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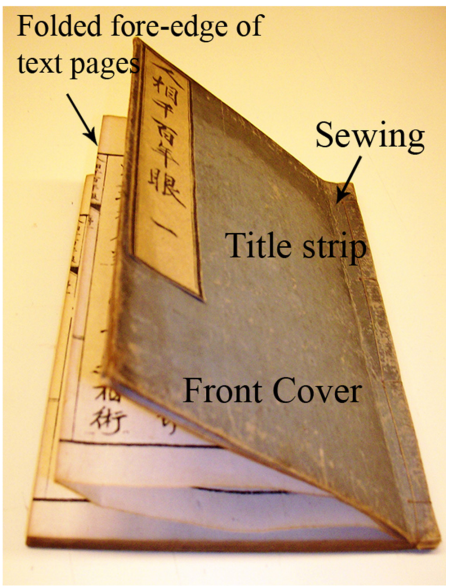
Investigation of Historical Japanese Paper: An Experiment to Recreate Recycled Paper from 18th–19th Century Japan

INTRODUCTION

Since 2003, I have been studying the physical traits of printed books from the 17th–19th century of the Edo period (Hioki 2008). The texts were almost exclusively produced by woodblock printing, on Japanese paper, and bound in side-stitched binding with paper covers (fig. 1). I was particularly interested in the book covers, including their decoration, structure, and materials. The cover decorations varied not only in their designs and colors, but also in their techniques, such as embossing (fig. 2) and burnishing (fig. 3).

The covers were usually constructed of one or more layers of poor quality paper. This inferior paper was made by the recycled papermaking process with waste paper such as discarded textbooks, written memos, and wrapping papers as the raw materials. An outermost sheet of the layered covers was made of thin, higher quality dyed paper (fig. 4). Recycled paper was selected for its softness, thickness, and its lower



LEFT TO RIGHT

Fig. 1. Example of a side-stitched binding. Text was printed on only one side of the text paper which was folded in half and sewn right-hand edge with paper covers.

Fig. 2. Embossed front cover of a mathematics text, *Kiku genpō chō ken bengi*, Dōkan Shimada; [Osaka : Kagaya Zenzō, 1828?]. LCCN: 2004552109, Library of Congress.

Fig. 3. Burnished back cover of a collection of cooking menus, *Shinsen hōchō kakehashi,* Hakuka Sugino, Osaka, 1803. LCCN: 99433295, Library of Congress.

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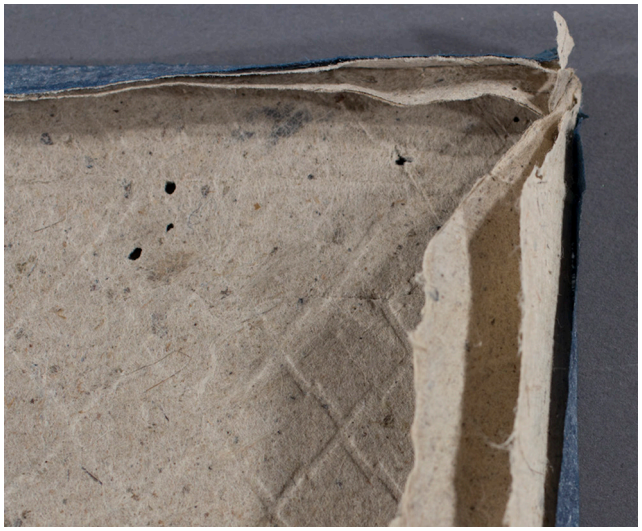

Fig. 4. Example of a book cover construction showing two laminated layers of recycled paper and a sheet of dyed paper.

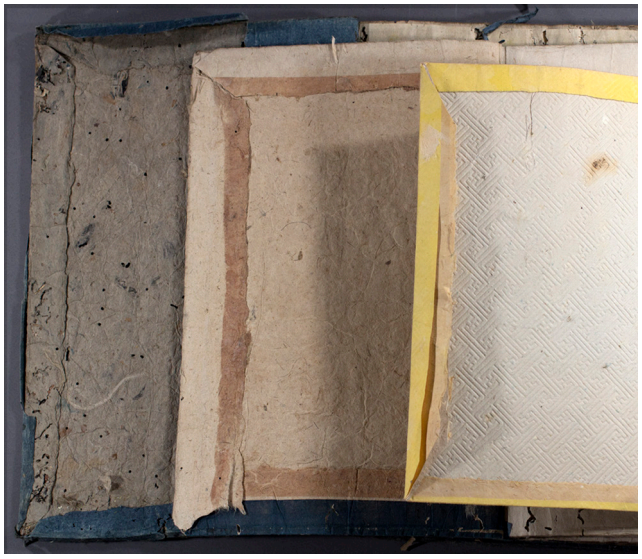

Fig. 5. Various kinds of Recycled paper used for book covers.

