount, testing the temperatures that affected the evaporation rate in various room sizes, and finally create a product image design.

Based on initial marketing information, it was found that spa business and aroma diffuser market trends in Thailand and the world seem to continue to grow (Business Research Department, Export-Import Bank of Thailand, 2012). Therefore, it was an interesting opportunity to design products to serve these markets. The research result considered as a new set of knowledge was the innovative invention using the water absorption quality of the earthenware soil texture with essential oils by able to indicate the duration of use per volume. In addition, the product was designed to be able to easily control the evaporation rate. It introduced a new product to the market of scented products used in households, spas and cars. This research has been integrated and responded to various dimensions, including the intellect and identity, craftsmanship, innovation, design, marketing, society, environment and sustainability.

RESEARCH OBJECTIVES

To experiment and find suitable clay body and glaze formulas.
To design aromatic earthenware used in houses, spas and cars.
To design a production process and transmit it to villagers of Hoa Boeng. To design the product's brand and packaging. To test the market and promote the distribution of the designed product.

Figure 1 Traditional earthenware making by a villager from Hoa Boeng village.

LITERATURE REVIEW

Surasak Waithayawongsakun (2012) wrote an article about porous ceramics that porosity was generally something we would not want to occur in ceramic textures. This was due to the fact that porosity could decrease the durability of ceramics. However, ceramics with high porosity in the texture, or the so-called porous ceramic, play significant roles in various types of industries. Porous ceramics owned several outstanding features, including the permeability, high surface areas, thermal insulation, and high temperature and chemical resistance. Porous ceramics could be divided into two types, including honeycomb ceramic and ceramic foam (which was also divided into open cell and close sell types). Porous ceramics could be formed by various methods, such as, dipping the foams into a suspension so the ceramic material particles impregnated the foam surface, and fired in a kiln so the foam would be burned and only a piece of ceramic material with the original structure of the foam remained. Another method was adding the organic matters, such as sawdust, coal slag, or powder, into the suspension. When forming the piece, such organic matters would be dispersed internally and dispersed when heated so there was porosity in the ceramic works. Another method was the sol-gel method in which the suspencion used was foamed and chemicalized so it became gel that would keep the foams inside the material. Porous ceramics could be used for various functions. As the open-cell ceramic foams were highly absorptive, they were usually used as filters for, such as, drinking water and liquid metal for casting process. Porous ceramics have high surface area so they are suitable for using in an ion exchange and catalyst carrier in chemical and automotive industries. Porous ceramics could also be used as thermistor, refractory, medical and dental supply.

Sansani Rakthaicharoenchip (2009) conducted a research on Porous Granular Ceramic for the Storage of Moisture under the Surface, and the findings revealed that the use of sludge, a waste from ceramic industry factory with more than 100 tons per month, instead of landfill as currently was, could be used as

raw materials for making expanded clay. From the experiment, the expanded clay has quality of dehumidification. Therefore, it could be used as planting materials and decorate gardens or decorate fishing tanks as it can reduce water evaporation causing the soil not overly tight so the roots could grow well.

Phimphawan Watthanophat and Saichit Daosukkho (2008) researched on Porous Bricks from Ceramic Waste and found that the ceramic waste in the industry could be used as a raw material for making porous bricks used for exterior floors where water can flow. They were also qualified as suitable for outdoor garden decoration because of the porosity of the brick could reduce the inclusion of water on the floor better than floor tiles.
To make the porous brick solid enough, it must be fired at 1000 °C which is lower than that of conventional ceramic firing and energy saving Phanuwan Chanthawan et al., (2015) conducted a research on Porous Ceramic: Extract of Lemongrass, and the results revealed that porous ceramic with alumina as the main component mixed with 10 g cellulose and 3 cc PVC having a porosity of 90.54% was used to contain lemongrass essential oil. It was effective in releasing the oil that acted to eliminate microbes in the honeycomb lasting up to 7-14 days per one time use of lemongrass essential oil, and efficiently up to 4 times than before and able to be reused. Porous ceramics were used to eliminate microbes in order to prevent disease outbreaks in the honeycomb. They were used in replacement of antibiotics that might leave residues in honey which could cause harm to the consumer.

