

# Reducing Energy Consumption: Efficient Boiler Operation

Over 90% of tea factory energy requirements are for heat used in withering and drying. Ensuring maximum boiler efficiency can significantly reduce energy requirements and production costs.

## Key principles of efficient boiler operation:

- Feed boilers with billeted wood to aid combustion
- Do not unnecessarily open boiler door - this disrupts combustion
- Open only 1 door when feeding boiler
- Use air preheaters
- Remove ash daily
- Eliminate leakages in the steam and condensate system
- Install a float valve in the condensate tank to regulate water addition
- Fully lag (insulate) the steam system to eliminate heat loss
- Avoid running numerous boilers at partial capacity
- Continually monitor flue gas to ensure correct air-fuel mix
- Use air flow control dampers and flue gas readings to regulate the amount of fresh air entering the combustion chamber



Always measure wood in wood cage prior to use



**Good practice:** Open only one door when filling the boiler



**Good practice:** All pipes are properly lagged



**Bad practice:** Leaking pipes have not been fixed



**Bad practice:** Lagging is falling off, exposing pipe work and causing energy loss

## Measuring boiler energy use:

Monitoring and measuring fuel wood consumption is important for analysis of boiler efficiency. Measure wood in a wood cage before use and record the amount used.

## Key principles:

- Confirm dimensions of wood measuring cage
- Ensure the wood cage is not broken
- Do not overfill wood cage



# Reducing Energy Consumption: Fuel Wood Billeting

Billeting is the process of chopping wood into smaller, regular sized pieces with increased surface area.

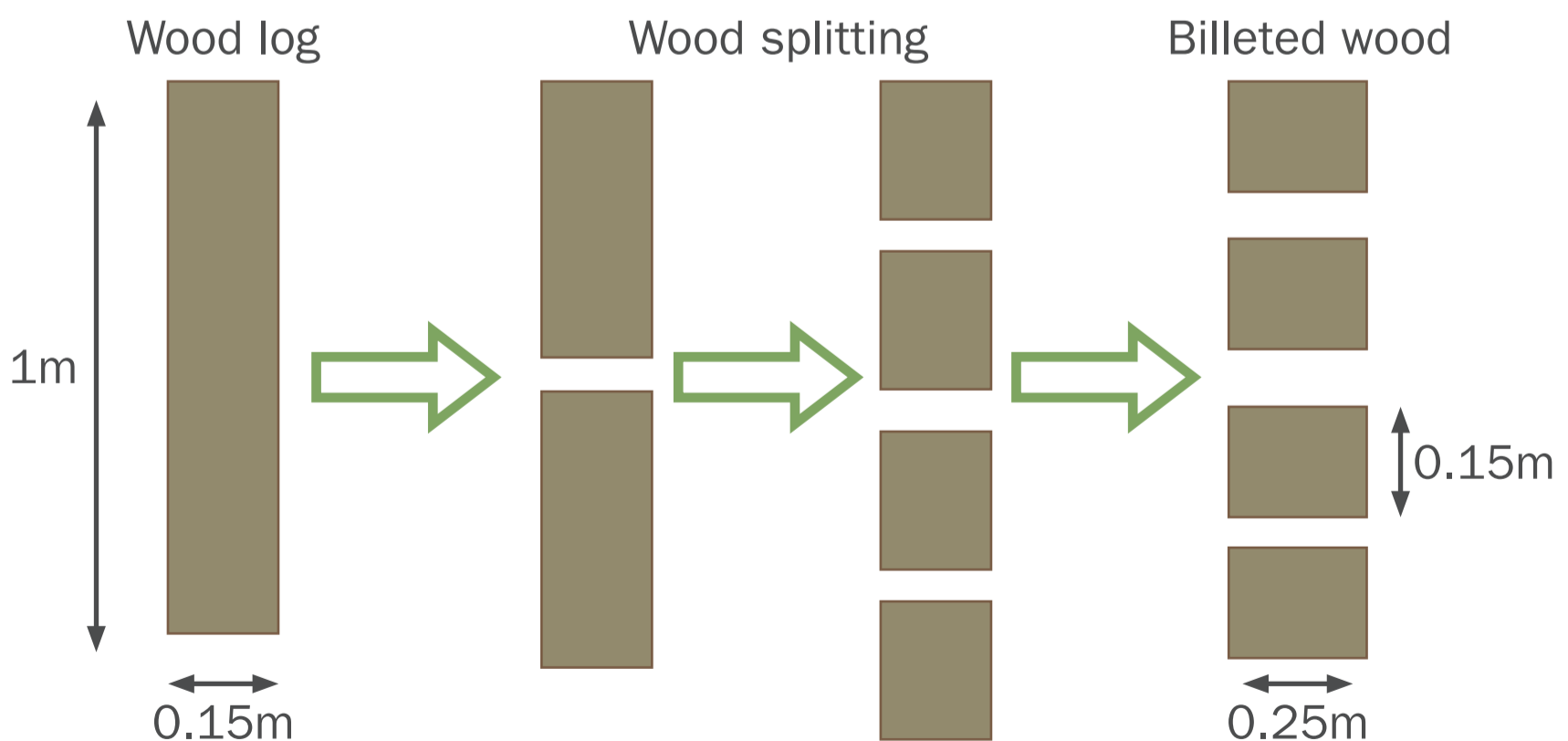
Feed boilers with properly billeted wood to achieve efficient combustion and regular and consistent steam supply. This will in turn reduce overall energy requirements.



