



Shri Shivaji Education Society Amravati's  
**Shri Shivaji Science And Arts College,**  
**Chikhli. Di: Buldana**  
**Department of Zoology**

**Add-on Course in Sericulture**

**Study Material**

**Harvesting and processing of cocoons**

**INTRODUCTION**

When the mature larva is placed in the mountage, it will spin a cocoon by ejecting a silk filament from its silk gland through an opening (spinneret). Silk filament is protein in nature, which hardens in contact with the air. You know that mature silkworm larva will take 3-4 days to spin a cocoon. After complete ejection of silk and formation of the cocoon, metamorphosis takes place and the larva transforms into pupa. In between, there is pre-pupal stage. This transient phase is very delicate. Normally, within ten days, the pupa again undergoes metamorphosis and emerges as a moth by piercing the cocoon.

**TIME OF HARVEST**

Harvest is commonly used to mean gathering or collection of ripen crops, especially in agricultural produce. In sericulture, harvest signifies to the collection and gathering of produced cocoons from spinning tray or mountage. After spinning a cocoon, the larva undergoes metamorphosis (complete change in morphology) and transforms into pupa. For completion of spinning and metamorphosis, about 5-6 days are required and you have to allow the larvae for this process. While harvesting, it may also be considered that during summer, the process is faster, whereas, in cooler months, it is slower. After pupation, when the integument of the pupa turns brown and hard on the 5th day (Fig.1.1), the cocoons may be harvested. The safest method is checking the condition of pupae by slit open a few pupae. Premature collection of cocoons or harvesting may lead to loss of silk content of the cocoons due to incomplete spinning or killing the delicate pre-pupa or pupa within the cocoons. Killing of pre-pupa or tender early pupa inside the cocoon will lead to stained cocoons, rendering it unfit for reeling.



(Fig): Pupa

To avoid this, harvest cocoons at 6th day after completion of full 5 days in mountage, counted from the last day of mounting. The pupa will be hard and cocoon shell will be dry. This condition will be suitable for safe handling and transportation of cocoon. Cocoons release moisture even after completion of spinning. Delayed harvest will lead to weight loss of cocoons. So, you should stick to the time of harvest.

## **METHODS OF HARVEST**

Methods for harvesting of silk cocoons varies, depending upon the mountage (spinning tray) used. Whatever the methods of harvest, first you remove litters and left-over of leaves, dead or un-spun larva, naked pupa (without cocoon), flimsy and melted cocoons from the mountage. Flimsy and melted cocoons may spoil the good cocoons by spilling stain.

## **Mounting Methods; Different Types of Mountages Used**

**Mountages** The most important device that helps or supports the silkworms (larvae) for comfortable spinning their cocoon is called cocoonage or mountage. Mountages play a vital role in quality cocoon production. Farmer's depending upon their resources use different types of materials available locally for making mountages. Types of material used, finishing of mountages, space available for spinning determines both the quality and quantity of the cocoons. Nearly 2 % of mature larvae make naked cocoons for want of proper mountages or cocooning space. To avoid formation of naked or deformed cocoons, ripe worms are picked from the rearing platforms and released on an appropriate mountages. It is used to enable the ripe worm to spin cocoon.

## **Mounting Methods**

### **(1) Chandrika:**

The most, common form of mountage in India is “Chandrika”. It is a rectangular bamboo mat on which a spiral bamboo tape is tied. The chandrika measures 1.8 m X 1.2 m. The tape is about 4-5 cm. broad and space between the spirals is about 4-5 cm. it became more popular than any other mountage because of the following advantages.

- a. Easily manufactured in the villages by bamboo weavers.
- b. Can be stored easily.
- c. It provides easy passage of air for quick drying of excreta of spinning worms and avoids staining.
- d. Easy to transport.
- e. Easy to disinfect.
- d. Low cost and light weight.



## **(2) Screen-type Mountage:**

It is made of bamboo or wooden or plastic reapers on which, instead of spiral bamboo tape, longitudinal strips with triangular peaks are placed. The screen can be folded and stored. This mountage can be kept clean and well- ventilated and hence, cocoons spun on this mountage are of good quality. It is more durable than chandrika. But occurrences of double cocoons are frequent in it.

## **(3) Plastic Mountage:**

Like Chandrika, but is made from plastic instead of bamboo and hence, more durable, easy to clean, not prone to rodent attack, and produce lesser number of double cocoons. Once invested, further maintenance, care or expenditure are not incurred. But these mountages are costly than Chandrika. The cocoons produced on these mountages are more flimsy and not of uniform size and hence not frequently used by farmers.



