

# Consumer Acceptance of Innovative Water Repellent Pineapple Fiber Papers

Jarinya Wuttitien and Kawee Srikulkit

**Abstract**—Thailand is one of the famous agricultural countries in South – East Asia because of the geographical location, rich in a variety of crops. Pineapple is one of the major agricultural products that mostly are grown in Prachuapkirikan, Petchaburi, Chanthaburi and Trad provinces. Pineapple fruit is the main product in the view of farmers. Nowadays, pineapple leaf considered as a waste is a good and valuable source of fiber for textile and paper products. Particularly, pineapple fiber paper is easily prepared. However, the main problem of pineapple paper is its ease of deformation arising from its wettability. Therefore, innovative water repellent pineapple paper was developed using [1] sol-gel technology. Successfully, the water repellent pineapple paper led to a variety of paper products which potentially could allure consumer attraction.

**Index Terms**—Pineapple fiber paper, water repellent paper, consumer acceptance.

## I. INTRODUCTION

According to Thai Office of Agricultural Economics, Thai pineapple products in 2011 were increased by 25.41% when compared to the previous year [2]. The products mostly included fresh pineapples and processed pineapple products. Harvesting of pineapple fruits commonly abandons tons of waste pineapple leaves. In the past, this waste was mostly burnt to prepare soil for the next farming, causing air pollution. Nowadays, pineapple leaves are found to be value-added source for making paper. Handmade pineapple paper is developed and commercially produced thanks to the support by Thai government under the campaign called as “One Tumbon One Product” which helps promote local industrial and also helps local people to earn additional income by developing products based on their local culture and resources. The aim of the study was to research on how to add more value to pineapple papers for increasing farmer income and supporting recycle of waste product project. The major disadvantage of pineapple paper is its ease of wetting, causing the deformation of paper dimension derived from swelling and breaking. In this study, coating of pineapple paper using sol- gel technology was investigated. The prototype product having water repellent property was created. Survey research was a tool for analyzing the consumer acceptance. One hundred of participants were the

descriptive statistical was employed to summarize in an appropriate way.

## II. THE REVIEW OF THE LITERATURE

### A. Water Repellent Pineapple Paper via Nano Coating

Dr. Issara Sramala and the researcher team from National Science and Technology Development Agency in Thailand (NSTDA) [3] researched and developed on water repellent mulberry paper by using polytetrafluoroethylene (Teflon) coating via Nano technology. The resultant properties of the mulberry paper included the water repellent property, fire resistant and its regular stickiness level. He also said that the process in coating this water repellent mulberry papers were similar to the process in coating strands and textiles because mulberry papers made up of cellulose fibers but short length and arrange in an improper way.

Dr. Roberto Cingalani and the researcher team from Italy [4] discovered and developed waterproof paper from nano coating technology without modifying its own basic properties. Paper is still paper, can be able to write, fold and print. The main process was making the monomer of pulp paper connect with nanoparticles by wetted with an acrylic solution containing manganese ferrites, which are magnetic. When it gets wet, the mixture forms a Nano-shell surround individual fiber, rendering the fiber water-repellent.

Zeshan Hu, Xiaoyan Zen, Jian Gong and Yulin Deng [5] researched and developed water resistance of paper by superhydrophobic modification with micro sized  $\text{CaCO}_3$  and fatty acid coating. They found that precipitated calcium carbonate with fatty acid salt mixing with binder of polymer can improve water contact angle of drop of water and paper surface.

Norton Company [6] developed and invented the Tufbak Gold T481 silicon carbide waterproof finishing paper with Silicon Carbide abrasive bonded to A-weight paper backing which will eliminate due to change of humidity level. As a result the paper is very flexible, longer life and high quality of surface finish.

## III. METHODOLOGY

### A. Tools and Chemical Preparation

- 1) Dynasilan 9116 (organosilane obtained from Evonik Industries AG)
- 2) Isopopanol
- 3) Aerosil dispersion (nano silica dispersion obtained from Evonik Industries AG)
- 4) Acetic Acid

Manuscript received January 9, 2013; revised March 10, 2013.