Fig. 6. Recycled paper book cover exhibiting contained impurities, such as pieces of fabric plants, paper, dust, and hairs.

cost for book covers. When certain cover decorations such as embossing were applied, the glued layers of thick and soft recycled paper cover became an effective support to carry impressive indentation (impression). Like the cover decorations, the recycled paper also varied in its color, thickness, and qualities. It could range from being thin and smooth to thick and dark gray in color (fig. 5), containing a high ratio of impurities such as dust, hair and pieces of fabric (fig. 6).

Investigating the technical aspects and historical background of the recycled papermaking could provide additional information about the book and help to identify the authenticity of book covers. The production methods and raw materials used were associated with a certain period of time and particular genres of texts. The manufacturing information can provide a clue on the makers and industry.

This is a report from the series of studies addressing the issues related to recycled paper. The state of recycled papermaking in the 18th–19th century Japan is briefly summarized, followed by an ongoing corroborative experiment to recreate recycled paper and book covers.

RECYCLED PAPERMAKING INDUSTRY IN THE 18TH–19TH CENTURY JAPAN

While papermaking started in Japan as early as the 7th century, it was the 18th century when production spread through the country that the quantity and types of paper produced drastically increased. In the 1736 publication *"Trading Goods in Osaka"* which recorded the important goods traded in the country's trading center, Osaka, paper was ranked 3rd after rice and lumber as having highest total cash value of commodities traded (Abe 1967) (table 1).

The production of cheaper and more affordable papers including recycled paper greatly increased, especially as they became the necessities for everyday life for the residents of the cities. For instance, the renowned scholar of the 19th century, Nobuhiro Sato, praised the commodity papers, including recycled paper, as the most useful of any paper (Sato 1928).

Japanese fine papermaking was carried out by farmers in poor farming areas during the agricultural off-season, using the raw materials of the *kozo* tree which grew in mountainous

Items	Quantity (unit)	Value (silver kan)
Rice	220,792 (koku)	8,638
Lumber	-	6,955
Paper	-	6,885
White cotton	11,178 (1000 tan)	5,172
Miscellaneous wood	38,698 (1,000 kan)	4,828
Cotton	1,604 (1,000 kin)	3,597
Copper	3,050 (1,000 kin)	3,512
Dried sardines	-	3,493

Table 1. List of the goods traded in Osaka in order of total cash value (Abe 1967,16).

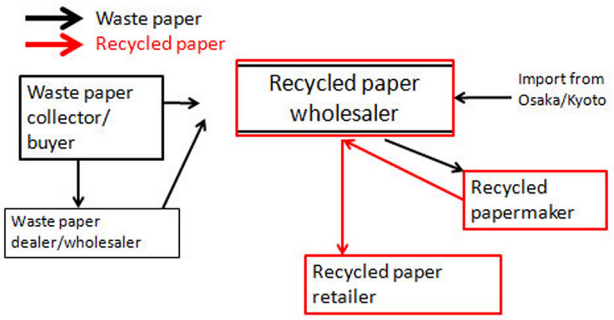

Fig. 7. Distribution of waste paper and recycled paper in the late 18th century in the Edo period.

areas. It also required sources of clean water and intensively skilled laborers (Kunisaki 1948)[1]. Conversely, recycled papermaking used raw materials such as discarded waste paper, secondhand texts, and trimmed new paper scraps, and its major production centers were the large cities, including Edo (today's Tokyo), Osaka, and Kyoto, mainly because these large cities were the biggest waste paper suppliers (Seki 1979).

Edo was the nation's largest waste paper supplier and paper consumer, and one of the biggest recycled papermaking regions (Seki 1943; Aida 2002). In Edo, all materials were recycled. A network of trash businesses such as waste collectors, brokers and wholesalers was developed. Trash was gathered on the street by sub-caste groups, and waste paper was also acquired by waste-paper buyers who went door-to-door.

The collected or purchased trash and waste paper was sorted into groups such as fabric, hair, and paper, and sold to waste paper dealers, brokers, and wholesalers, who then sold it to the recycled paper wholesaler (Yamano 2006). The recycled paper wholesalers then marketed the waste paper to the paper-making villages. When the supply from Edo area ran short, these merchants imported waste paper from the Osaka and Kyoto regions by ship. In addition to the distribution of raw materials, the wholesalers also controlled the dispersal of the final products. They purchased finished recycled paper from the papermakers and sold it to the retailers. A wholesale merchant might advance waste paper or cash to paper-making peasants, returning later to collect the processed goods in exchange for debts (Abe 1967, 32–33). By the early 19th century, the recycled paper business was controlled by the wholesaler monopoly, which found this arrangement very profitable (fig. 7).