Billeting – step by step



The wood is chopped into small, regular sized pieces





# Reducing Energy Consumption: Wood Fuel Storage & Seasoning

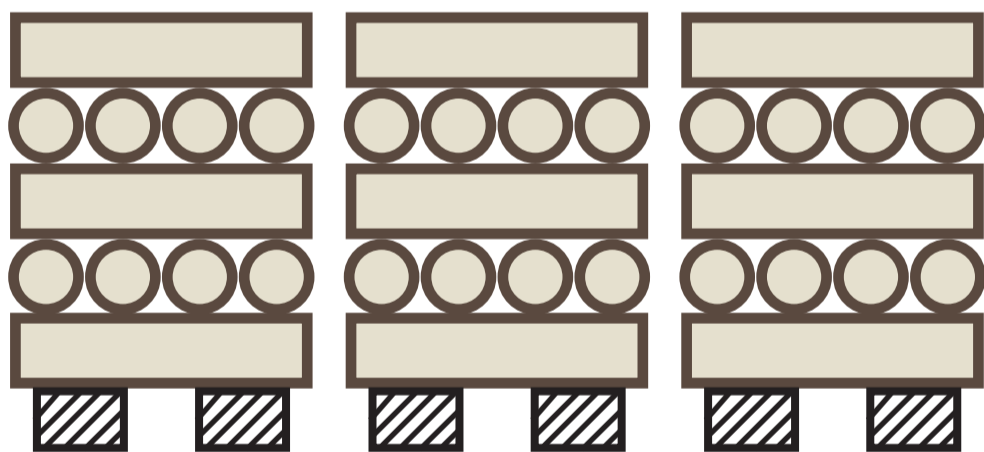
Seasoning is the process of drying wood to reduce moisture content. The benefits of proper seasoning include: reduced wood consumption, efficient boiler operation, and reduced smoke.

## Key principles of wood seasoning:

- Stack wood properly to allow airflow
- Stack wood of same type (soft/hard) together for even seasoning
- Stack in max height 4m and 1m gap between stacks
- Leave for 6 months until moisture content reaches desired level
- Cover wood to protect from rain
- Wood cover should contain clear material to allow sunlight, increasing moisture evaporation



Use the 'First in First out' principle. Wood first into the seasoning shed should be the first issued to the boiler. To achieve this, reference all firewood according to: time of purchase, volume purchased, type of wood, and possible issue date to boiler. There are a number of different methods used to stack wood:

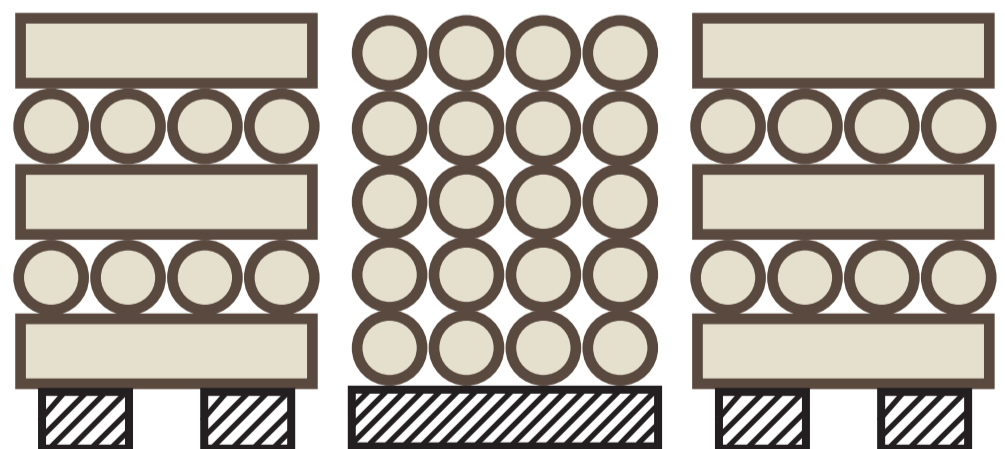
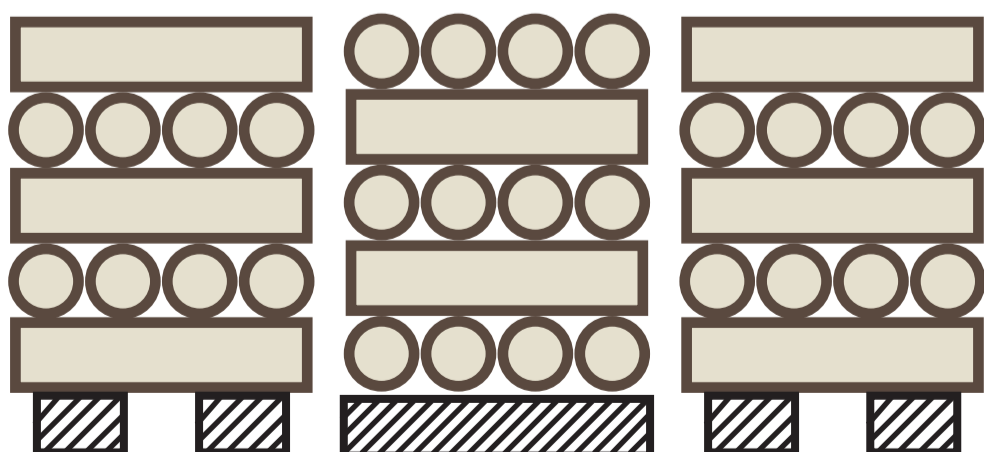


**Stacking method A – Three tower system**

Good aeration & even drying

## Stacking method B – Two tower system

Avoids rollover, maximises space, longer drying time



**Stacking method C – Three tower alternate row system**

Maximum stability, good aeration, short seasoning time



# Reducing Energy Consumption: Withering

Withering uses around 40% of a factory's total electricity consumption and over 50% of total thermal energy consumption (wood fuel from boilers), making it the most energy intensive process in the tea factory. To minimise energy consumption, fans and warm air use should be kept to a minimum.

## Opportunities to reduce energy consumption:

- Ensure uniform spread of tea to reduce air resistance
- Use minimal amount of steam
- Ensure air dampeners are parallel to air flow
- Do not unnecessarily open trough doors
- Keep heat exchangers clean to minimise energy loss
- Maintain fans and motors to avoid friction and vibrations: grease, align and repair
- Check and maintain optimal fan blade alignment: 16°
- Upgrade fans to 48" diameter, 6 blade fan, 5.5kW motor

**Good practice - Six blade fan with guard**  
New 48" six-blade fans achieve faster withers, reducing energy consumption.



## Good practice - Tea Spreading

Even and thin tea layer allows uniform air circulation, resulting in good withering and minimum energy use.



**Good practice - Six blade fan with guard**  
New 48" six-blade fans achieve faster withers, reducing energy consumption.





# Reducing Energy Consumption: Tea Cutting (CTC)

Cut, Tear, Curl (CTC) operation accounts for around 20% of total factory electricity consumption. Below are key ways to reduce CTC electricity consumption.

