Comparison of KEMOMI Technique Between Master Craftsman and Unskilled Worker

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Abstract. The Nara FUDE, made of several kinds of fibers with different properties, can achieve quality. However, the insufficiency of the mix process of the fibers may lead to the unstable quality of the final product. Fiber bundle of about 400 pieces of brush were mixed by hand at one time, which was called 'KEMOMI'. In this study, subjects with three different experiences were chosen (Master worker with 17 years of experience, Intermediate worker with 8 years of experience, Unskilled worker with 8 month of experience.). Refer to the method of the analysis of 'KEMOMI', three colours were in the rested fiber bundle, two kinds of filaments painted red and blue on the opposite of the taper side as well as the non-painted white colour. In order to analyse the progress degree of KEMOMI, binary coded processing was carried out on the picture taken every elapsed time during 'KEMOMI'.

Keywords: Nara FUDE · KEMOMI · Traditional handicraft · High quality brush · Master work

1 Introduction

Nowadays, traditional handicrafts are faced with serious problems such as decrease in demand as a result of the changing of the lifestyle and the decrease of the successors. Carrying out the motion analysis as well as the process assessment on the manufacture of the traditional crafts is of great meaning. Among them, there are also companies that have achieved the production with low cost but high quality from the heritage of the traditional craft skills. Soliton corporation is one of them and has made the flexible use of the traditional handicraft by making parts of the process automatized. And soliton corporation has succeed in the quantification of the worker's motion from an independent view, which did not mean only bringing the process in to automation but also managing to reappear the handy motion of the craft worker.

In the case of adopting of the automation, 30 times improvement in the production of that of the previous method can be realized, that made it possible for the new products to compete against the cheap products imported from oversea. However

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automation will not be brought into the whole processes, and the important process is still controlled by human hand, aiming at the manufacture of products with wisdom and human feelings, which is identified as products with high quality. This study has thrown a light upon the unknown process of the handicraft manufacture. The Nerimaze method, as a symbol of the Nara FUDE, refers to that a bundle of fiber for only one calligraphy brush will be took out and inverse into the water and shape into the desire shape, meanwhile the receipt and the size will also be changed according to the characteristic of the calligraphy brush. More than 10 kinds of natural fiber will be adopted from animals to make the calligraphy brush with suitable rigidity and good ink maintenance property. The adopting period of the fiber as well as the body section of the animal may bring great influence to the finishing process. Thus the ancient calligraphy brush craft had been thinking about the slight difference, such as flexibility, strength and length, between the natural animal fibers and put them together in a fantastic way according to the sufficient experience and long years' effort. In this way, the Nara FUDE was designed and manufactured.

Fibers are not able to demonstrate the performance only by mixing the filaments with different characteristics, synergy of high performance only begins to appear when filaments are uniformly distributed. As a result, different fibers were chosen and mixed together in order to produce the brush with high quality. However if those different fibers are not mixed sufficiently, the quality of the final product will not be stable. By the process of 'KEMOMI', all kinds of the fibers were mixed according a certain ratio, and distributed evenly. In this study, with the using of the binary coded method on the 'KEMOMI' process simulating the Nerimaze method of Nara FUDE, subjects with three different experiences were chosen (Master craft`s man with 17 years of experience, Intermediate worker with 8 years of experience, Unskilled worker with 8 month of experience.), the degree of the process of 'KEMOMI' was carried out and analyzed. Information and the essential points got from the analysis results, can give a support to correct direction and plays an important role in the training of the unskilled worker.

2 Method

2.1 Operation Condition of the KEMOMI Process

In this study three types of PBT filaments listed below was used to manufacture the brush.

(1) 520 M-0.14 Round shaped (TORAY MONOFILAMENT CO., LTD.)
(2) SOW-W-0.10 Round shaped (Suminoe Textile Co., Ltd)
(3) 521 M-0.15 Star shaped (TORAY MONOFILAMENTCO., LTD.)