#### **(4)Japanese low Cost Mountage:**

In this modified Japanese mountage, a wooden frame of 4 longitudinal rods is attached by means of cross-spokes at two ends to a central axis. Each rod has a number of pegs placed at equal distances. These pegs are connected by long threads of twisted rice straw in a regular pattern like that of charpoy. The size of frame and the number of pegs can be modified according to the requirement of the rearer. This mountage is cheap, more durable and make less chances of disease spread.



**(5) Bamboo Strip Mountage:**

Made of bamboo strips that are either nailed on wooden reaper or placed in grooves of wooden reapers. Several such frames are placed one above the other with the lower one keeping on four uniform bricks or wooden blocks. This mountages are cheap, durable, easy to handle, and harvest the cocoons.



**(6) Bottle Brush Mountage:**



This recently introduced mountage consists of a thick coconut or jute fibre rope into which 6-9" sticks (midrib of coconut leaves) are inserted very closely. These are used by the worms as support. The worms spin their cocoons in the space between the sticks. This mountage is very cheap; can be made easily and occupies little space compared to Chandrika.

### **(7) Rotary mountage:**

It has pieces of cardboard to form 13 rows, consisting of 12 sections and each amounting to 156 sections. Ten pieces are put into frame as a set (Fig. 3.6). When this frame is hung up with wire holding at by ends, the frame can be turned around two axes. This frame produces fewer spoiled cocoons and raises the reelability of cocoons. Good cocoon percentage is more than 80. It is the best type and suitable for large scale silkworm rearing because it does not only lead to increased cocoon quality but also saves labour in mounting and harvesting.



### **DEFLOSSING :**

After harvesting of cocoons, you will find that the cocoons are covered with a soft and loose layer of silk filaments, which is called floss. Removing of the floss layer from the cocoon is called Deflossing. Deflossing is a pre-requisite for extraction of silk (Reeling). During the process of reeling, floss is removed by brushing. In this process, some portion of reelable silk also goes as waste. Deflossed cocoons minimize the loss during reeling. Cocoons used for egg production are also deflossed for assessment of quality and easy emergence of moth.

### **1 SORTING OF COCOONS:**

After deflossing, if you spread and look into cocoons, you will find most of the cocoons are with a particular shape and size because the shape and size are inherited racial or genetic characters, even though you will find some odd shaped and defective cocoons. Removal of odd shaped and defective cocoons from the lots is called sorting of cocoons. Defective cocoons

affect the reeling performance and quality of the silk. Therefore, unsuitable cocoons are to be sorted out from the good cocoons to get optimum result during reeling.

**The cocoons are sorted into:**

**a) Good b) Double c) Uzi pierced d) Flimsy or thin shelled e) Melted or stained and f) Thin-end cocoons.**

Sorting will improve the product image and marketability. Reelers always prefer uniform shape in a lot. Uniform shape improves reeling performance and silk quality. Sorted out defective cocoons can be sold in different rates.

**1. Melted and Stained Cocoons:** If spinning larvae or pupae die inside the cocoon during spinning or transportation, it causes melting or inner soiling. Sometime, inner melted material ooze out and cocoon gets stained. Staining of cocoons may be due to urination also.

**2. Flimsy or Thin Shelled Cocoons:** Weak or undernourished silkworms spin loose or less compact cocoons. These become flimsy or thin shelled. Reelability of these cocoons is poor.

**3. Deformed Cocoons:** Weak larvae or improper mountage causes deformed cocoons. These cocoons affect reelability and quality of raw silk.

**4. Thin-end Cocoons:** Thin end cocoons may be due to genetic character of the silkworm races or may be due to improper rearing and spinning environment. These cocoons affect reeling performance.

**5. Pierced Cocoons:** Cocoons may be pierced due to the emergence of maggot or parasitic Uzi fly or emergence of silkworm moth. These are unsuitable for reeling.

**6. Double Cocoons:** Double cocoons are abnormally large mostly with oval shape with two or more pupae inside. This may be due to genetic character or overcrowding in the mountage. Improper mountage also causes double cocoons. Two or sometimes more filaments are entangled in these cocoons. These cocoons can't be reeled normally, can be reeled into a special type of silk, called 'dupion'.

## **ASSESSMENT OF COCOONS:**

Cocoons produced are to be marketed. Following points/ characters are generally considered to assess the cocoons in fixing the price.