RECYCLED PAPERMAKING PROCESS

Relatively little is known about the materials and the processes involved in recycled papermaking in the 18th–19th century. Recycled papermaking was perceived as too simple of a process that involved less-skilled peasants to be worthy of documenting (Seki 1973). In addition, the handmade recycled papermaking tradition seemed to vanish by the 1970s, and no Japanese papermakers continue this type of papermaking today. To find detailed or exact recycled papermaking processes, I studied the literature, interviewed Japanese papermakers for their comments, and came up with a plausible theoretical or hypothetical process which is summarized in Table 2 with a comparison to fine Japanese papermaking.

For recycled papermaking, first, waste paper was soaked in water for a couple of hours or cooked with ash and other alkaline agents. A viscous agent such as *tororo-aoi* plant was probably added to the pulp. The soaked or cooked waste paper was then hand-beaten. Then, a sheet of paper was formed on the screen of a mould by sheet-forming methods which probably required less skill than the traditional *nagashi-zuki* method, which consists of repeated motions of scooping up the solution, shaking the mould, and discarding the excess. The formed sheets were piled up. Next, a weight was placed on top of the pile to remove extra water. Then, each sheet was dried on a wooden board under the sun.

	Fine papermaking	**Recycled papermaking**
Raw materials	Inner bark of *kozo* (paper mulberry), other plants	**Waste paper**
Additives	Viscous formation aid (*tororo* plant)	**Was viscous formation aid used?**
Fiber preparation	Steamed, dried, re-hydrated, removed the core and outer bark, and cooked with alkaline agents Repeatedly washed and hand beaten	**Was it soaked in water?** **Was it cooked with alkaline agents?** **How long was it hand beaten?** **Ink-removal method by repeated washing and hand beating?**
Sheet formation	*nagashizuki*	**Was it a combination of *nagashizuki* and Western style ?**
Drying	Couching: laid on top of each finished sheet, no use of interleaf Gently removed water under heavy weight overnight Dry on a wooden board outside	**Was it dried on wooden boards?**

Table 2. Hypothetical process of recycled papermaking with fine Japanese papermaking for comparison.

Unfortunately, as shown in table 2, these hypothetical production steps invite many questions. To investigate the manufacturing processes in depth, I undertook some collaborative research to re-create recycled papers and book cover decorations with Anne Covell, an MFA candidate in Book Arts at the University of Iowa Center for the Book (UICB), in 2012.

RE-CREATING HISTORICAL RECYCLED PAPER

A series of experiments is divided in three trial phases:

- Trial 1: Thai *kozo* test
  - Experiments conducted by Anne at UICB in 2012–2013 to determine the recycled papermaking process using Thai kozo.
- Trial 2:19th century textbook test
  - Four days of experiment completed by Anne and Kazuko on July 24–27, 2013, at UICB facilities to recreate recycled paper using 19th century printed Japanese books
- Trial 3:University of Kentucky (UK) test
  - Follow-up experiments of the July 2013 carried out by Kazuko in February 2014 at UK's conservation lab using 19th century printed Japanese books

Trial 2 and 3 are briefly summarized below. A full report will be published after the completion of the experiments.

TRIAL 2

Materials/tools[2]

Waste paper (fig. 8)

- Five volumes of a multiple volume set of woodblock printed book, "**通俗漢楚軍談**" **(***tsuzoku kanso gundan*) were used. The first edition of this title was published in 1695 as a 15 volume set. The five copies used were the later edition; however, publication date was unknown. They were purchased at a book store in Kyoto in 2012.

Viscous agent

- *Tororo-aoi* plant: a frozen root (125 g) was mashed with wooden mallet and mixed with 4 L water (fig. 9)
- Polyacrylamide (PME)

Alkaline agent

- Wood ash (provided by Tim Barrett) 75 mg was added to 15 L water, boiled, left overnight, and strained to obtain clear solution.
- Soda Ash (sodium carbonate)

Papermaking moulds consisting of a deckle with a synthetic fiber screen and a wooden box (frame size : approximately 22 x 28 cm) (fig. 10)

Methods

1. The waste paper was prepared through various methods:

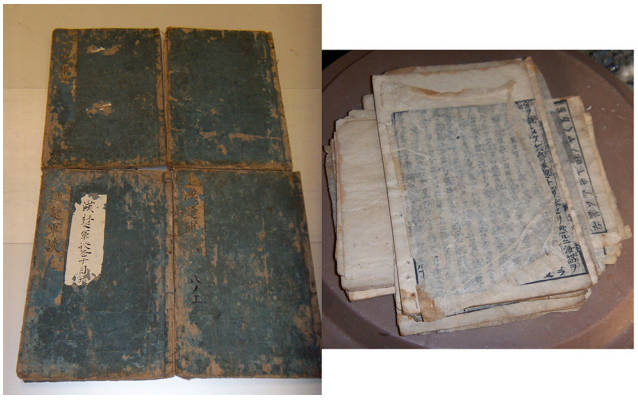

Fig. 8. Book covers (left) and text paper (right) of the volumes used for Trial 2.