## Sharpen the CTC Rollers

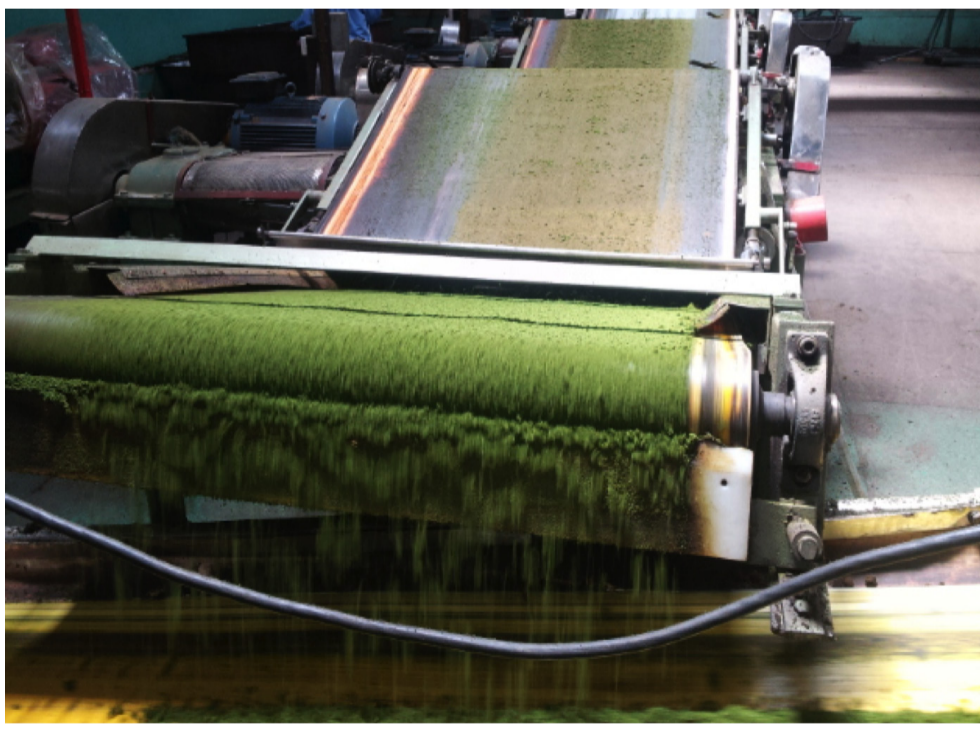
Correct sharpening of CTC rollers is key to well cut and rolled tea. Well-meshed rollers operate more efficiently resulting in lower energy demand. Ensure rollers are sharpened to the correct angle and depth.



## Reduce Friction

Reduced friction results in better tea cutting and leads to considerable energy savings:

- Use the recommended roller pressure settings
- Ensure machinery is well maintained
- Clean machinery at the end of each day



## Ensure line is running at recommended throughput

To optimise the CTC energy utilisation index (EUI), ensure the line operates close to the manufacturers recommended throughput. For example, significant energy savings can be achieved when a line operates at an average throughput of 2500kg/hr instead of 2000kg/hr over one year.



# Reducing Energy Consumption: Fermentation and Drying

Tea drying is the second most energy intensive process after withering. Around 40% of a factory's heat requirements are required for tea drying and 20% of electricity requirements to power the large fans.

Fermentation also requires heat and electricity, although in smaller amounts; heat to stimulate fermentation and electricity to run the machinery. Below are key strategies to reduce energy requirements.



## Opportunities to reduce energy use in fermentation

- Ensure uniform and optimal thickness of tea on fermentation bed to minimise air requirements
- Keep steam use to a minimum
- Ensure air ducts have no leaks and are properly insulated
- Avoid unnecessarily opening the dampeners

## Opportunities to reduce energy use in tea drying

- Ensure the equipment and fans are cleaned after use
- Ensure air dampeners are set at the correct angle between the wet and dry end of the dryers (450-300) to reduce resistance.
- Ensure air intake is well controlled
- Avoid unnecessarily opening of flow control dampeners
- Ensure all steam pipes are insulated
- Ensure fans are not damaged and all machinery is in good working order with no friction, e.g. regular greasing and replacement of worn bearings
- Record the temperature of tea entering the dryers to ensure the correct amount of steam is applied