### **A) Cocoon Weight:**

Cocoons are being sold on weight basis. You will find that the weight of the cocoons gradually decreases due to moisture loss and consumption of the fat till the pupa transform into moth and emerge out. So, immediately after harvest, defloss, sort, and weigh the good cocoons. This will be the weight of green cocoons. Make a label indicating race or combination, date of spinning, green weight, etc. while taking to the market.

## **B) Rendita:**

It represents the quantity of green (fresh) cocoons required to produce 1 kg. of raw silk. If 10 kg. of green (fresh) cocoon of a lot is required to produce 1 kg raw silk, then Rendita of that lot is 10. It is an indicator of price fixation of the cocoon when purchased for reeling.

## **2 Cocoon Stifling:**

Cocoons in their fresh condition with the pupae alive in them cannot be stored for a long time as the living pupae are soon transformed into moths (i.e., generally within eight to ten days in a warm climate and ten to twenty days in a very cold climate), which emerge from the cocoons by piercing the shell through one end. Cocoons from which moths have emerged are called pierced cocoons. They are useless for reeling raw silk because the continuity of the bave in them is broken. Reeling cocoons, therefore, have to be subjected to a process of stifling with the object of killing the pupae inside without interfering with the structure of the silk shell around it. Cocoons can be stifled by several methods but the popular methods in reeling industry are sun drying, steam stifling and hot air conditioning.

### **A) Sun drying**

Sun drying consists in killing and drying the pupae by prolonged exposure of freshly harvested cocoons to scorching hot sun. The cocoons so treated can be preserved for any length of time without fear of moth emergence or their deterioration by any means. The method is simple. Immediately after the harvest of cocoons they are thinly spread out on mats and kept in the hot sun from sunrise to sunset every day for several days till the pupae are killed and the cocoons completely dried. Sun dried cocoons are very light and when shaken make a rattling sound.



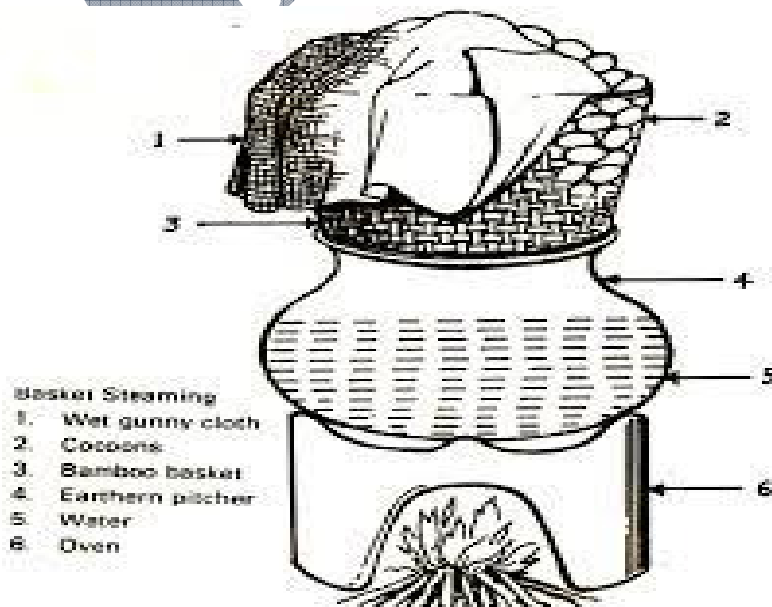
Although sun drying is simple and cheap, it is not suitable for modern reeling. Sun drying is possible only when there is bright and hot sunlight continuously for several days soon after cocoon harvest. Silk is very sensitive to sunlight and when cocoons are exposed to action of bright and hot sunlight for a prolonged period as in the sun drying process, the original strength of the bave is very much affected impairing reelability of the cocoons and injuring the quality besides increasing wastage of silk in reeling.