Fig. 9. Thawed *tororo-aoi* roots mashed with a mallet.

Fig. 10. Papermaking mould consisting of upper screen frame and lower box.

  - soaked in water for 2 days, uncooked
  - cooked with soda ash for around 2 hours, and
  - cooked with wood ash liquid for over 2 hours
2. The prepared paper was beaten on a wooden board using two wooden mallets for various minutes (5–26 minutes), and then washed gently under running water. In order to see the effect of beating and washing to remove *sumi*-ink from the paper, the paper was repeatedly beaten and washed.
3. The beaten and washed paper was added to water. It was mixed well with *tororo-aoi,* PME, or neither by using a long wooden stick.
4. The mixed pulp was poured on to the deckle mould where it was suspended in water and mixed by hand. The amounts of pulp varied ranging from 450 ml to 1000 ml to achieve a desired thickness. A total of around 50 sheets were made.
5. A wet sheet of paper was laid on top of a post of previously couched sheets (fig. 11), and left from 2 hours up to 17 hours under the weight of a water filled trashcan. Over half of the sheets were interleaved with synthetic fabric between each sheet; the rest were laid without using interleaf.
6. The damp sheets were peeled off the pressed pack one at a time. They were air-dried flat on a drying rack, or brushed onto wooden boards and air dried in a conservation lab.

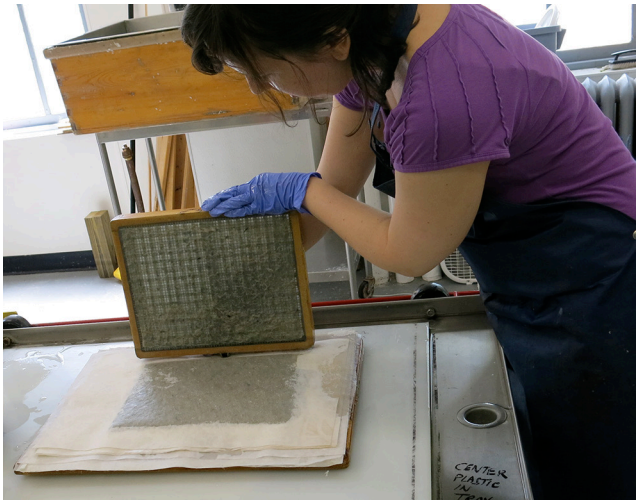

Fig. 11. A sheet formed on the mould's screen transferred onto a pile of previously made paper interleaved with synthetic fabric.

Fig. 12. Bookcover paper and text paper used for Trial 3.

TRIAL 3

Materials/tools

Waste paper (fig. 12)

- A variety of bookcover paper (208 g) and woodblock text paper printed with black soot ink (18 g) were used. The outermost colored sheets of the covers were removed and put aside due to their heavy sizing. Both were collected by Setsuo Kushige, a Japanese paper conservator, and given to the author. The source of the covers and texts were unknown.

Viscous agent

- Polyacrylamide : PME (6g) was dissolved in 4 L water

Japanese papermaking mould consisting of wooden frames (21 x 30 cm) with a woven bamboo *su* mat

Methods

1. Book covers and text paper were torn into small pieces by hand and soaked in water for 94 hours.
2. The soaked paper was beaten on a wooden board using two wooden mallets for 30–45 minutes and then, washed gently under running water for a couple of minutes.
3. The beaten and washed paper, water, and PME were mixed well by using a wooden stick for a few minutes.
4. Sheets were formed by using various formation methods including *nagashizuki*, *tame-zuki* (Western form), and combination of two. Single to multiple charges (2–3 times) were required to achieve a desired thickness. A total of 21 sheets were made.
5. The couched and piled wet sheets of paper were gently pressed with hands over the *su*, and left overnight for 17 hours under around 32 kg weights. Synthetic fabric was interleaved between each sheet for over half of the wet sheets.
6. The damp sheets were air-dried on wooden boards in a conservation lab.