Surakan Ruaysungnoen (2009) researched on Design for Value-Added Northeastern Earthenware at Hoa Boeng village in Khon Kaen, and the results found that the design guideline gained was a product design for home decoration, garden decoration and spa use, and created a novelty with free shapes. The shapes were inspired by surrounding natural shapes, such as the shapes of grains, pebbles, etc. These shapes were then developed into simple, making them look modern and could easily be produced by the folk craftsmen. The results of the prototype produced by the villagers were large and medium size square planters, small-medium-large twin ceramic pots, tall vases, spiral pattern basins, hanging planters, spiral pattern water-sprouting earthen jars, anthill lamps, washing basins, pressed-pattern top-twisted pots, pressed-pattern basins, building-shaped orchid pots, and duck-shaped pots. According to the market test results in Khon Kaen, it was found that the best selling products were hanging planters, small twin pots, medium twin pots, pressed-pattern top-twisted pots, spiral-pattern tall vases, and square planters, respectively. According to the questions given to the customers who bought products from this project, it was revealed that the customers decided to buy these products because they looked different and had not been seen in any market before. Another reason was that these products were handmade. Some customers suggested that the products looked fragile, not durable, not suitable for heavy use, and the square planters looked overly big, and if filled with water it would seep out, so this should be improved.

Stephan Augustin, Inventor of the Terracooler, received the BMW Foundation Young Leaders Award 2010 during the 10th Munich Economic Summit. The “Terracooler” is double-wall bell-shape terracotta Cover using water for natural

cooling and preservation of all kinds of daily food. Temperature inside can be cooled down up to 25-40% compared to outside air temperature and extend shelf-life of produce up to ten time longer than without cooling. Terracotta is a type of soil similar to earthenware which is a high capacity of absorbing water. This is the main material of this research project (terracooler.org).

Lada Phansukhumthana, Inthira Makhaphatthanasin, and Warali Bangluang (2009) conducted a research on Ceramic Accessory with Aromatic Scent, and the results reveal that ceramic clay fired at temperatures lower than 1,000 °C had high porosity suitable for packaging perfume and essential oil, but their limits were of strength and product type's development. This research was carried out using soil texture mixed with feldspar and sand milled in a milling pot into slip and formed up in a plaster mold fired at 1,200 °C. To make the ceramic aroma, the capillary action principle was used. In an aroma ceramic design, aroma ceramic clay could be used to make the whole product or partly used in making. In the design of the aroma clay, a hollow would be made inside in order to retain the essential oil. If the aroma clay was partially used, the capillary action principle would be in use. A part of the clay unglazed would be would be designed with a stick dipping into the glass bottle, or ceramic bottle with a glazed ceramic pot, in which to contain the essential oil so it would absorb and evaporate the scent. However, there is a caution that the soil texture porosity or thickness must chosen suitably to the type of product. This would provide the desired absorption rate and prevent the excessive leakage of the essential oil. Key factors for controlling the ceramic clay porosity after fire were the materials used, the preparation, and the temperature inside the kiln. Another important factor was the glazing method used to cover the aroma ceramic clay for containing the essential oil part as there should not be any mark that could let the oil leak out, such as crackles or pin holes.

The Business Research Department of the Export-Import Bank of Thailand (2012) answered a question on the opportunity of Thai spa business after launching the Asean Economic Community (AEC) that it would continue to grow as the AEC would take part in supporting tourism by facilitating the conveniences of travelling between the member countries. As about 80% of the income from the spa business in Thailand came from the foreign tourist customer group, the World Tourism Organization estimated that foreign tourists in ASEAN would increase up to 120 million in 2015, the year in which AEC was completely established, from an average of 67.6 million people in the previous year. With the strength of the Thai spa sector being renowned and internationally recognized, as well as the current trends in maintaining health and reducing stress, it is expected that the Thai spa business would expand in following years.