Three kinds of PBT filaments after "KEGUMI" was mixed 40 g each in this experiment. Two kinds of filaments were painted red and blue on the opposite of the taper side, which allows checking the mixing degree by eyesight. The bundle of filament was made and the process of "KEMOMI" was taken place. The Fig. 1 is illustrating the scene of the 'KEMOMI' process by worker.

Fig. 1. Scene of 'KEMOMI' process

In this study test subject with three different experiences was chosen (Master worker with 17 years of experience, Intermediate worker with 8 years of experience, and unskilled worker with 8 month of experience). The subject work will judge the 'KEMOMI' process degree independently by check the color of the bottom of the fiber bundle. Ten times of 'KEMOMI' process were repeated, and the white threshold percentage was calculated and the process time was recorded (Fig. 2).

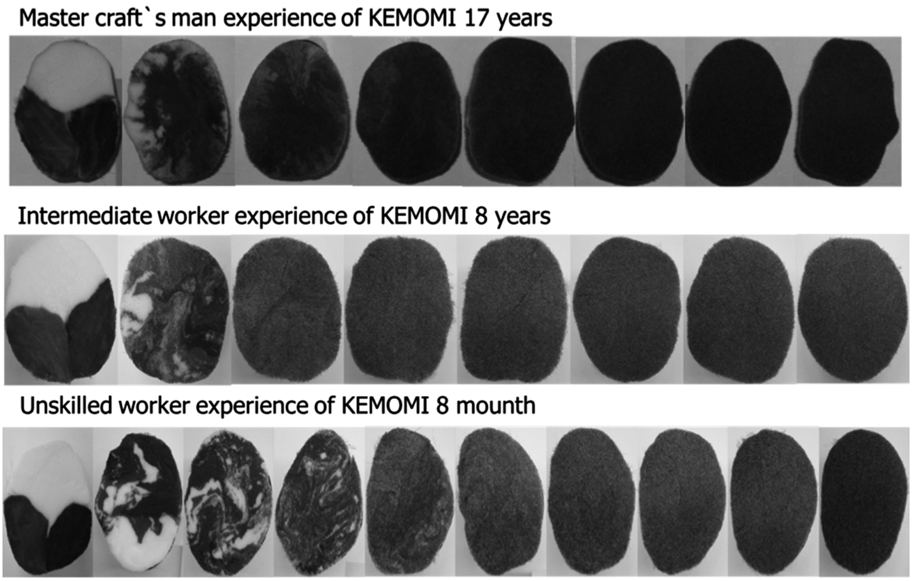

Fig. 2. States of fiber bundle from bottom sight

2.2 Analyzing Method of the 'KEMOMI' Process

To analysis the progress degree of KEMOMI, binary coded processing was carried out. For the first step, the experiment for deciding the optimal threshold value used for analysis was conducted. In this study binary coded processing was operated by using unimodal binary coded processing method. The picture image of the base of the fiber bundle was taken every elapsed time during "KEMOMI", also with one minute extra time. The images of the master worker as an example are shown in Figs. 3 and 4. Ten times of 'KEMOMI' process were repeated for every subject.

In order to determine the optimal threshold value for analysis, picture image of the last lapsed time which is thought as the most progressed "KEMOMI" process was used for the first step of analysis. The image was cut to 320 × 240 pixel size for binary coded processing. To analyze the "KEMOMI" progress, distribution of the white fiber was focused and threshold value used for next analysis step was computed when the number of lumps of a white pixel becomes the maximum in the final minutes of KEMOMI. The optimal threshold value presupposed as the same value from which the number of lumps of the white pixel became the maximum.

The second analysis was carried out to analyze the share of a white pixel in fiber bundle using this threshold. The image of every elapsed time was partitioned to Upper, Left, Right parts for analysis and each image was analyzed based on a similar threshold computed in the first step, and the occupancy rate of the white pixel at every elapsed time was calculated. There by the progress degree of "KEMOMI" process became possible to be measured. As the Fig. 3 is showing, the changing of the state of the fiber of different kind in the case of the master worker can be seen by human eyes. In this way the optimal threshold value can be collected and calculated.