FINDINGS FROM THE EXPERIMENTS

1. Paper preparation method

It is widely believed among historians that the waste paper was not cooked but simply soaked in water overnight (Aida 2002). However, soaking in water for several hours does not seem to be enough to break down the strong and durable Japanese paper. To confirm this process, in Trial 2, we treated the waste paper with two methods including soaking in

Fig. 13. Text paper soaked in water for two days. The paper was later torn into small pieces, beaten, and washed. Courtesy of Anne Covell.

Fig. 14. Text paper cooked with soda ash for over two hours. Courtesy of Anne Covell.

Fig. 15. Paper samples made in Trial 2, washed and beaten once. The paper on the right used uncooked waste paper; the left used waste paper cooked with wood ash.

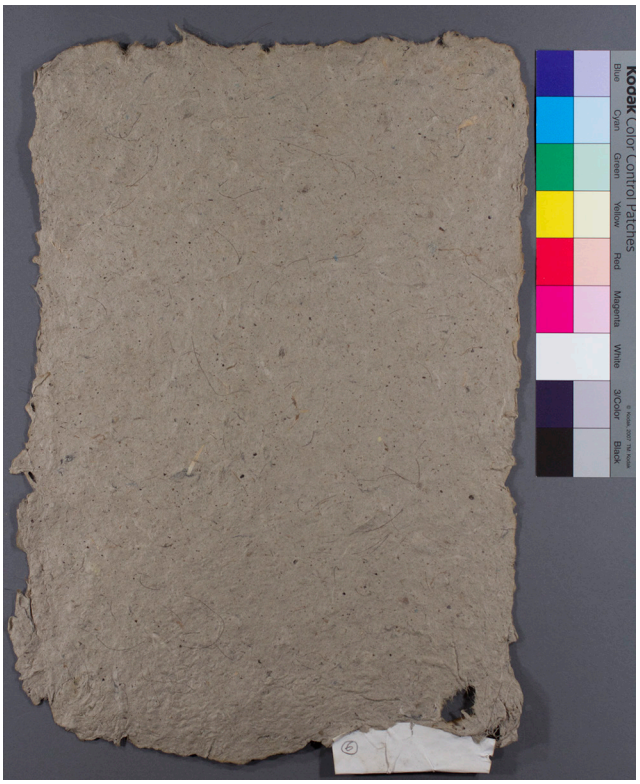

Fig. 16. Paper sample made in Trial 3, which used uncooked waste paper.

water for 48–94 hours (fig. 13) and cooking with soda ash or wood ash (fig. 14).

Both methods successfully produced paper. The uncooked waste paper, however, was not well broken down as the printed letters remained visible in the final product (fig. 15). The uncooked recycled paper was darker in color and displayed greater unevenness in fiber distribution than that in the paper made through cooking. Based on this result, in Trial 3, I employed only the uncooked method, which used much poorer and rougher quality of waste paper than Trial 2 did. The produced recycled paper displayed very similar color, texture, and appearance to a type of historical paper I tried to recreate (fig. 16). The experiments proved that the uncooked method was technically possible to make recycled paper. Some types of paper including book covers were probably made that way considering the papermaking economy

in which the cost of cooking materials such as wood would be prohibitively high for the recycled papermaking peasants.

2. Viscous agent

The use or absence of the viscosity agent, *tororo-aoi* plant is questionable. While recycled papermaking started as an agricultural off-season operation, the papermakers around the urban cities such as Edo could have had easier access to dealers and consumers and greater exposure to the cash economy, could have been more aware of the profitability of recycled papermaking than the farmers in the countryside, and could have expanded their operations to a year-round business (Aida 2002). If that shift happened, the papermakers would not have used *tororo-aoi* plant for their manufacturing because it would easily rot and became unusable in the hot season.

In our Trial 2, we had no alternative but to add a viscous agent. The pulp liquid without the agent just quickly drained from the screen of a mould. In the follow-up Trial 3, I increased the waste paper concentration to thicken the pulp, hoping the higher fiber ratio would help sheet formation. However, the fiber was not distributed evenly throughout the mould surface, resulting in the formation of entangled fiber clumps. Consequently, I had to add a viscous agent, though the amounts used were much more reduced than in the previous trial. The challenge was now whether and/or how we could eliminate the use of a viscous agent. We suspected that the processed fiber was still too long. However, in Trial 3, I used raw materials mainly from bookcovers composed of recycled paper. Should their fiber have already been broken-down and shortened to a maximum degree? Would an increase of beating time produce shorter fibers? Would more beating make harder, crisper, and stronger paper- which are not the traits I was looking for in this type of recycled paper? To answer these questions, the next steps would be experimenting with various beating times, as well as analyzing the length and the form of the fiber.