The most similar products available on the market today are the Aromatic Stone Diffuser produced by Amphan Aroma Incense Group in Mae Sot District, an OTOP group with its original product of aroma incense and odor eliminator charcoal. This aromatic stone diffuser is a new product brought to contest in the Knowledge-Based OTOP (KBO) at a national level in 2015. The product made into 1-5 finalists. The problem of this group's product was that it could not

control the strength of the essential oil scent causing it to excessively dry up. (Figure 2)

Figure 2 Aromatic Stone Diffuser by Amphan Aroma Incense Group

An air freshener for car brand, "MAYA", formerly a luxury house air freshener that had been successfully used by high-end customers, has expanded its product lines to include air-freshener for cars which is quite a large market. Most modern air-referener for cars have similar scents and are not for a top-level market. MAYA's concept is a natural aromatic air-freshener that gives relaxing scent but not too strong to irritate your nose or not too light that you could barely smell it. It is safe to inhale and does not harm the equipment inside the car, and has a sleek design (See Figure 3). The target audience are working people who are very active as well. MAYA has a variety of scents, such as Earl Gray, Thai Spa or Apple Blossom, all designed in the form of a dry intense perfume to prevent the impact on the car interior and well packed in special fabric bags preventing from leakage. The silicone used as a mask material is also odorless and giving non-toxic residue. The price of each product is 590 baht, a refill is 490 baht per bag, each last upto 30 days (MGRonline, 2015).

Figure 3 MAYA's Air Freshener for Cars received the Demark and Good

Design marks from the Ministry of Commerce. Image Source: https://mgronline.com/smes/detail/9580000122163

Therefore, this project's aroma earthenware uses essential oils extracted from plants to experiment whether they help the users to relax, contain non-toxic or chemical substances, do not cause allergies, as well as provide natural scents that are not as strong as chemical perfume normally used in the market today. In general, the use of essential oils is in the treatment called "aromatherapy". Using these oils also does not cause sticky stains sticking in the car's air-conditioning system.

RESEARCH METHODOLOGY

The raw material used in the experiment to identify clay bodies formula is mainly soil from Hoa Boeng village mixed with ball clay and grog. The triaxial blend is then used as a method to find the formula. The level between the ingredient ratio can be determined from each of 10 or 20, which can determine the number of ingredient ratio from 21 points, 36 points and 66 points or more. Here, the 36 point diagram is used (Figure 4).

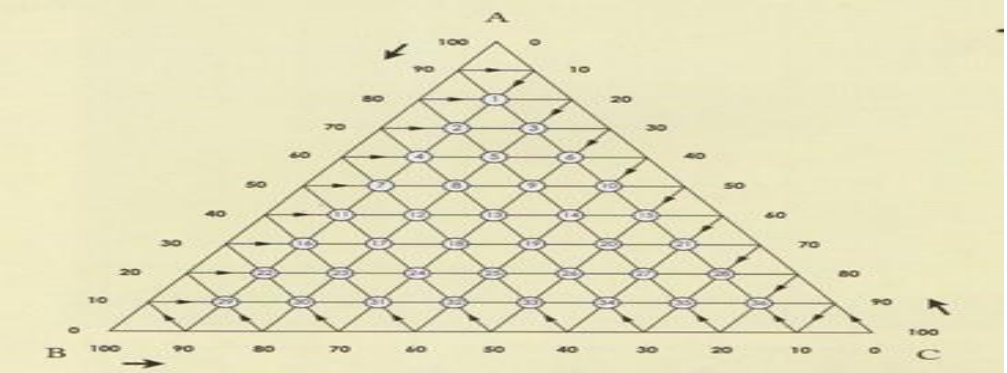

Figure 4 Triaxial Blend Diagram of 36 points.

