

2018 Khamouk study

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Introduction

Khamouk is a traditional wood putty used for Buddhist images in Lao PDR. It is made of lacquer mixed with the ash of the Bodhi tree. Some of the major uses of khamouk include using a mold to make reliefs to put on walls of Buddhist temples, making rahotsu (the curls of hair of the Buddha) for statues, and repairing cracks in Buddhist statues. While there are many people who can make khamouk well, it is extremely uncommon to measure the ingredients and create recipes for perfect khamouk for various purposes. Therefore, in this study, we measured precisely to determine recipes for various kinds of khamouk, and tested drying time and hardness for molded khamouk.

Experiment 1 – Khamouk for Rahotsu

On February 27, 2018 we asked Virairavan Phonsamai, an expert in khamouk production, to make khamouk for use in rahotsu (Buddhist curl) molds. This



Figure 1



Figure 2

type of khamouk is firmer and contains a higher percent of Bodhi tree ash than other varieties. After production, it is put in a silicon mold (figure 1), then after drying, is shaped with a knife (figure 2). Then it is affixed to the head of the Buddhist statue using lacquer or glue (figure 3). Using lacquer is the traditional method, but the curls fall off easily and so modern glue is usually used for modern statues.



Figure 3



Figure 4

Figure 4 shows the finished Buddha head with a complete set of curls.

Methods and calculation of Experiment 1

2/27/2018 Khamouk test. Data in grams			
	①	②	③
Ash dish	8.9	8.9	9.1
Rubber gloves	10.2	10	9.9
Lacquer dish	2.7	2.6	2.1
Lacquer dish + lacquer	12.5	13	12.7

Lacquer remaining after pouring + dish	4.7	3.8	4
khi thao (ash of Bodhi tree) + dish	44.9	40.9	37.4
khi thao + dish after making khamouk	24.1	15.7	15.3
finished khamouk	27	31.9	28.1
rubber gloves + khamouk on gloves	11	11.4	12.1

Chart 1

In the experiment, we used lightweight plastic dishes and rubber gloves, and weighed everything in grams. The temperature was 26 degrees and the humidity was 71%. The experiment was repeated three times. Each time Virairavan Phonsamai was asked to make khamouk suitable for rahotsu using the materials we provided. During the process of creation, some of the ash blows away, and therefore a difference of about 1 gram is usual between the amount of materials used and the finished product.

Calculation of 2/27 experiment in grams			
	①	②	③
Weight of rubber gloves after creation minus weight before creation	11.0-10.2 =0.8g	11.4-10 =1.4g	12.1-9.9 =2.2g
Weight of khi thao plus dish before creation minus weight after creation	44.9-24.1 =20.8g	40.9-15.7 =25.2g	37.4-15.3 =22.1g
Weight of lacquer dish plus lacquer before creation minus weight after creation	12.5-4.7 =7.8g	13-3.8 =9.2g	12.7-4.0 =8.7g
Khi thao used plus lacquer used	20.8+7.8 =28.6g	25.2+9.2 =34.4g	22.1+8.7 =30.8g
Finished khamouk plus material remaining on gloves	27+0.8 =27.8g	31.9+1.4 =32.3g	28.1+2.2 =30.3g
Ratio of ash to lacquer	20.8 ÷ 7.8 =2.66:1	25.5 ÷ 9.2 =2.74:1	22.1 ÷ 8.7 =2.54:1



Figure 5



Figure 6



Figure 7

First, lacquer was heated and then cooled. Next, ash was measured and a small well made in the center of the ash with fingertips. The cooled and measured lacquer was poured into the well in the ash (figure 6). Then the measured ingredients were mixed. The mixing process is very delicate and should be done with the fingertips. For approximately 10 minutes the mixture was folded again and again while increasing the amount of ash to an appropriate concentration. When Viraivan Phonsamai was satisfied with the khamouk she stopped mixing and the remaining ingredients and the finished khamouk were weighed (figure 7).

Results and conclusions of experiment 1

The ratio of khi thao to lacquer was as follows: in the first test, 2.66 to 1; in the second test, 2.74 to 1; and in the final test, 2.54 to 1. When asked for subjective data, Viraivan Phonsamai said that the second khamouk made was the best and the last was just a little bit moist for the making of rahotsu. Therefore, we concluded that the optimum ratio for khaouk to be used in the making of rahotsu was approximately 2.7 to 1.