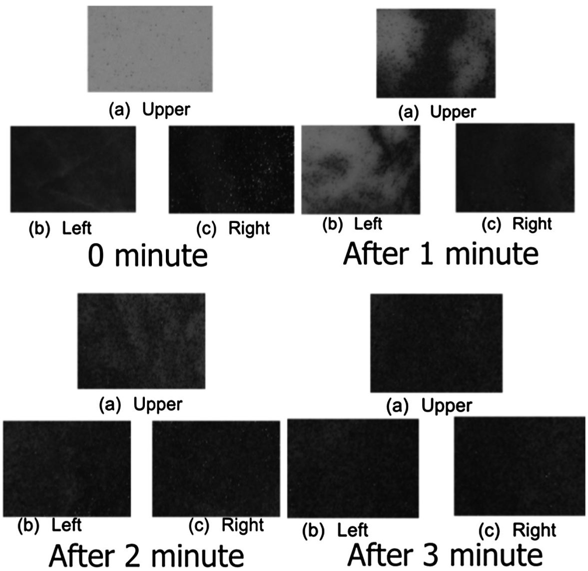

Fig. 3. The fiber mixing state of the master worker in the first 3 min

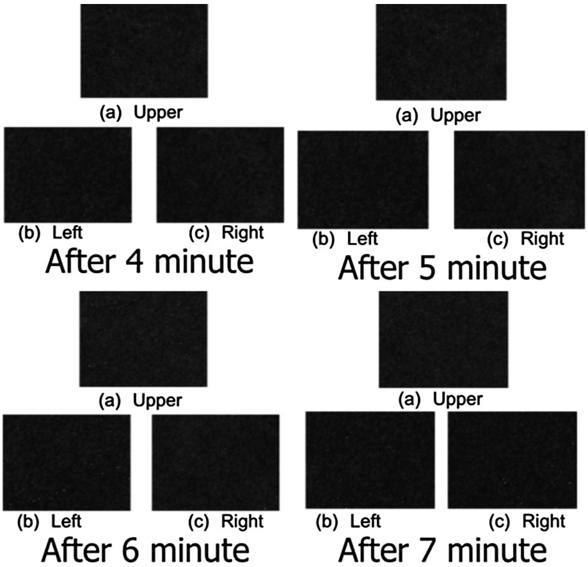

Fig. 4. The fiber mixing state of the master worker from 4–7 min

3 Results and Discussion

3.1 Result of the Master Worker

In this part, the optimal threshold values of all the parts the upper side the left side as well as the right side were collected and calculated. The average 'KEMOMI' process time for master worker is 6.9 min and the white threshold percentage is 13.98 % as the Fig. 5 showing below.

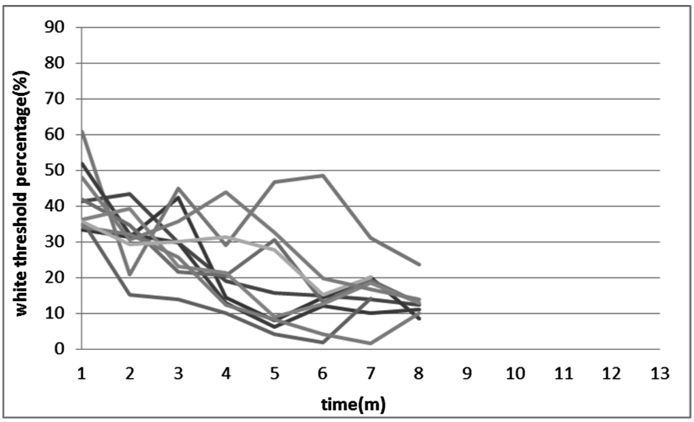

Fig. 5. Procedure of 'KEMOMI' process of the master worker

3.2 Intermediate Worker B (8 Years' Experience)

For the intermediate worker with 8 years' experience, the average 'KEMOMI' time is 7.9 min and the white threshold percentage is 11.16 % as the Fig. 6 showing below.