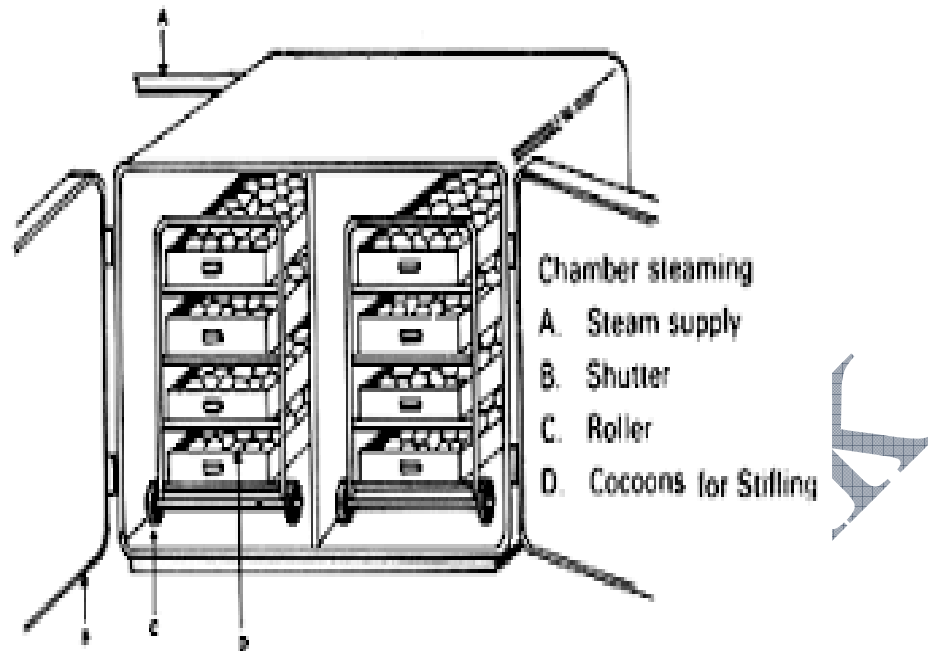




## B) Boiling /Steam Stifling

The process of removing the threads from killed cocoon is called reeling. The cocoons are cooked first in hot water at 95-100°C for 10-15 minutes to soften the adhesion of silk threads among themselves, loosening of the threads to separate freely, and to facilitate the unbinding of silk threads. This process is called cooking. Cooking enables the sericin protein to get softened and make unwinding easy without breaks.





Immediately after stifling, the cocoons are spread on spacious, well-ventilated shelves and left for three to four days partial drying prior to reeling. The cocoons must be turned over frequently to prevent the growth of mould. If left for extended periods, such as more than a month, the risk of mould is pronounced even with frequent turning and satisfactory ventilation. This damage is especially acute during the rainy season.

#### **Disadvantages of Steam Stifling**

Steam stifling of cocoons has certain drawbacks. Steam stifling only kills the pupa inside and **does not dry it. The pupa normally contains moisture in the form of body fluids**, to the extent of nearly 65 per cent of its own weight. This large moisture content makes the pupa fragile and weak, and so such cocoons cannot be kept stored in thick layers, because of the risk of the pupae in the lower layers getting crushed under the weight of the cocoons above and the body fluids spoiling the silk of the cocoons.

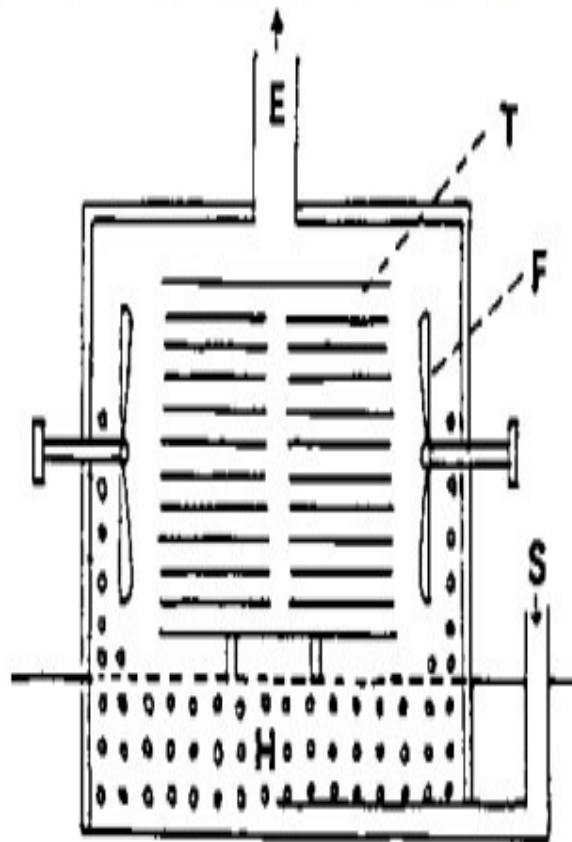
### C) hot air drying

- Shelf-carrier/Cabinet type dryer:

Shelf carrier type drying performs the drying operations in a chamber which has shelf carrier with many trays. The cocoons are dried by the flow of hot air current.