Table 1 Percentage of ingredients in Triaxial Blend Diagram of 36 points. (A= soil from Hoa Boeng village, B=Grog, C=Ball Clay)

Formula 1 A = 80 B = 10 C = 10	Formula 2 A = 70 B = 20 C = 10	Formula 3 A = 70 B = 10 C = 20	Formula 4 A = 60 B = 30 C = 10	Formula 5 A = 60 B = 20 C = 20	Formula 6 A = 60 B = 10 C = 30
Formula 7 A = 50 B = 40 C = 10	Formula 8 A = 50 B = 30 C = 20	Formula 9 A = 50 B = 20 C = 30	Formula 10 A = 50 B = 10 C = 40	Formula 11 A = 40 B = 50 C = 10	Formula 12 A = 40 B = 40 C = 20

Formula 13 A = 40 B = 30 C = 30	Formula 14 A = 40 B = 20 C = 40	Formula 15 A = 40 B = 10 C = 50	Formula 16 A = 30 B = 60 C = 10	Formula 17 A = 30 B = 50 C = 20	Formula 18 A = 30 B = 40 C = 30
Formula 19 A = 30 B = 30 C = 40	Formula 20 A = 30 B = 20 C = 50	Formula 21 A = 30 B = 10 C = 60	Formula 22 A = 20 B = 70 C = 10	Formula 23 A = 20 B = 60 C = 20	Formula 24 A = 20 B = 50 C = 30
Formula 25 A = 20 B = 40 C = 40	Formula 26 A = 20 B = 30 C = 50	Formula 27 A = 20 B = 20 C = 60	Formula 28 A = 20 B = 10 C = 70	Formula 29 A = 10 B = 80 C = 10	Formula 30 A = 10 B = 70 C = 20
Formula 31 A = 10 B = 60 C = 30	Formula 32 A = 10 B = 50 C = 40	Formula 33 A = 10 B = 40 C = 50	Formula 34 A = 10 B = 30 C = 60	Formula 35 A = 10 B = 20 C = 70	Formula 36 A = 10 B = 10 C = 80

Bring each clay mixing formula to fire at 1000 °C and then test to determine the percentage of shrinkage and water absorption using the following formula:

% water absorption = weight of test piece after fired with water saturation - water after test tube piece after fired x 100

Water after test tube piece after fired and test to find slip casting formulas.

Test the volatility of essential oils by using the appropriate soil formula from the experiments to cast into various shapes, such as, round shape, dome shape, cubic shape, and pyramid shape. Then coat these specimen only on the outer surface coating and fire at 1,000 °C, suitable for use in homes, spas and cars. The specimens are drilled with 1-3 holes so the essential oil will be forced out these ways. Then test these ceramics by placing in an office, bathroom, bedroom, spa and car, and calculate the scent evaporation rate by weighting them for two months.

Collect marketing data by using questionnaires. Ask purposive questions to 300 buyers who buy air-fresheners for cars, houses and spas at department stores, car accessories shops and convenience stores, as well as asking 90 vendor or shop owners. In addition, collect data from documents, internet and products available on the market to use as information for designing purpose for this project.

The design of the aroma earthenware product consists of the following methods: data analysis to summarize the concept of design, sketch, model, and design

development, and produce ceramic prototype and patent product patents of this project. Design production processes that villagers can implement themselves and transfer techniques to villagers. Design product packaging for transportation and marketing promotion, and design product branding. Find marketing and distribution channels for products designed by showcasing in two trade fairs in Bangkok, including BIG (Bangkok International Gift & Houseware Fair) and Baan Lae Suan Fair, and let consumers at both fairs evaluate the designs.