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- 5) Air compressor
- 6) Spray nozzle
- 7) Spray Container

#### B. Procedure

- 1) Mix all chemical in appropriate ratio and pour in the spray container.
- 2) Connect the air compressor with a spray nozzle and the spray container.
- 3) Spray the chemical on both side of half dry or dry pineapple fiber paper.
- 4) Dry pineapple fiber paper 2-3 days for getting best waterproof pineapple fiber paper.
- 5) Now pineapple fiber paper will change its property to superhydrophobic when contact with water as shown in below figure [7].

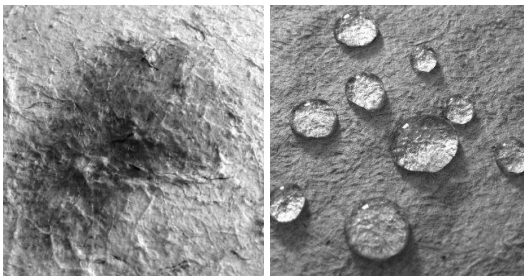


Fig. 1. The comparison of original pineapple fiber paper and pineapple fiber paper coating with Sol-gel when contact with few drops of water.

#### C. Survey Questionnaire Preparation

[8] The survey questionnaire contains four parts which are: 1. Knowledge, attitude and behavior of the consumer to the product 2. Marketing mix 3. Consumer acceptance 4. Demographic information. In the first part, the questions will be asking about the knowledge, attitude and behavior of the participants to the cellulose papers product (Mulberry papers, Pineapple fiber papers, Banana fiber papers and etc.) and also about the existing waterproof papers. In the second part, the questions will be asking about the marketing mix for the person who used the existing waterproof papers. In the third part, the question will be asking about the consumer acceptance but before doing this part the participant have to evaluate and test the product sample and compare to the original product. In the fourth part, the participants need to give the information about their demographic like gender, age, education and income level.

#### D. Survey Questionnaire Distribution

[9] This survey questionnaire will be distribute to 20 of secondary school students, 40 of students from faculty of Art and 40 of power purchasers. The sample of waterproof pineapple fiber paper and the original of pineapple fiber paper will be pack and attach along with the survey questionnaire.

## IV. RESULT AND DISCUSSION

#### A. Demographic Information

The survey was conducted in Bangkok, the capital city of Thailand and the city where 9% of Thai people live. After gather data from the survey, found that 31% of the

participants were male and 69% of the participants were female. 51% of the participants were at the range of age 20 – 29 years old, 26% of the participants were at the range of age 30 – 39 years old, 20% of the participants were at the range of age 10 – 19 years old and 3% of the participants were at the range of age 20 – 29 years old respectively. For the education level, 47% bachelor degree, 20% secondary school, 19% higher bachelor degree and 14% vocational level. For the participant's occupation, 60% were high school/ university students, 21% were company employees, 5% were public servants and 4% were owner of business. For the participant's income rate (Baht), 35% have 5,001 – 10,000 Baht, 28% have 20,001 – 30,000 Baht, 28% have less than 5,000 Baht, 26% have 10,001 – 20,000 Baht, 7% have 30,001 – 40,000 Baht and 4% have more than 40,001 Baht respectively.

#### B. Knowledge, Attitude and Behavior of the Consumer to the Product

##### 1) Cellulose paper

In terms of knowledge, attitude and behavior of the consumer to cellulose paper product (Mulberry papers, Pineapple fiber papers, Banana fiber papers and etc.), about 97% of participants had ever bought cellulose paper product and 3% of participants never buy cellulose paper product before. 76.29% of participants bought cellulose paper from stationery store, 58.76% of participants bought cellulose paper from department store, 10.31% of participants bought cellulose paper from supplier and 3.09% of participants bought cellulose paper from online store respectively. For about the purpose of buying cellulose paper, 62.89% bought for handcraft, 54.64% bought for decoration thing, 45.36% bought for wrap a gift and 5.15% bought for other purpose like bought for their children. 72.16% of participants considered to buy cellulose paper from their attractiveness, 43.30% of participants considered from their colorfulness, 37.11% of participants considered because they are eco-friendly, 18.56% of participants considered from their cheapness, 12.37% of participants considered from their stickiness and 6.19% of participants considered from other factors like design and texture which matching with the buyer purpose.