#### Shelf-carrier/Cabinet type dryer

T: cocoon tray, H: heater, F: fan, S: air inlet, E: air outlet



### 3. Cooking of Cocoons [for separation of Silk fibres].

The cooking process is done for softening the sericin to facilitate easy unwinding of the silk filament at the same time. The sericin should be retained with the fibroin to facilitate agglutination of filaments in the thread forming. The sericin content of the silk filament ranges from 25 to 30 per cent, which varies in different races. In cooking process 7 to 8 per cent of sericin is dissolved.



### 4 Deflossing/Brushing:

The unreelable, tangled mass of silk, found on the outside of cocoons is called floss. Deflossing is the removal of the floss to find out the actual reeling ends of the cocoon that can undergo continuous reeling. In India, deflossing is mostly done by peeling off the floss layer with hand. However, it can be done with simple device like brush or broom made of



Fig. 3.12. Deflossing or brushing of cocoons by brush

bamboo root sticks to save time and labour

## 5 Reeling:

After boiling (cooking) and brushing, reeling started. Reeling is the extraction of continuous silk thread of desired thickness from the cocoon without any break. Before reeling, light brushing of the cocoon surface is done to find out the tip of the silk filament.

Then the ends are all separated out and gathered together, this is called end picking (Fig. 3.13). Generally, filaments from multiple cocoons are combined together and transferred onto the reeling or spinning machine, which then automatically unravels the cocoons and simultaneously create a single strand of silk from the cocoons.

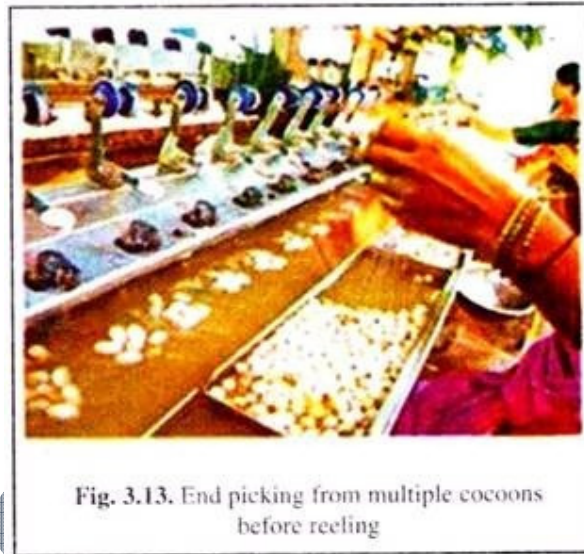


Fig. 3.13. End picking from multiple cocoons before reeling

Throughout the reeling process, the cocoons remain in boiling water. When one cocoon gets exhausted, the second one is immediately substituted to reel a continuous and uniform yarn. So the important steps in reeling are brushing, end picking, casting, binding and traversing.

The individual filament must be inter-wined or twisted and cemented firmly so that the reeled filament does not break during subsequent processing of fabrics. This twisting and cementing is done with the help of a special device, called Croissure, which remains attached with the reeling machine.

Croissure helps in twisting and agglutinating the have as well as it squeezes out excess water from the reeled thread to make it dry. Reeling can be done by 3 systems:

### A) Charkha-Reeling:

In this manually operated system, inferior quality or defective cocoons are reeled. Here cooking and reeling are done in one basin. Following cooking at high temperature, the soften cocoons float in basin. The reeling ends are then taken out from 4-5 cocoons and twisted around themselves with the help of charkha reel (Fig. 3.14) to make uniform thread. Charkha reeling machine is traditionally home-made and used mainly in villages for small scale silk production.



Fig. 3.14. Charkha reeling

It uses chambon type of simple croissure where threads from two reeling ends are interwinded to form few spirals. So the silk reeled by charkha is of poor quality.

### (A) Cottage Basin System:

In this system, cooking and reeling are done separately. Boiling water basin is used for cooking while reeling is done in a hot water basin kept near the cooking basin. Cottage basin reeling machine uses travellettcroissure. It consists of 3 pulleys to enable the thread to interwine around itself and also better removal of water and gum spots from the thread (Fig. 3.15 a).

Cottage basin is also attached with traverse or distributor which is a modified hot rod. After being squeezed by the croissure, the thread is further dried as it passes on the traverse before reaching the reel. So cottage basin yields silk of good quality with uniform thickness. In India, as much as 806 tonnes silk are produced by 4000 cottage basin systems.