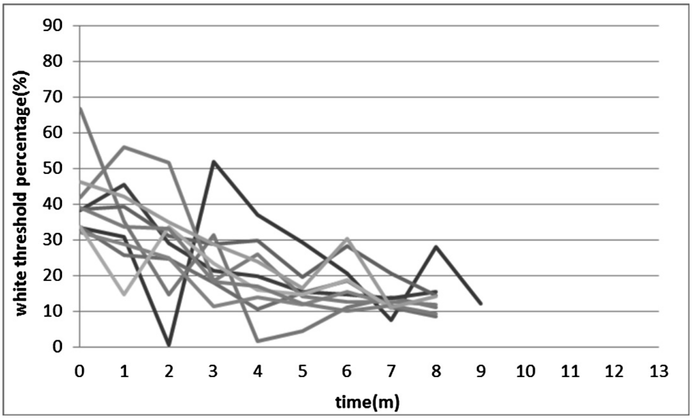

Fig. 6. Procedure of the 'KEMOMI' process of the Intermediate worker B

3.3 Unskilled Worker A (8 Month' Experience)

While for the unskilled worker with experience of only 8 months, the average 'KEMOMI' time is 11.8 min and the white threshold percentage is 14.02 % as the Fig. 7 showing below.

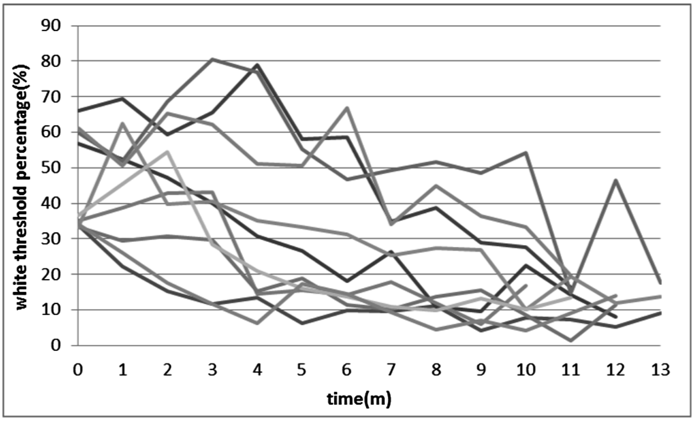

Fig. 7. The procedure of the 'KEMOMI' process of the Intermediate worker A

The results of average of the process time of the three subjects were illustrate in the Fig. 8. According to the degree from the calculation, the efficiency deviation of process of the three subjects was F = (2,27) = 7.19, p > 0.05, which means there were actually difference among the three subjects.