3. Sheet forming methods

Making a fine Japanese paper requires high sheet formation skills involving the elaborate *nagashizuki* method. On the contrary, it seems that forming a sheet of recycled paper with small size, uneven thickness, and rough surface should be easily mastered by an unskilled worker like me. In Trial 3, my attempts to form a sheet of recycled paper through *nagashizuki* method, however, met with repeated failure. I then undertook a so-called half *tamezuki* method, which was a combination of *nagashizuki* and Western sheet forming methods (Shishikura 2011). It was clear that the quality and preparation of the fiber influenced sheet formation. The use of crudely prepared, poor quality pulp limited my attempts to manipulate the methods (fig. 17).

The type of historical recycled paper varied in its quality and appearance, and the level of skills and forming methods of the papermakers varied, too. Further investigation of historical paper will be required on this issue.

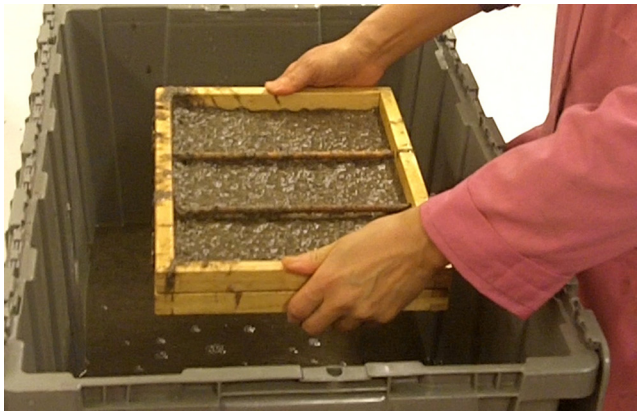

Fig. 17. Sheet forming during Trial 3, showing the gray and coarse textured pulp on the Japanese papermaking mould.

4. Drying methods

Very little documentation has been recorded about the methods of drying recycled paper. It is widely accepted among historians that recycled paper was dried on a wooden board in the way conventional paper was dried. However, wooden boards which could be around 180–200 cm in height and 35–50 cm in width did not seem to us to be easily affordable by the poor farmers who made cheap recycled paper. An alternative method is air-drying; however, this approach would cause too much planar distortion making it difficult to handle the paper for assembling and packing. In Trial 2, we experimented both air-drying on a rack and board-drying (fig. 18), and examined their effects on the physical traits of the paper. To our surprise, the air-dried paper cockled a little bit, but not as much as we anticipated (fig. 19). A reason of this minimum cockling would be the relative slow drying process of the packed wet sheets by removing extra water overnight. Further investigation is needed (Barrett 1989).

This result suggested that air-drying was technically a possible option. Therefore, the choice of drying methods probably depends on their economic and practical aspects. I found these conditions in 2013 when I visited Shigeo Shimada at his papermaking studio and house in Saitama prefecture in Japan. He makes a kind of recycled paper for Papier-mache dolls from a mixture of newspaper, *kozo* and cotton fibers. His paper was much larger and thicker than the paper I made, and he dried the paper on the ground (fig. 20). Mr. Shimada said in his experience any paper which was smaller than the current size would be quickly dried and easily blown off by a strong wind unless weights were placed on each sheet which would not be practical. The recycled paper produced in the 18th–19th century was much smaller than Mr. Shimada's, and as he pointed out, drying that type of paper on the ground was probably not efficient. In addition, this method demands a larger space than board-drying, in which the boards would vertically rest on the supports and use smaller space efficiently. Hanging the paper

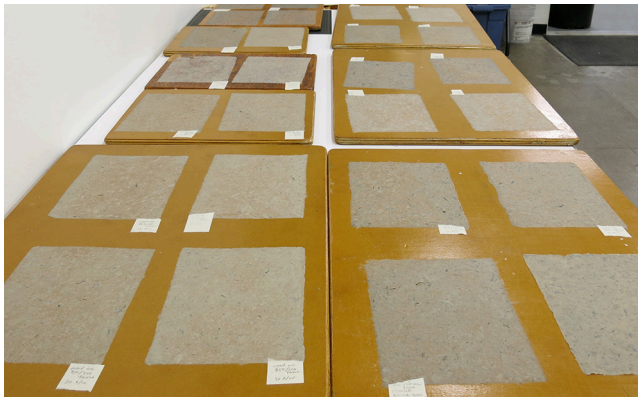

Fig. 18. Paper dried on wooden boards.