**Fig. 3.15(a).** Reeling by college basin system. Note : cocoons are kept in hot water basin while reeling.

**(B) Filature System:**

In this power-driven multi- end reeling device, cooking and reeling are done separately. It is a modern device where continuous reeling is done from cocoons of superior quality. The silk produced by filature is also of superior quality because of increased cleanliness and uniformity in thickness of the fibre. However, only 8% of the total silk production in India is contributed by filature.

## 6. Chemical Processing of Raw Silk:

The raw silk thread, thus produced is rigid, stiff and not soft in touch and also lacks in lustre due to presence of sericin and other impurities on the surface.



Fig. 3.15(b). Travellette croissance of cottage basin.  
Note the pulleys



Fig. 3.15(c). The distributor rod makes the thread  
more dry.



## **So it needs following treatments:**

### **(A) Degumming of silk:**

Degumming is the removal or elimination of sericin and other impurities from raw silk. It is carried out to impart the lustrous and softness on silk. Degumming is generally carried out by following treatments:

#### **(a) Extraction with water:**

In this process, silk thread is treated in hot water (100-130°C) for 30 minutes to 4 hours, which can cause degumming of sericin. It is a safer process with minimum degradation to the silk fibre.

#### **(b) Treatment with alkali/acid:**

Degumming with alkali or acid depends on pH, temperature, time of treatment, strength and nature of the reagents used. Alkalis used for degumming include sodium carbonate and bicarbonate, caustic soda, trisodium phosphate etc. Alkali treatment should be done for 30 minutes to 2 hours at a pH > 8.5. In a similar; way acid treatment at pH < 3.0 can eliminate sericin.

#### **(c) Digestion with enzymes:**

Enzymatic digestion by proteolytic enzymes like trypsin (pH 8.0), papain (pH 5.2), chymotrypsin, and pepsin at a temperature of 40-50°C were proved to be useful for degumming.

### **(B) Weighting of silk:**

Removal of sericin from the silk fibre results in weight loss of 22-25%. Thus the silk becomes further expensive. Therefore, such weight loss can be compensated by treating the silk with suitable compounds that adds weight or fix colour to the silk.

## **7. Re-Reeling:**

Sometimes silk after being reeled on device like charkha or cottage basin, may suffer from some defects like short length, broken threads, entanglements, hard gum spots, etc. These problems may create wastages of thread during subsequent throwing and twisting. To

overcome these defects silk is first reeled on small reels and later is transferred to standard sized hanks (Fig. 3.16). This process is called re-reeling.

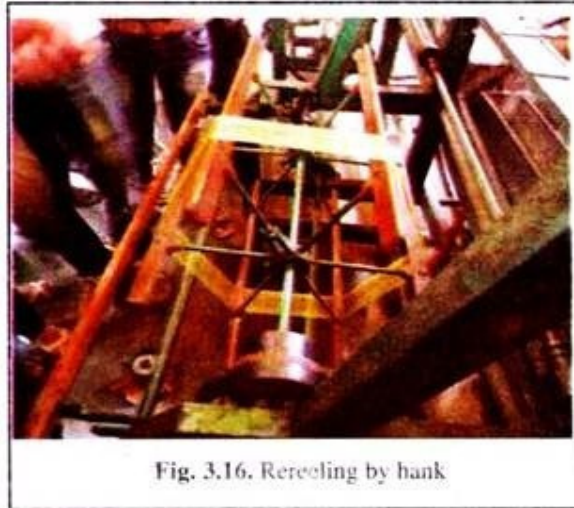


Fig. 3.16. Rereeling by hank

## 7. Lacing and Skeining:

Re-reeled silk hunk is then tied with a coloured silk thread by the two ends. The hunk is then divided into five parts and is laced with a cotton thread. This lacing prevents entangling of the silk in later operation. The cleaned and laced hunks are then put on a skeining machine to be skeined. During this process, the hunk is twisted and folded upon itself to form a number of tight spirals or skeins (Fig. 3.17). The skeining prevents ruffling and further entanglement of filaments during packing.



Fig. 3.17. Spiral skeins of silk thread

The skeins are then made into books. In a book, eight skeins are placed in horizontal row and five in vertical row. Each book is then tied with separate cotton bands at three different places and wrapped with tissue paper. Books are kept in bales of twenty kg weight. Thus, silk threads are kept in store house as bales. Store house should be free from humidity and air.

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**Mr. Yogesh V. Giri**  
**PhD Scholar**  
**MSc-Biotech & Zoo**  
**CSIR-JRF**  
**Department of Zoology**