##### 2) Existing waterproof paper

In terms of knowledge, attitude and behavior of the consumer to existing waterproof paper product, only 29% of participants have ever bought waterproof paper product and 71% of participants never buy waterproof paper product before. 58.62% of participants bought waterproof paper from department store, 37.93% of participants bought waterproof paper from stationery store, 10.34% of participants bought waterproof paper from online store and 3.45% of participants bought from other source respectively. For about the purpose of buying waterproof paper, 51.72% bought for handcraft work, 44.83% bought for wrap a gift and 37.93% bought for decoration thing. For the satisfaction level of existing waterproof paper, after used the product 51.72% of participants feel neutral, 27.59% of participants feel satisfied, 13.79% of participants feel very satisfied, only 6.90% feel unsatisfied and no participant selected very unsatisfied.

C. Marketing Mix

In this part, the participants who had ever bought waterproof paper will rate the importance level of existing waterproof product throughout the marketing mix criteria [10]. The value of each rate will be 5 mean very important, 4 mean important, 3 mean neutral, 2 mean slightly important and 1 mean low important. The result will be shown in the form of standard deviation and mean as follow.

TABLE I: MARKETING MIX’S RESULT IN PRODUCT PART

Marketing mix criteria	5	4	3	2	1	X	SD	n
1. Product								
1.1 Eco-friendly waterproof paper	10	19				4.34	0.13	29
1.2 Mould and humidity prevention properties	14	11	4			4.34	0.19	29
1.3 Retain its original texture.	9	13	7			4.07	0.20	29
1.4 Harmless when contact direct to human skin	19	7	3			4.65	0.18	29
1.5 Colorfulness and design	12	10	6	1		4.14	0.23	29
1.6 Quality	14	9	5	1		4.24	0.23	29
1.7 Smell	10	7	9	3		3.83	0.27	29

TABLE II: MARKETING MIX’S RESULT IN PRICE PART

Marketing mix criteria	5	4	3	2	1	X	SD	n
2. Price								
2.1 Reasonable price	11	9	9			4.07	0.22	29
2.2 Product price compare to existing product price	7	17	4	1		4.03	0.19	29

TABLE III: MARKETING MIX’S RESULT IN PLACE PART

Marketing mix criteria	5	4	3	2	1	X	SD	n
3. Place								
3.1 Convenience	7	13	6	3		3.83	0.25	29
3.2 Spread all over	8	10	8	3		3.79	0.26	29

TABLE IV: MARKETING MIX’S RESULT IN PROMOTION PART

Marketing mix criteria	5	4	3	2	1	X	SD	n
4. Promotion								
4.1 Price discount	7	14	5	3		3.86	0.24	29
4.2 Give-away gift	6	11	8	4		3.66	0.26	29
4.3 Advertise about eco-friendly	9	14	6			4.10	0.19	29
4.4 Advertise about the product guarantee with the research	13	12	1	3		4.21	0.25	29
4.5 Advertise in various media eg. TV, online radio and etc.	6	10	10	3		3.66	0.25	29
4.6 Display the product by showing the example of how to use it	11	15	2	1		4.24	0.20	29

D. Consumer Acceptance

In this part, participants need to test the sample waterproof pineapple fiber paper and compare to original pineapple fiber paper before start evaluating in this part. Participants need to rate the level of likelihood. The value of each rate will be 5

mean extremely likely, 4 mean likely, 3 mean neutral, 2 mean unlikely and 1 mean extremely unlikely. The result will be shown as follow.