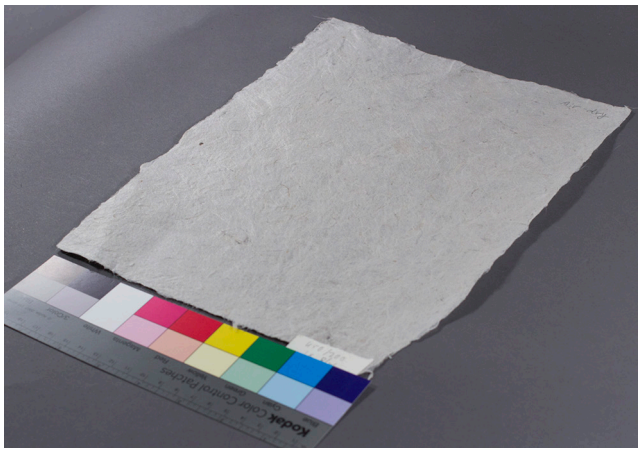

Fig. 19. Air-dried paper sample.

Fig. 20. Shimada's paper spread and dried on the ground in the front yard of the house and papermaking studio.

outdoors invites the problem of its being blown away, too. Indoor hanging like Western papermaking was probably out of reach for the papermakers due to the cost of construction.

Could the peasants afford the drying boards? Probably yes. To dry this type of low-quality paper, the boards didn't have to be high quality, and even the poor farmers could afford them. Actually, Mr. Shimada has seen the use of low-grade boards, which were made of pieces of lumber put together, for drying low quality paper. In addition, the papermaking peasant could get the boards via the "putting-in" system. This type of practice was documented in the renowned paper making villages in Mino, where wholesale merchants advanced the raw materials or cash to peasants and collected the final products of paper to pay off their loan.

5. Sumi-ink removal method

Several documents on recycled papermaking from the 18th–19th century recorded the methods of removing the writing and printing ink applied to the paper (Seki 1979)[3]. The methods are broadly divided into two groups, including one by fermentation and another by a set of steps of cooking and repeated beating and washing. According to these documents, two rounds of beating and washing could produce light gray paper and the third round would yield white paper. We experimented with the latter process, and tried various numbers of beatings and washings to determine their effect. We were at first skeptical about the effect of cooking, beating and washing. However, the results were impressive, as can be seen in the pictures[4] (figs. 21–22).

How did this ink-removal process work? *Sumi*-ink was made of a mixture of carbon particles from soot and hide glue (膠). The carbon particles applied to the paper surface penetrated the voids between the paper fibers and adhered to them as the hide glue dried. Beating and washing physically separated these particles from the fibers and removed the particles with water. By repeating washing and beating, even solidly adhered particles could be freed and washed away.

The effect of boiling with alkaline agent (such as ash) was briefly explained by Eizaburo Okada (Okada 2002). The alkaline-cooking would make cellulose fibers swell, leading to the peeling-off effect of the *sumi* particles which had adhered to the fiber surface. The alkaline agent also could help dissolving hemi-celluloce resulting in the removal of the particles which were trapped in the hemi-celluloce compounds. Finally, the agent would chemically break down the binder (hide glue).

The success of this experiment supported a possibility of the wider use of waste paper for papermakers than we previously understood. Especially, from the late 18th century onward, when a serious shortage of *kozo* plants and the subsequent increase of its price became the norm, even prominent papermaking villages used waste paper mixing with *kozo* fibers to produce higher quality paper. Indeed, in 1819, the self-controlled union at Echizen Gokasho village issued a warning of its intent to destroy stocks of the highly prized *hosho* paper if they found

Fig. 21. Pulp prepared by cooking with soda ash, washed and beaten once (upper left); and washed and beaten three times (lower right). Courtesy of Anne Covell.

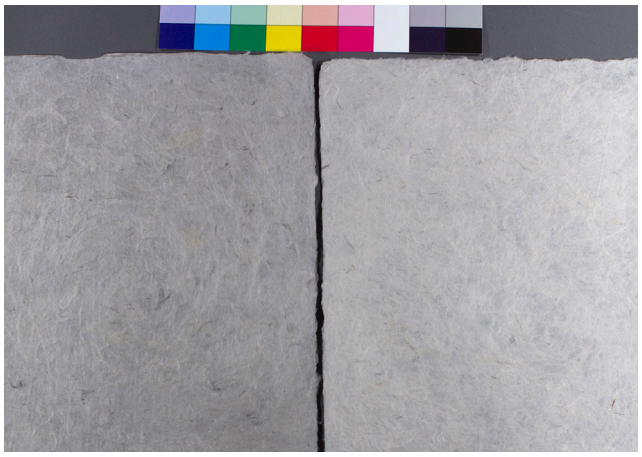

Fig. 22. Paper samples made from the pulp shown in figure 21, washed and beaten once (left); and three times (right).

its production had secretly included a mixture of waste paper imported from Osaka and Kyoto region (Kobata 1978).