RESEARCH RESULTS

Clay bodies formula experiment results shown in Table 2

Table 2 The results of clay body's formula experiment results (fire at the temperature of 1,000 °C)

Formula	Length after fire (cm.	% Shrinkage	Weight after fire (gram)	Weight after boiling (gram)	% water absorption
1	9.1	9.0	76.87	84.74	10.24
2	8.95	10.5	80.23	91.22	13.69
3	8.8	12.0	79.13	86.00	8.68
4	9.1	9.0	79.30	91.13	14.92
5	8.85	11.5	75.80	87.01	14.79
6	8.8	12.0	77.91	86.82	11.43
7	9.2	8.0	79.63	95.62	20.08
8	9.15	8.5	78.97	93.60	18.52
9	8.9	11.0	80.22	88.71	10.58
10	9.0	10	75.18	84.34	12.18
11	9.5	5.0	79.22	96.52	21.84
12	9.2	8.0	77.19	93.20	20.74
13	9.15	8.5	80.13	95.97	19.76
14	8.85	11.5	79.08	88.95	12.48
15	8.8	12	77.16	83.15	7.76
18	9.3	7.0	80.41	96.99	20.62
19	9.0	10.0	80.51	90.60	12.53
20	9.0	10.0	79.56	87.69	10.21
21	9.0	10.0	75.55	84.35	11.64
25	9.2	8.0	80.05	96.59	20.66
26	9.0	10.0	80.34	92.99	15.74
27	8.9	11.0	78.04	87.33	11.90
28	8.85	11.5	75.70	81.89	8.18
33	9.2	8.0	82.72	98.09	18.58
34	9.25	7.5	81.29	97.09	19.44
35	9.0	10.0	74.88	86.00	14.85
36	8.95	10.5	72.23	81.80	13.25

Note: Formula 16, 17, 22, 23, 24, 29, 30, 31, and 32 could not form due to the lack of stickiness but excessive grog in the clay.

Summary: The appropriate formulation used to cast and test the evaporation rate of the essential oil is formula number 13 (clay from Hoa Boeng village 40%, grog 30%, ball clay 30%) because of low shrinkage percentage of 8.5% and high water absorption at 19.76%. The formula for slip casting is Hoa Boeng village clay 40%, white clay 20%, and ball clay 40%, which provides appropriate specific gravity and good flow of water in soil. For the experiments of coating, the main formulation found is 70% fritillic soil, 30% Hoa Boeng village soil, by mixing the the main coating formula with coloring agents, including Fe2O3, CoO, CuO, MnO and various color stains, and fired at 1,000 °C after coated with colors and glazed.

Test the absorption of essential oils and evaporation rates in various rooms and cars. The specimens were casted and glazed in accordance with the formula number one. The specimens were glazed only on the outer surface (see figure 5). When the essential oil is added to the specimen, the inner surface will absorb all the essential oil without any residue liquid within no more than six hours. The outer surface, glazed, will restrain the oil and scent evaporating through the three holes made to adjust the aroma level. The evaporation experiment result reveals that the type of essential oil used is the key factor for evaporation. For example, eucalyptus oil will evaporate faster than lavender. Adding about 10 grams of each essential oil, the eucalyptus will last for one month and the lavender will last for two months. The size of the holes opened affects the degree of the scent and evaporation rate of the essential oil.

Figure 5 the clay body formulas gained from the experiments are casted into various shapes and forms with holes drilled to test about the essential oil evaporation rate.

The results from an analysis of data collected from the questionnaires are summarized into a concept of aroma earthenware design that is "Isan wisdom + nature of adorable animals + simplicity" with the following design conditions:

- Function: used to freshen the air inside houses, cars and spas. A refill of an essential oil can last one month. The designs are in both standing and hanging. Sizes are not wider than 5 cm and not longer than 8 cm, with minimum height as possible. About one to three holes were drilled with lid on top.

- Content: designed by using Isan wisdom plus the lovely animal and fun.
- Material: porous ceramic clay and glazed on either side with bright color and glossy surface
- Process: formed by slip casting in plaster mold and painted with ceramic colors, and then glazed at 1,000 °C. Process techniques shall be transmitted to the villagers.
- Form: designed with an inspiration from the Isan wisdom, lovely animal movements and simplicity.
- User: designed for a wide range of target customers.
- Marketing: focused on the market of air fresheners for cars and spas with distribution channels on internet and in trade fairs in the country.
- Innovation: porous ceramic that controls the essential oil evaporation rate.