TABLE V: CONSUMER ACCEPTANCE IN SPECIFIC CHARACTERISTICS

Characteristics	5	4	3	2	1	X	SD	n
1. Outer appearance	42	45	12	1		4.28	0.35	100
2. Surface and texture	45	42	12	1		4.31	0.36	100
3. Water-repellent	46	46	7	1		4.37	0.33	100
4. Quality	34	55	11			4.23	0.32	100
5. Overall	49	39	12			4.37	0.34	100

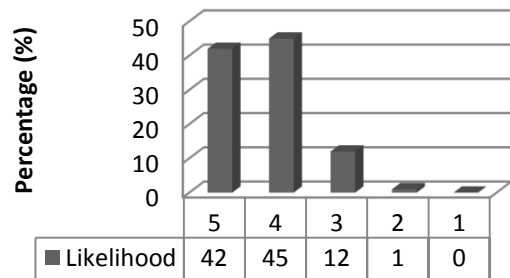


Fig. 2. Likelihood level in outer appearance characteristic.

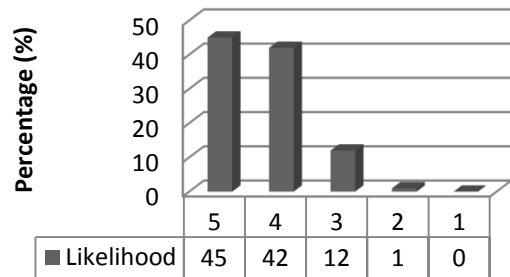


Fig. 3. Likelihood level in surface and texture characteristic.

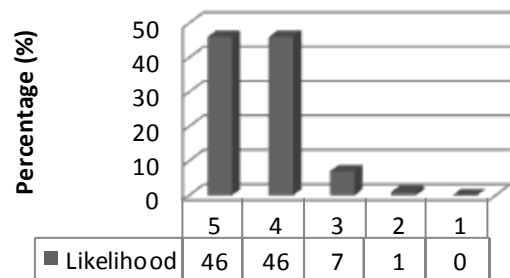


Fig. 4. Likelihood level in water-repellent characteristic.

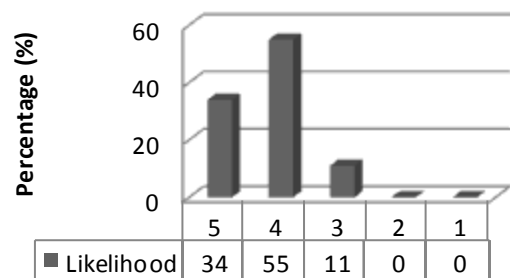


Fig. 5. Likelihood level in quality characteristic.

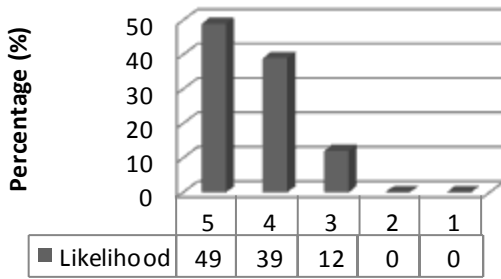


Fig. 6. Likelihood level in overall characteristic.

At the end of this part, participants need to rate the degree of interest to this waterproof pineapple fiber paper product. 4 mean Very interest, 3 mean Interest, 2 mean Not sure and 1 Not at all interested.

TABLE VI: DEGREE OF INTEREST

ConsumerAcceptance		4	3	2	1	X	SD	n
Degree of interest		27	65	7	1	3.18	0.30	100

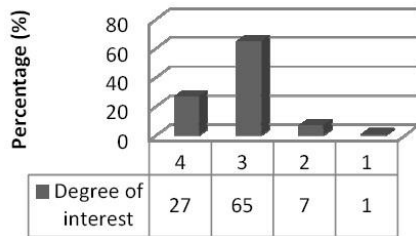


Fig. 7. Degree of interest.

### V. CONCLUSION

At the end of the study, its show that survey research was one of the powerful tools in order to get the result of the consumer. After conducted survey research to the sample target population, the overall result was very satisfied as 65% of participants who test prototype product interest to buy it and also about 27% was very interest in this product compare to not sure and not at all interested which were 7% and 1% respectively. Waterproof pineapple fiber paper product will be an innovative product for Thai farmer to gain more income and help their local area to grow more.

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