SUMMARY

This project demonstrates the unique benefit of collaboration between a conservator and a papermaker. When the research is limited to a few sketchy historical documents and remaining artifacts, this type of collaborative experiment is one of the most effective research approaches. From the experiments, I learned much about the diversity and complexity of papermaking. Like high quality Japanese paper, recycled paper had great varieties of physical appearance and quality. These variations could have been the result of the quality of the raw material properties of waste paper and its processing methods, which were difficult to determine. The nature of the waste paper and organic processes of papermaking made the research challenging.

Investigating the technical aspects of recycled paper production can provide valuable information about the papermakers, the industry, and their society, and fill the gaps in the history of this lost craft. If we could confirm the technical possibility of a year-round operation of recycled papermaking by further testing the viscous agents[5], that would support the theory that urbanized farming areas could shift from conventional seasonal agricultural activity to full-time, manual production influenced by a cash economy. Recycled papermaking might then be seen as an important precursor to the coming industrial paper factory. The success of the ink removal experiment confirms the technical possibility of this practice and supports a theory that in the 19th century the use of waste paper spread greatly, even to the fine papermaking villages. It brings us a new perspective on the quality of hand-made Japanese paper. The use of waste paper mixed with plant fibers could be regularly practiced and therefore found in unexpectedly high quality papers. Fiber examinations of the paper artifacts from this time period can give clearer answers to these hypotheses.

ACKNOWLEDGEMENT

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NOTES

1. During the Edo period, papermaking was monopolized by *han* (regional states) governments and became their most important tax revenue source. To protect competitiveness, *han* tightly restrained the manufacturing information and banned publishing it. *Kamisuki chōhōki* was published in 1796, which was the first ever published manual of papermaking during the *han*'s strict censorship.
2. The publications by Kizaki (Seki 1979) and Barrett (1983) were consulted to study the methods, tools, and materials employed for the experiments.
3. Of the pre-Meiji publications, *Kamisuki taigai* (1784) by Morisue Kizaki has the most detailed descriptions of the recycled papermaking processes, including ink-removal methods. Okura's *Kamisuki hitsuyo* (1836) has brief description of the ink-removal method through fermentation. *Kamisuki houdenjyu,* a manuscript, written around 1804-1833 by an undetermined author, has the description of ink-removal method through cooking with ash. These records were compiled and found in Seki's work (1979).
4. A video clip of the beating and washing process recorded in Trial 2 shows the effect of the process on ink removal. The video is accessible at: http://uknowledge.uky.edu/libraries_present/81/

5. *Noriutsugi* (Hydrangea paniculata) was another major viscous agent widely used during the Edo period. Unlike *tororo-aoi, noriutsugi* does not lose its viscous effect with high temperature. Therefore, for a year-round operation, *noriutusgi* should be further tested.

BIBLIOGRAPHY

Abe, M. 1967. "Dai 2 setsu: Kinsei-ni okeru seisanto ryutsu". In *Kami parupu*, ed. Suzuki, Tokyo: Gendai Nihon Sangyo Hattatsushi Kenkyukai. 13–20.

Aida, T. 2002. Asakusashi no sanbyakunen, *Hyakumanto* (January) 113.

Barrett, T. 1989. Early European papers/contemporary conservation papers: A report on research undertaken from fall 1984 throughout fall 1987. *The Paper Conservator* 13: 21–22.

—. 1983. *Japanese papermaking: traditions, tools, and techniques*. New York: Weatherhill.

Hioki, K. 2008. Japanese printed books of the Edo period (1603–1867): History and characteristics of block-printed books. *Journal of the Institute of Conservation* 32:79–101.

Kobata, A. 1978. *Nihon keizaishi no kenkyū*. Kyoto: Shibunkaku Shuppan. 150–151.

Kunisaki, J. 1948. *Kamisuki chohōki; a handy guide to papermaking*, trans. C. E. Hamilton. Berkeley: Book Arts Club.

Okada, E. 2002. Kuwankonshi; Rekishi-ni miru kamino recycle. Tokyo: privately printed. 88–93.

Sato, N. 1928. *Keizai yōroku.* ed. Takimoto, S., Tokyo: Iwanami Shoten.

Seki, Y. 1943. *Edo Tokyo kamisuki shikō*. Tokyo: Fuzanbo.

—. 1973. *Wakan kami bunken ruijū: Edojida*. Tokyo: Chiyoda Insatsu. 7–8.

—. 1979. *Edo Meiji tesukigami seizō kōtei zuroku*. Tokyo: Mokujisha. 201–205.

Shishikura, S. 2011. *Hikkei kotenseki komonjo ryōshi jiten*. Tokyo: Yagi Shoten. 90–101.

Yamano, K. 2006. Kenkyu note: Monokatadonya to jisukikami ryutus wo meguru ikko. *Adachi kuritsu kyōdo hakubutsukan kiyō*, 28 go:1–14.

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