The aroma earthenware product design results consist of a variety of design drafts based on the concept of design (figure 6). These drafts were made into prototypes by plaster molds, formed by slip casting and painted with ceramic colors. After leaving to dry, the drafts then were biscuit fired at 800 °C, dipped in glazing liquids following the formula 1 in the experiment before fired at 1,000 °C for total of 10 models (figure 7) which all have later been patented as the project's product design.

Production Process Transfer Result, including clay preparation, slip casting, product decoration and painting techniques for the villagers in Hoa Boeng village (Figure 8). Packaging and Branding Result, based on product design conditions in each aspect as following,

- Function: to protect the product during the transportation and create the product brand image.
    - Content: Green Design and Northeastern Wisdom
    - Material: use recycle paper and bright colors
    - Form: simple
    - Logo: designed to be remembered easily, representing the product and simplicity

The product brand name is "Ezanclay" representing the origin of Isan or the northeast region of Thailand, representing the earthenware and is easy to remember.

The concept used in designing the logo in this project was based on being Isanness and the representation of traditional earthenware making wisdom in Hoa Boeng village by using the patterns of villagers making pottery in the ancient ways in the designs.

Packaging Design Results consist of simple shapes, using brown corrugated paper which is recyclable. According to consumer survey data, the packaging

design should emphasize on the durability of being overlapped during transport times, and holes should be drilled through the packaging to be able to see the products of various sizes as each prototype is not in the same size (Figure 9).

Showcased products in a booth in Bangkok International Gift & Houseware Fair (BIG & BIH) between 17-21 October 2017 at the Bangkok International Trade and Exhibition Centre is a convention and exhibition hall (BITEC) in Bang Na District, and in Baan Lae Suan Fair between 27 October to 5 November 2017. The Project's Aroma Earthenware assessment was collected from consumers in both fairs by purposive questioning and specifically questioned those who purchased or were interested in the products. The respondents came from a wide range occupations, both male and female, with a total of 124 people. Results have suggested that the products should be added with Thai style, such as Thai elephant and dog shapes, and these animals should have different facial expressions. The surface should be matte or semi-gloss as it will be make it more popular among potential buyers. The colors of these products should also be light, pastel and bright. The products produced look fragile. Some models are too high, and that makes it feel that they will fall easily. The earthenware should add benefits of using them in people's everyday life, such as using in cars, putting on desks, etc. The logo "Ezanclay" somehow seemed to be not easy to read. It looked harsh and serious. Instead, it should be designed to fit the styles of the product that are lovely and casual. The packaging style is not unique; it does not well represent the product and its aroma function.

Figure 6 Sketch Design

Figure 9 Packaging and Logos

SUMMARY AND DISCUSSION

This research has designed aroma earthenware by using the porous clay ceramic to absorb the essential oil. The products' surface was glazed and drilled with holes in order to control the essential oil evaporation. Adding essential oil of 10 grams can last about one month. The aroma earthenware products can be used to freshen the air in houses, cars and spa rooms. The concept of design in this project was "nature + Isan wisdom + simplicity". The products were made in bright and colorful colors with glossy surface. The shapes used were inspired from traditional northeastern woven fishing gears, rice storage and ancient pottery production. The products were made based on the clay body formula for forming gained from the experiment by slip casting in plaster mole. The clay used to decorate the earthenware was painted with colors and glazed at 1,000 °C. A total of ten prototypes were made with packaging and brand logo and tested in two fair showcasing. The product prototypes were assessed and received suggestions for further improvement.

This research creates an innovation of porous ceramic used to absorb essential oils by glazing and drilling holes to control the evaporation rate as an integration. The product designs are based on the northeastern wisdom, logo and packaging, marketing promotion, social support, the use of local materials and the production by the locals. In addition, it is also a breath of life for the traditional pottery making profession of villagers in Hoa Boeng village and Thailand that is at risk of being lost in the near future.

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