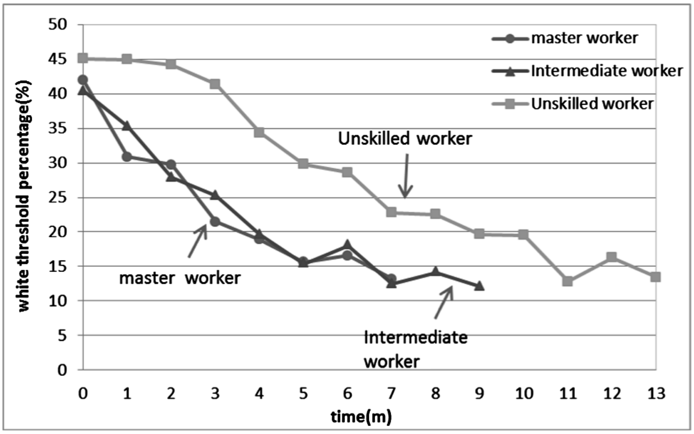

Fig. 8. Comparison of the procedure of the 'KEMOMI' process

4 Further Research

The average 'KEMOMI' process time for master worker is 6.9 min and the white threshold percentage is 13.98 %; for the intermediate worker with 8 years' experience, the average 'KEMOMI' time is 7.9 min and the white threshold percentage is 11.16 %; while for the unskilled worker with experience of only 8 months, the average 'KEMOMI' time is 11.8 min and the white threshold percentage is 14.02 %. From that all of three subjects can judge the 'KEMOMI' process degree and control the white threshold percentage below 15 % by check the color of the bottom of the fiber bundle during the process. Besides, it can be known from the figure that the intermediate worker can not judge and decide the time to stop the process and cost more time although white threshold percentage below 15 % was also achieved just as the master.

Thus, it is essential to judge and stop at the very point that the 'KEMOMI' process was finished, in order to improve the efficiency of the work time. What's more, in the case of unskilled worker A, the standard of 15 % was realised, however, it was still necessary to analyse the data for decreasing the operation time in future. From the figures it also can be seen that, for the unskilled worker A, the decrease of the white threshold percentage was slow in the first three minutes. Thus it was supposed to carry out the research on the comparison and difference on the motion between the master worker and the intermediate worker.

5 Conclusions

In this study, the "KEMOMI" process was researches and experiments were carried out among subject workers with experience of different years. This research managed to make the process judging by experience and institution into quantification standard. Obviously the result from the research can be a useful direction in training the unskilled workers in shorter time and thus try to solve the problem and make a contribution to the cultivation of the successor of the traditional handicraft industry.

References

1. Asada, M., Sakata, M., Shiono, T., Koshino, T., Yoshikawa, T., Takai, Y., Goto, A., Hamada, H.: Characteristics of motion during plaster model stuffing. In: Proceedings of 12th Japan International SAMPE Symposium and Exhibition, POS-5, pp. 1–6 (2011a)
2. Asada, M., Sakata, M., Shiono, T., Takai, Y., Goto, A.: Observation of surface structure of KYO-KAWARA (Ceramic material for roof component) fabricated by traditional skillful technique. In: Proceedings of the ASME International Mechanical Engineering Congress and Exposition, vol. 3, pp. 655–659 (2011b)
3. 小田原晶子•佐藤ひろゆき•杉江朋彦•森迫　清貴•塩野剛司•北島佐紀人•仲井朝美•濱田泰以.複合材料としての京壁.日本複合材料学会誌,vol. 35, no. 1, pp. 27–32 (2009)
4. 柴田勘十郎•仲井朝美•榎本晃朗•後藤彰彦•濱田泰以.京弓作製時における材料の見極めに関する研究.日本材料学会学術講演会講演論文集,vol. 60, pp. 49–50 (2011)
5. 柴田勘十郎•奈須慎一•久米雅•仲井朝美•濱田泰以.接着剤の違いにおける京弓の変形挙動と弓力の関係. Dynamics and Design Conference 2009,“422-1”–“422-4” (2009)
6. Tsuji, K., Takai, Y., Goto, A., Sasaki, G., Ohta, T., Hamada, H.: Human motion of weaving “Kana-ami” technique by biomechanical analysis. In: Advances in Ergonomics in Manufacturing, pp. 178–186. CRC Press (2012a). Chap. 19
7. Tsuji, K., Narita, C., Endo, A., Takai, Y., Goto, A., Sasaki, G., Ohta, T., Hamada, H.: Motion analysis of weaving “Kana-ami” technique with different years of experience. In: Proceedings of the ASME International Mechanical Engineering Congress and Exposition, IMECE2012-88809, pp. 1–6 (2012b)
8. Hamada, A., Ohnishi, A., Tanaka, T., Kume, M., Nakai, A., Yoshida, T
9. Biomechanical analysis of an-wrapping motion of the Kyogashi sweets expert. 京都光華女子大学短期大学部研究紀要, vol. 48, pp. 57–70, December 2010