Experiment 2 – Softer khamouk for molding or for repairing cracks



Figure 8



Figure 9

For molding or for repairing cracks in Buddhist statues, the khamouk for rahotsu is too firm. A slightly softer variety that can be readily put into small cracks or fine lines of a mold is necessary. Figure 8 shows a mold for reliefs that were used on a temple wall in Luang Prabang. Figure 9 shows khamouk being used to fill a crack in statue #41 from Wat Visounnarat, which was being restored during February and March of 2018.

Methods and calculation of Experiment 2

3/7/2018 Khamouk test. Data in grams		
	①	②
Ash dish	8.9	8.9
Rubber gloves	10.3	10.9
Lacquer dish	2.3	2
Lacquer dish + lacquer	12.3	12
Lacquer remaining after pouring + dish	4.1	3.9

khi thao (ash of Bodhi tree) + dish	34	34
khi thao + dish after making khamouk	14.9	13
finished khamouk	25.8	27.7
rubber gloves + khamouk on gloves	11.4	11.8

Chart 2

In the experiment, we used lightweight plastic dishes and rubber gloves, and weighed everything in grams, as in Experiment 1. The temperature was 25.9 degrees and the humidity was 58%. The experiment was repeated twice. Both times Viraiwan Phonsamai was asked to make a soft khamouk suitable for molding using the materials we provided. As explained above, during the process of creation, some of the ash blows away, and therefore a difference of about 1 gram is usual between the amount of materials used and the finished product.

Calculation of 3/7 experiment in grams		
	①	②
Weight of rubber gloves after creation minus weight before	$11.4-10.3=1.1g$	$11.8-10.9=0.9g$
Weight of khi thao plus dish before creation minus weight after	$34-14.9=19.1g$	$34-13=21g$
Weight of lacquer dish plus lacquer before creation minus weight after	$12.3-4.1=8.2g$	$12-3.9=8.1g$
Khi thao used plus lacquer used	$19.1+8.2=27.3g$	$21+8.1=29.1g$
Finished khamouk plus material remaining on gloves	$25.8+1.1=26.9g$	$27.7+0.9=28.6g$
Ratio of ash to lacquer	$19.1 \div 8.2=2.33:1$	$21 \div 8.1=2.59:1$

The process of mixing and folding ash into the khamouk was the same as described above. The difference was subjective; Viraiwan Phonsamai stopped

creation when she felt the khamouk was an appropriate concentration for molding.

Molding of khamouk made in Experiment 2



Figure 10

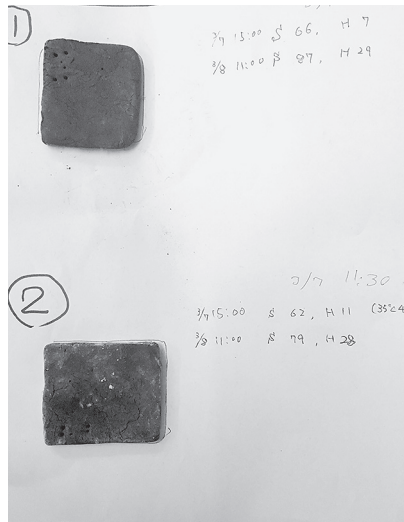
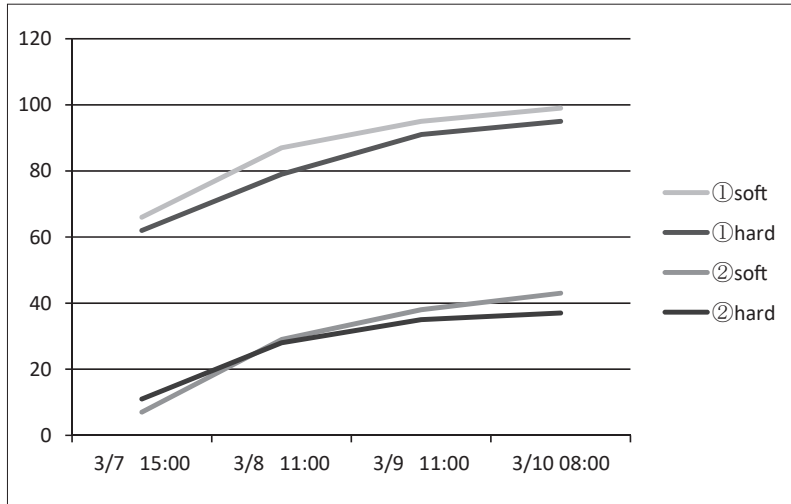


Figure 11

To test hardness and drying time, the khamouk made in experiment 2 was put into a rectangular flat mold and dried. The mold was 71 mm long, 52 mm wide and 5 mm deep on the inside. However, the amount of khamouk created was not enough to completely fill the mold. The dimensions of the created khamouk slabs were as follows: for the first test, 5.2 mm × 0.5mm × 4.8mm, volume = 12.48mm³; for the second test, 5mm × 5.8mm × 0.5mm, volume = 14.5mm³.



	3/7 15:00	3/8 11:00	3/9 11:00	3/10 08:00
① soft	66	87	95	99
① hard	7	29	38	43
② soft	62	79	91	95
② hard	11	28	35	37

As the period of measurement of dryness was not long enough to make definitive statements, we cannot make conclusions, but looking at the data it is clear that hardness increases in proportion to drying time. Because khamouk becomes hard over a period of time from 3 days to one week, it is useful as a material for sculpting. Materials that dry too quickly cannot be thoroughly shaped before becoming hard, and materials that dry too slowly are not useful, especially when working in a limited time frame.

Experiment 3 – inexperienced people making khamouk

As a final experiment, we had three people without experience in khamouk production attempt to make it after watching Viraivan Phonsamai making it. Three of the people were students, with little experience of such activity, and

one was a professor (Minoru Suzuki).

Calculation of amateur experiment in grams				
	① mari	② ikeuchi	③ waan	④ suzuki
Weight of rubber gloves after creation minus weight before	10.7-10.4 =0.6g	10.4-10 =0.4g	11.1-10.1 =1g	11-10.2 =0.8g
Weight of khi thao plus dish before creation minus weight after	38-21.8 =16.2g	38-25 =13g	38-20.5 =17.5g	38.2-23.9 =14.3g
Weight of lacquer dish plus lacquer before creation minus weight after	11-3.7 =7.3g	11-3.9 =7.1g	12-4.8 =7.2g	10.7-3.5 =7.2g
Khi thao used plus lacquer used	16.2+7.3 =23.5g	13+7.1 =20.1g	14.3+7.2 =21.5g	14.3+7.2 =21.5g
Finished khamouk plus material remaining on gloves	21.5+0.6 =22.1g	18.8+0.4 =19.2g	19.6+0.8 =20.4g	19.6+0.8 =20.4g
Ratio of ash to lacquer	2.22:1	1.83:1	2.43:1	1.98:1
subjective information	too hard to use	too hard to use	used for rahotsu	put in mold

Several important points can be learned from this experiment. First, while an experienced khamouk maker can put 2.7 times as much ash as lacquer into khamouk and still have a usable substance, an inexperienced maker cannot make a usable substance even using 1.83 times as much ash as lacquer. This shows how difficult and how important the mixing process is. Second, no matter who makes khamouk, roughly the same amount remains stuck on the gloves and roughly the same amount is lost during the process of creation. Finally and most importantly comes the question of who can make it and why. Subject #1 watched Viraiwan Phonsamai and tried to copy her hand movements, but had no experience and therefore could not make anything close to useful khamouk. Subject #2 had experience with clay and tried to make khamouk with the same texture as usable clay, but this experience did not enable him to make usable

khamouk. Subject #3 watched Viraivan Phonsamai and imitated her hand movements as exactly as possible and could make usable khamouk, although the concentration of ash to lacquer was less than the optimum concentration. Subject #4 has 30 years of experience in making epoxy pate and made khamouk considering the texture for epoxy pate, and could make a soft and usable khamouk, although the concentration of ash to lacquer was not as high as expected.

Conclusions

This study led to several important conclusions. First, khamouk made by an experienced person for use in rahotsu molds should be made using an ash to lacquer ratio of about 2.5-2.7 to 1. Second, khamouk made by an experienced person for use in molding or for repairing cracks in Buddhist statues should be made using a ratio of about 2.3-2.6 to 1, slightly less than for rahotsu and therefore a little bit softer. And finally, if an inexperienced person wishes to make khamouk, he/she should either watch an experienced person very carefully or have experience with similar pates.

This study considered khamouk in Lao PDR. We have yet to explore other countries in the area, so further research will be necessary in the future.